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Design Thinking and the Precautionary Principle: Development of a Theoretical Model Complementing Preventive Judgment for Design for Sustainability enriched through a Study of Architectural Competitions adopting LEED

par
Carmela Cucuzzella

Faculté de l'Aménagement

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Présentée par :
Carmela Cucuzzella

a été évaluée par un jury composé des personnes suivantes :

Georges Adamczyk
Président-rapporteur

Pierre De Coninck
Directeur de recherche

Daniel Pearl
Codirecteur de recherche

Michel Gariépy
Membre du jury

Joris van Wezemael
Professeur de géographie humaine
Département des Géosciences, Université de Fribourg, Suisse
Examinateur externe

RÉSUMÉ

Cette thèse contribue à une théorie générale de la conception du projet. S'inscrivant dans une demande marquée par les enjeux du développement durable, l'objectif principal de cette recherche est la contribution d'un modèle théorique de la conception permettant de mieux situer l'utilisation des outils et des normes d'évaluation de la durabilité d'un projet. Les principes fondamentaux de ces instruments normatifs sont analysés selon quatre dimensions : ontologique, méthodologique, épistémologique et téléologique. Les indicateurs de certains effets contre-productifs reliés, en particulier, à la mise en compte de ces normes confirment la nécessité d'une théorie du jugement qualitatif. Notre hypothèse principale prend appui sur le cadre conceptuel offert par la notion de « principe de précaution » dont les premières formulations remontent du début des années 1970, et qui avaient précisément pour objectif de remédier aux défaillances des outils et méthodes d'évaluation scientifique traditionnelles.

La thèse est divisée en cinq parties. Commençant par une revue historique des modèles classiques des théories de la conception (*design thinking*) elle se concentre sur l'évolution des modalités de prise en compte de la durabilité. Dans cette perspective, on constate que les théories de la « conception verte » (green design) datant du début des années 1960 ou encore, les théories de la « conception écologique » (*ecological design*) datant des années 1970 et 1980, ont finalement convergé avec les récentes théories de la «conception durable» (*sustainable design*) à partir du début des années 1990.

Les différentes approches du « principe de précaution » sont ensuite examinées sous l'angle de la question de la durabilité du projet. Les standards d'évaluation des risques sont comparés aux approches utilisant le principe de précaution, révélant certaines limites lors de la conception d'un projet. Un premier modèle théorique de la conception intégrant les principales dimensions du principe de précaution est ainsi esquissé. Ce modèle propose une vision globale permettant de juger un projet intégrant des principes de développement durable et se présente comme une alternative aux approches traditionnelles d'évaluation des risques, à la fois déterministes et instrumentales.

L'hypothèse du principe de précaution est dès lors proposée et examinée dans le contexte spécifique du projet architectural. Cette exploration débute par une présentation de la notion classique de «prudence» telle qu'elle fut historiquement utilisée pour guider le jugement architectural. Qu'en est-il par conséquent des défis présentés par le jugement des projets d’architecture dans la montée en puissance des méthodes d’évaluation standardisées (ex. Leadership Energy and Environmental Design; LEED) ? La thèse propose une réinterprétation de la théorie de la conception telle que proposée par Donald A. Schön comme une façon de prendre en compte les outils d’évaluation tels que LEED. Cet exercice révèle cependant un obstacle épistémologique qui devra être pris en compte dans une reformulation du modèle.

En accord avec l’épistémologie constructiviste, un nouveau modèle théorique est alors confronté à l’étude et l’illustration de trois concours d'architecture canadienne contemporains ayant adopté la méthode d'évaluation de la durabilité normalisée par LEED. Une série préliminaire de «tensions» est identifiée dans le processus de la conception et du jugement des projets. Ces tensions sont ensuite catégorisées dans leurs homologues conceptuels, construits à l’intersection du principe de précaution et des théories de la conception. Ces tensions se divisent en quatre catégories : (1) conceptualisation - analogique/logique; (2) incertitude - épistémologique/méthodologique; (3) comparabilité - interprétation/analytique, et (4) proposition - universalité/ pertinence contextuelle. Ces tensions conceptuelles sont considérées comme autant de vecteurs entrant en corrélation avec le modèle théorique qu’elles contribuent à enrichir sans pour autant constituer des validations au sens positiviste du terme. Ces confrontations au réel permettent de mieux définir l’obstacle épistémologique identifié précédemment.

Cette thèse met donc en évidence les impacts généralement sous-estimés, des normalisations environnementales sur le processus de conception et de jugement des projets. Elle prend pour exemple, de façon non restrictive, l’examen de concours d'architecture canadiens pour bâtiments publics. La conclusion souligne la nécessité d'une nouvelle forme de « prudence réflexive » ainsi qu’une utilisation plus critique des outils actuels d’évaluation de la durabilité. Elle appelle une instrumentalisation fondée sur l'intégration globale, plutôt que sur l'opposition des approches environnementales.

Mots clés : conception du projet (design thinking), durabilité, principe de précaution, prévention, jugement, réflexivité (reflection-in-action), rationalité technique, complexité, systémique, concours d'architecture, LEED

Abstract

This thesis is a contribution to the general theory of design thinking. In the prevalent demand for a sustainable development, the main objective of this research is the construction of a theoretical model of design thinking that contextualizes standard sustainability evaluation tools. The basis of these normative tools is analyzed in four dimensions: ontological, methodological, epistemological and teleological. Indications of potential counter-productive effects of these norms for design thinking confirm the need for a theory of qualitative judgment. Our central hypothesis revolves around the benefits of the underlying conceptual framework of the 'precautionary principle' for design thinking, the first formulations of which goes back to the early seventies in Germany, and was in fact created as a way to address the failures of traditional scientific evaluation tools or methods.

The thesis comprises five parts. Beginning with a historical perspective, a review of classical models of design thinking, specifically focuses on the evolving approaches for addressing sustainable development. Theories of "green design" coming from the early sixties, theories of ecological design of the seventies and eighties are finally converging on the developing theories of "sustainable design" formulated in the early nineties.

The underlying theories of the precautionary principle are then reviewed and explored for the specific context of design within the perspective of sustainability. Current methods of standard risk assessment methods are compared to a precautionary approach, revealing their conceptual limits for design thinking. A preliminary theoretical model for design thinking is then constructed adopting the theories underlying the precautionary principle. This model represents a global vision for judging the design project in a context of sustainability, rather than on traditional approaches for risk assessment, which are purposive and instrumental.

The precautionary principle is further explored for the specific context of architectural design. This exploration begins with a historical perspective of the classical notion of 'prudence' for guiding architectural judgment. In light of the contemporary issues related to sustainability, we then examine the challenges of judging architectural projects given the increasing international prominence of such standard evaluation methods (i.e. Leadership in Energy and Environmental Design, LEED). The thesis proposes a reinterpretation of design thinking as proposed by Donald A. Schön is introduced such that the use of tools, like LEED can be contextualized. This exercise reveals an epistemological barrier, which shall be taken into consideration when reformulating the theoretical model.

In accordance with a constructivist epistemology, a new theoretical model is therefore confronted to the study and illustration of three contemporary Canadian architectural competitions adopting the standard evaluation method LEED. A preliminary set of 'tensions' identified in the judgment process and design thinking is further categorized into their conceptual counterparts. These are: (1) analogical/logical conceptualization; (2) epistemological/methodological uncertainty; (3) interpretive/analytic comparability; and (4) universal/contextual relevance of the proposal. These conceptual tensions are considered as vectors that come into correlation with the theoretical model, enriching it, yet without validating it, in the positivist sense of the word. These confrontations with the real, help better define the epistemological barrier identified above.

This thesis therefore highlights the often underestimated impact of environmental standards on the judgment process and design thinking, with particular, albeit non restrictive, reference to contemporary Canadian architectural competitions for public buildings. It concludes by stressing the need for a new form of "reflective prudence" in design thinking along with a more critical use of current evaluation tools for sustainability founded on a global integration rather than on the opposition of environmental approaches.

Keywords: design thinking, sustainability, precautionary principle, prevention, judgment, reflection-in-action, technical rationality, complexity, systemic, architectural competitions, LEED

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DEDICATION

For Mark and Jordan

INTRODUCTION: THE CRISIS OF EVALUATION AND JUDGMENT FOR DESIGN PROJECTS FOR SUSTAINABILITY

As concerns regarding the stress on the earth's resources and its impacts on societies by human activities are increasingly unquestionable, design[1] can play a major role in addressing the problems related to the deterioration of the environment, to the increasing gap in social structures, to the decline of cultural diversity, and for any hope for an equitable sharing of the economic benefits of globalization. These are immense ambitions for design, yet according to the United Nations Environmental Programme (UNEP) and the Wuppertal Institute,

> *"Actions taken by designers, producers and consumers are all interlinked and can affect each other, and the global environment, in far-reaching ways. (…) The challenge is to manage these interdependencies in a way that advances human development without causing harm to the environment." (2007, p.2)*

The increased significance of design in achieving environmental, economic, and social policy goals is a reflection of the growing concerns that have come to be accepted as fundamental for design (Fletcher & Goggin, 2001). However, most methods for design are focused on the principle of prevention, a principle that allows for the optimization of current products, buildings or artifacts through the identification of weaknesses or risks – a cause-effect approach (Van Der Ryn & Cowan, 2007; McDonough & Braungart, 2001; WBCSD, 2000).

The precautionary principle has been established within the last 40 years as a way to address some of the limits of prevention (Stirling, 2006; Whiteside, 2006; Godard, 2005; van Griethuysen, 2004; Ewald, Gollier & Sadeleer, 2001; Kourilsky & Viney, 2000; Latour, 2000; Ewald, 1996; Lascoumes, 1996; O'Riordan & Jordan, 1995a). This principle will be used as a basis for the construction of a theoretical model to help understand the

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1 Within the framework of this thesis, design is defined as an activity that seeks to improve a given situation to a desired situation (Simon, 1996b). It will be defined in a more comprehensive manner in Chapter 1.

tensions that exist between design thinking (a creative activity with the intent of projecting a possible and desired future) and the use of traditional evaluation tools or methods for sustainability.

EVALUATION APPROACHES FOR SUSTAINABILITY TO SUPPORT JUDGMENT

There has been much attention given to the domain of evaluation methods for projects in a context of sustainable development at the international scale. In fact, there has been an emergence of multi-national organizations demanding their governments impose new laws and regulations that will enforce an adherence towards sustainability[2], including demands for developing strategies that will allow them to respect the Kyoto protocol[3].

Many international organizations are currently working on sustainable initiatives. For example, Global Reporters Initiative (GRI)[4] considers the reporting of economic, environmental, and social performance (referred to as sustainable performance) by organizations as comparable to financial reporting. Another example is the International Standards Organization (ISO)[5], in particular the ISO 14000 (Environmental Management Standards) and 26000 (Guidance on Social Responsibility). ISO 26000 has just been currently approved for release for final draft. Additionally, Life Cycle Initiative (LCI)[6] of the United Nations Environmental Program (UNEP) and the Society of Environmental Toxicology and Chemistry (SETAC), created in 2004, focuses on the operationalization of the analysis and management of life cycle thinking. An active contributor to this LCI UNEP/SETAC initiative is the Integration of Social Criteria into Life Cycle Assessment Task Force. Another non-profit organization, the Centre for Sustainable Consumption and

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2 Sustainability is defined in this thesis as *"(…) the possibility that humans and other life will flourish on Earth forever. Flourishing is the key to a vision of a sustainable future*" (Ehrenfeld, 2009, p.6).

3 This protocol is referred to as the Kyoto Protocol to the United Nations Framework Convention on Climate Change. Further information is available on URL=<http://unfccc.int/resource/docs/convkp/kpeng.html>. It was not ratified by the United States.

4 GRI was established in 1997. UNEP joined them as a partner in 1999. The GRI Reporting Framework is intended to serve as an international accepted framework for reporting on an organization's sustainable performance. More information regarding this organization can be found on URL=<www.globalreporting.org>.

5 More information regarding this organization can be found on URL=<www.iso.org>.

6 More information regarding this organization can be found on URL=http://lcinitiative.unep.fr/.

Production (CSCP)[7], claims that actions taken by designers, producers and consumers are inter-related and can affect each other and the global environment in extensive ways. The CSCP contributes to the Johannesburg Plan of Implementation (JPOI), a plan of action agreed at the World Summit on Sustainable Development to promote sustainable patterns of consumption and production (UNEP, 2007). The Leadership in Energy and Environmental Design (LEED) developed in 1998 by the US Green Building Council (USBGC) is a rating system to help assess specific performance criteria of buildings or communities. Since 2003, the Canada Green Building Council has developed its own version modestly tailored for Canadian climates, construction practices, and regulations. Consequently, the largest source of energy consumption and emissions in the world is buildings. This is why architects in North America and around the world are proposing the 2030 Challenge[8], which states that by the year 2030, buildings should be carbon neutral (RAIC, 2007). In fact, the Royal Architectural Institute of Canada (RAIC) is asking that governments create mandates otherwise this target cannot be reached. The International Initiative for a Sustainable Built Environment (IISBE) is an initiative that focuses on guiding the international construction industry towards sustainable building practices[9]. As part of the international Green Building Challenge, the GBTool has been developed[10].

There are many more conventions, standards, norms or systems available at the international or national levels to assist in the evaluation (and further judgment) of projects, products, buildings or artefacts in general. The dominant vision of many of these strategies or methods is that technical innovations and approaches can solve the current problems humanity faces regarding the environmental and social crisis.

This list is also illustrative of the fact that the concerns and issues regarding sustainability are countless, and that any one of these approaches, methods or tools cannot pretend to be comprehensive. On the most part, the various assessment systems are based on

7 The CSCP was established in 2005 as a not-for-profit think-tank and “do-tank” from the collaboration between: the United Nations Environment Programme (UNEP) and the Wuppertal Institute (WI). More information regarding this organization can be found on URL=<http://www.scp-centre.org>.

8 More information regarding this challenge can be found at www.architecture2030.org.

9 More information can be found at http://iisbe.org/about.

10 More information can be found at www.iisbe.org/gbc98cnf/sponsors/gbtool.htm.

quantitative, rigorous methods of evaluation adopting statistical or probabilistic modes of risk analysis (environmental, economic or social) and are considered preventive.

However, the broader social, cultural and environmental problems that humans face today cannot be evaluated using only quantifiable or standard methods and therefore require alternate ways for assessment and resolution (Droz & Lavigne, 2006; Whiteside, 2006). In particular, the long-term repercussions of situations related to social and cultural concerns (where there is little certitude of knowledge) should, in complement to the preventive modes of assessment, employ a different mode of assessment (Cucuzzella, 2007; Godard, 2005; Harremoës *et al.*, 2001; Kourilsky & Viney, 2000; Ewald, 1996). This is because in these situations, the consequences or risks may be non-observable, not measurable, unpredictable, non-repeatable and/or non-causal. Therefore deterministic modes of evaluation are inadequate as they remain within the universal and reductive realm and therefore may omit a more global yet local perspective of the real world problem being assessed.

Potential risks related to environmental, social or cultural situations, where the repercussions may be far-reaching, may be addressed using the precautionary principle (Whiteside, 2006; Harremoës *et al.*, 2001). In this mode of assessment, besides expert decisions based on statistical or quantifiable methods, other modes of assessment are necessary because such situations have risks or consequences that are not quantifiable; where the experts disagree on their outcomes and where the diverging views cannot be ignored (Dupuy & Grinbaum, 2005; Dupuy, 2002). Looking only at the quantitative results of evaluation without considering issues not easily quantifiable (i.e. social repercussions, cultural significance, etc.) within a systems perspective may create more problems than resolutions.

Basing such decisions on such expert methods alone implies that the decision will be based, not only on the implicit value system of these experts, but also on the narrow and limiting perspective that such evaluation systems provide (Whiteside, 2006; Tukker, 2002; O'Riordan & Jordan, 1995b). The views of the community or the views of a participant group related to the situation may help in the broadening of such values and are integral in these situations of uncertainty, since the values and visions of the experts alone represent only a fraction of the values that should ideally be represented. This is because the values that are pertinent within traditional science domains cannot typically be adopted to reflect the values of society (Droz & Lavigne, 2006; Sclove, 1995). Therefore it also becomes fundamentally important to consider other methods of evaluation that may not be based on such formal cause-effect modes of thinking for arriving at a judgment.

Evaluation and Judgment For Design for Sustainability

According to Dewey (1933) the process of thinking consists of making a series of judgments where elements such as evidential facts, principles, and tacit knowledge, may all be necessary in the process of judgment. Evidential facts are a result of the evaluation of empirical data – an objective perspective. Principles provide the worldview – a normative perspective. Tacit knowledge is the knowledge acquired through experience and is considered subjective. Habermas (1984) states that these three perspectives – objective, normative and subjective – are necessary to constitute a strong argument. These three perspectives can also be related to what Habermas terms the cognitive-instrumental, the moral-practical, and the aesthetic-expressive; all three dimensions of modern culture that have become increasingly separated as they have become increasingly expert driven (Habermas, 1985).

Design thinking is an ongoing reflective process comprised of a series of judgments (Schön, 1983). Therefore the designer is continually reflecting on evidential facts, principles and tacit knowledge in their practice. Consequently, judgment occurs throughout the design process. In this sense, evidential information, such as that resulting from sustainability evaluation tools or methods, is just one dimension of a judgment deliberation process for design, a process that must assimilate basic principles and worldviews as well as tacit knowledge in order to reach a final judgment.

Sustainability assessment methods may help evaluate a variety of artefacts (projects, buildings, services, products, etc.) at different scales, for different purposes, focusing on specific pillars, and at various phases in the process of creation or development[11], through their generally quantitative methods of evaluation, generally with the intent to reach some kind of judgment. However, on their own they are insufficient to direct action, as this requires the reflection of the other dimensions – worldviews and tacit knowledge.

The Design Project in a Context of Sustainable Development

The ways in which designers currently address the ongoing environmental and social crisis is through the use of many of these quantitative tools available (Van Der Ryn & Cowan, 2007; Lofthouse, 2006; 2004). In other words, these tools are used by designers in their design process as a way to direct their intervention. The areas of the project, product or building identified by such tools as being problematic, or the set of indicators to consider for the design project, in many ways, becomes the driver of design projects that adopt such tools[12]. The main reason why this approach to solving the problem is promising is because it represents a systematic approach to addressing a very complex design problem through reduction, where the solution is fairly predictable (Whiteside, 2006; Dupuy & Grinbaum, 2005; Dupuy, 2002).

In this sense, the design situation becomes reduced to a solvable design problem, where the reflective space of the designer is, on the most part, compromised and relinquished to what Schön (1983) refers to as Technical Rationality. This approach may be appropriate for solving problems in the natural sciences, but in design, where the situations are not problems with a clear and finite set of variables, but instead represent wicked problems as defined by Rittel and Webber (1973), this becomes problematic.

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11 For example, when using LEED in an architectural design project the designers may have to continually check to ensure that they are on target with the credit requirement. The assessment of the project in this case can be done at various phases of the design process. It can be done during preliminary conceptualization, where LEED can be used as a checklist in order to decide which credits will be addressed, or it can be done any time between the conceptualization process and the time when the project is submitted. In this case then LEED would be used as evidential data to ensure that the required rating is obtained. This evidential data should however be assimilated into the wider conception of the project.

12 The eco-design approach for addressing environmental concerns is a good example of this. Eco-design will be presented in Chapter 1.

Wicked problems represent those situations that include the complexity of real life situations, such as, problems related to living conditions, the social revitalization of a community, cultural significance of place and its importance for improving quality of life, etc. Such problems have many dimensions, where each of these dimensions cannot be separated and solved in a disconnected manner. In other words, in a manner that does not consider the organization and the interrelationships of the various dimensions, or does not consider the relationship of the dimensions to the emerging containing whole. This is why a global and systemic[13] approach is necessary for design for sustainability, since there are many dimensions to consider regarding the concerns of sustainability, with other dimensions (that may intersect) to consider regarding the design of the artefact itself. This is because the activity of design not only seeks to understand and address the 'what is' of a situation, but must also seeks to conceptualize the 'what can be' or the 'what should be' for any given situation in order to improve it – the idea of projection (Boutinet, 2005; Nelson & Stolterman, 2003; Simon, 1996b).

From this definition of design, then a strict use of such instrumental tools that seek to reduce the activity of a designer to that of a problem solver is limiting since the reflective space necessary to project an intention of change is constrained by the predictability or prescription of these tools or methods. This represents the main problematic of this research.

WHY THE PRECAUTIONARY PRINCIPLE?

This research began with a realization that in a context of sustainability, traditional methods of environmental or social risk evaluation present limits for evaluation and judgment for design, when used on their own especially for long-term solutions that aim to integrate varying concerns that may encompass various domains and may transcend existing conceptual or practical boundaries. Traditional quantitative methods of evaluation cannot adequately assess long-term visions as uncertainties and contradictions

13 A global and systemic approach will be elaborated in Chapter 2. This is where the theoretical framework will be presented.

are far too great, and therefore the predictability of long-term impacts is unreliable within this more traditional perspective. As pertinent as these standardized, quantifiable evaluation methods may be to help understand the impacts of design projects, on their own, they represent fragmented realities and cannot address the inter-related issues of sustainability since they present disjointed knowledge. Even if these approaches are fundamental to help build disjointed parts of the larger design situation (or project), ways in which to integrate the varying concerns, visions and claims is essential.

This is why this research is exploring and appropriating the theoretical foundation of the precautionary principle[14] as the basis for the construction of a theoretical model that may help to address and assess the broader qualitative issues of design projects that are difficult to assess with traditional methods of evaluation for sustainability. This principle is defined as (UNCED, 1992, Principle 15):

> *"In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."*

It is important to highlight that this definition presupposes the existence of an elite group of scientists in the 'States' of concern that adopts this principle. The precautionary principle is founded on the failure of science for assessing risks, risks that science itself creates. Risks can refer to social, cultural, technical or economic.

At first glance, this principle can be observed to have four main components: (1) imperative to protect the environment (which may include the eco-sphere, the socio-sphere, the cultural-sphere, etc.); (2) threats of serious or irreversible harm; (3) lack of full scientific proof; and (4) a requirement for an anticipative course of action projected into the future. So, the definition of the precautionary principle in a general context can be defined as a principle that tries to guide development (and action) in the absence of

14 In June 1992, the United Nations Conference on Environment and Development held a conference in Rio de Janeiro, known as the 1992 Rio Earth Summit. At this conference, five agreements were signed, one of which was the Rio Declaration on Environment and Development (UNCED, 1992). This agreement identified 27 principles that sought to define the rights and responsibilities of nations regarding sustainable development. Principle 15 defines the precautionary principle.

certitude and in the presence of potential risks. It therefore allows the establishment of a responsible, anticipative action that considers not only immediate consequences, but also long-term consequences, and therefore requires a form of collective decision making in order to justify a course of action (Whiteside, 2006; Godard, 2005; Kourilsky, 2002; Bourg & Schlegel, 2001; Harremoës *et al.*, 2001; Kriebel *et al.*, 2001; Tickner, Raffensperger & Myers, 1998). Precaution has been typically adopted for policy making in western societies. It has become, in European regulation of science and technology, a general principle for the protection of the health of human beings, animals, plants, and the environment (Tallacchini, 2005). The precautionary principle has had many applications: in environmental policy decisions (chemical contamination), socio-economic decisions (fisheries - quotas), technology issues (Y2K bug), health safety decisions (bovine growth hormone), economics (inflation regulation), and physician's patient care (physician's obligation to 'first do no harm') (DeFur & Kaszuba, 2002). This research will focus on its relevance in evaluating and judging design projects in a context of sustainability.

Design Thinking and the Precautionary Principle: a Model for Complementing Traditional Sustainability Evaluation Methods

An approach for assessing design projects founded on the precautionary principle is suggested in this research because it presents a fitting complement to the current methods of assessment in a context of sustainability. This principle is primarily concerned with the exploration of global and long-term repercussions for defining anticipatory courses of action. However, because this principle focuses predominantly on long-term consequences where the uncertainties are great, where traditional evaluation methods fail, and where value systems, visions and concerns are diverse, it opens up the question of ethics[15]. In other words, it opens up the question of *how to guide* an action or judgment about some intention (of a design solution) given that the information about its repercussions is ambiguous or non-existent. So an initial question that arises is: do we

15 Ethics refers to both (1) a guiding philosophy; (2) a theory or system of values (Weinstock, 2006).

need a completely new vision of the evaluation and judgment processes in a context of sustainable development[16] or just some refinements to current methods?

This question presents a spectrum of sorts – on one end of the spectrum there is the option to reorient the assessment process, and on the other end of the spectrum there is an option to fine-tune existing methods. The existence of an epistemological barrier separates the two ends of this spectrum. This gap will be addressed through a reflection of the precautionary principle.

This research will therefore focus on the study of the precautionary principle and design thinking, as a way to complement the ways in which evaluation currently occurs in design for sustainability. This principle, when combined with design thinking, may (1) help reveal the divergences in design discourse engendered in understanding the long-term repercussions of a design project and (2) may help understand the interconnected nature of the repercussions of design solutions.

So a more specific question arises: which forms of assessment will allow for a comprehensive and integrated understanding of the long-term repercussions of design projects in a sustainable development context in order to decide on a course of action or reach a judgment? This research is therefore suggesting that design thinking and the precautionary principle may complement existing preventive approaches for evaluation and judgment for design for sustainability.

Main Research Objective

The main objective for this research is the construction of a theoretical model for evaluation and judgment of design projects for sustainability based on the precautionary principle and design thinking. The intent of this conceptual model is to complement current methods of evaluation. The way in which this conceptual model is complementary

16 Sustainable development is defined as "development, which meets the needs of the present without compromising the ability of future generations to meet their own needs." (Brundtland, 1987, p.43)

to current evaluation methods for sustainability is that it focuses on the design project as a whole in contrast to separating the various dimensions of projects for evaluation.

The pertinence of the development of the theoretical model is to understand and characterize the epistemological barrier that exists between the use of current standard evaluation tools for sustainability and design thinking. In order to enrich this model, various practical tensions are identified in a design situation. These are then categorized into their conceptual counterparts and embedded within the theoretical model. They are representative of the tensions between design thinking and the use of evaluation tools.

The empirical design situation in which these tensions will be studied is the architectural competition. The architectural competition represents a window where such observation is possible since the data is public and accessible. Consequently, the exploration of such tensions in this field is equally important for the domain of design, as competitions represent a design format whose main objective is to find the best design based on a series of alternative proposals. The notion of comparison is then inherent in the competition. In this sense, the architectural competition represents the concrete and empirical situation with which these tensions will be observed, and from which the theoretical model is enriched.

EMPIRICAL STUDY

The judgment process for architectural competitions must take into account, not only the technical, quantitative or budgetary aspects of a project, but must also consider the projects based on their intrinsic qualitative aspects. Consequently, today, with the ever increasing demand worldwide for the use of environmental evaluation tools for design for sustainability (Moore & Engstrom, 2005), the planning and creation process has been impacted – and not always in the most obvious way.

This research will focus on questions regarding the ways in which environmental sustainability evaluation tools like LEED are used by designers and in turn, how the jury within the context of a competition judges the resulting projects. Some questions in this study are: Have the designers addressed all four pillars of sustainability? Have the teams in their discourses considered the interrelations between the technical (certification requirements and structural), the social (context and practical), the cultural (symbolic and aesthetic) and/or the economic (budget) dimensions of their projects? If not, what is the epistemological barrier that inhibits this integrated vision? In other words, have they adopted a systemic and global vision? Has the jury recognized this perspective in the teams' proposals (if the proposal adopts such an approach)?

The environmental evaluation method of focus for the empirical study will be the Green Building Rating System LEED, where the intent will be to understand how the broader concerns of architects are assessed by the jury, particularly when the results of expert evaluations (i.e. the LEED rating system) are an important consideration and a main criterion in the context of the sustainable architectural competition.

PURPOSE OF RESEARCH

A variety of quantitative methods for evaluating dimensions of sustainability[17] have emerged in the last 30-40 years. It is not surprising that such methods of evaluation have surfaced as increasingly significant for design yet present difficulties regarding the judgment of design projects. For example, in architectural competitions, the sustainable development dimension is, on the most part, comprised of only the requirement for LEED credits[18]. This is already a reductive perspective of sustainable development. In addition, this leaves much room for divergences of interpretation regarding the expectation of the client where the various architectural proposals may then have very different approaches (scope of sustainability, definition of sustainability, number of sustainability pillars addressed, depth of sustainability solutions, etc.) for addressing the sustainability criteria.

Some may consider the sustainable development dimension in all its complexity of the four pillars (cultural, social, environmental and economic) of which it is comprised. Others may simply add the technical systems onto their projects in order to accumulate the LEED

17 One example is the rating system for buildings called, Leadership in Environmental Design (LEED).

18 A survey in the Canadian Competition Catalogue (www.ccc.umontreal.ca) highlights this fact.

credits – a much reduced commitment to the main objectives of sustainable development. As a result these divergences among the projects regarding the interpretation of the sustainable development pillar in an architectural competition present difficulties when judging and selecting a winning project. In a more general design context, this ambiguity and limited perspective of the definition of sustainability is equally problematic since the only concrete handle that a designer has to sustainability is the evaluation tool.

Therefore, the main problematic in this thesis is the way in which design thinking, both in a context of a design project as well as in a context of a jury deliberation process, is impacted by the use of such instrumental tools for sustainability. As fundamental as such tools are for assessing elements of environmental sustainability, they may reduce the reflective thinking space of designers or jurors. By focusing on the results of such methods or tools, instead of the wider implications and intentions of the design project, then these tools present difficulties and tensions in design thinking that cannot be ignored. These tensions may be indicative of the presence of an epistemological barrier between the use of such standard evaluation tools and design thinking. This research is therefore seeking to first, reveal the existence of an epistemological barrier, and then characterize it through the categorization of the tensions observed.

In order to clearly state the purpose of this research, a few clarifications of what this research will not do, is equally important. The main purpose is *not* to add more indicators so that sustainable development can be more precisely evaluated in a context of a design project. The main justification for not following this path is because adding more indicators will not help overcome the epistemological barrier that exists between the use of such evaluation tools and design thinking. This thesis is also not an attempt to provide recommendations to architectural competition organizers on how to integrate the sustainability dimension, although as a secondary outcome, this research may provide some indications regarding this. The reason for this is because the primary purpose is to develop a theoretical model to better contextualize these tools for design thinking. This thesis will also not attempt to judge the architectural projects or the jury deliberation process of the competitions since the intent is to use competitions as the window in which the theoretical model may be enriched. In other words, this research is not about architectural competitions in and of itself, but about the construction of a theoretical model to help complement existing preventive evaluation and design approaches for sustainability. Competitions are used as a way to help enrich the proposed model by identifying tensions in the textual discourse of the finalist projects and the jury reports regarding the use of environmental evaluation tools.

In order to build the theoretical model, a reflection of the main epistemological, ontological, methodological and teleological dimensions of the precautionary principle and design thinking are explored. By adopting this framework of reference and using it as the main theoretical lens, the main purpose is to demonstrate that such tools may, at times, reduce the design thinking capacity of reflection into one of problem-solving and therefore mutilating the richness that design thinking may engender for projects in a context of sustainability.

This thesis will show that at times, the use of tools like LEED may lead to counter-productive results, as defined by Illich (1978) since the focus on technology to address the issues of environmental sustainability without looking at the larger social or cultural possibilities, may shift the repercussions of a design project from one domain to the next – engendering a contradiction since design may not result in the desired and improved situation, as initially intended.

Tools like LEED reside within a paradigm of the prevention principle – a paradigm of efficiency and optimization of prescribed or diagnosed problems. This is why the underlying theoretical canvas of the precautionary principle integrated with design thinking is suggested as a way to emphasize the importance of reflection-in-action as defined by Schön (1983) with a global and systemic approach as defined by Le Moigne (1999a) for design in a context of sustainable development. The intent is to reveal the existence of an epistemological barrier between preventive approaches for design for sustainability and design thinking.

Therefore, the main purpose of this thesis is to understand the tensions between design thinking and the use of quantitative evaluation tools for sustainability. An understanding of these tensions will not only help characterize the epistemological barrier, but also help enrich the theoretical model that was developed based on a reflection of the precautionary principle. This theoretical model is not meant to change practice but rather as a means to contextualize such sustainability evaluation tools within design thinking and in turn, better understand how they can be better integrated within the larger context of the design project.

Main Components of Research

There are three main research components to this thesis, separated into 5 chapters.

First, a theoretical model for the evaluation and judgment of design projects for sustainability will be constructed based on a reflection of the precautionary principle and design thinking. Since judgment constitutes the essence of reflective thinking (Dewey, 1933), it is inherent in design thinking as defined by Schön (1983). Therefore this model will adapt to Schön's (1983) definition of design thinking. Schön (1983) proposes that both problem-setting and problem-solving are necessary components of design thinking. However, the way in which these two activities occur when sustainability evaluation tools are used in a design project may not be in the way that Schön (1983) intended. When the evaluation tools are given a very important weighting in the design project, the problem-solving activity may overwhelm the problem-setting activity because of the need to adhere to and abide by the quantitative results of such tools. The tensions residing between these two activities in design thinking in a context of sustainability will be the focus of the empirical study.

Second through the empirical study of architectural competitions, the difficulties encountered in judging architectural design projects in a context of sustainability will be observed. Here the tensions between the sustainability dimension and other architectural dimensions identified in the projects' descriptive text and the jury reports are the focus. This second part represents the empirical observations necessary to enrich the theoretical model. The tensions observed in this second component of the thesis will help characterize some of the difficulties between problem-solving and problem-setting in a context of sustainability.

Third, these tensions will be correlated back to the theoretical model that was constructed in the first part, a model based on the precautionary principle and design thinking for the judgment of design projects for sustainability. The competition documents (i.e. descriptive texts of proposals, illustrative panels, and jury reports) are used as a way to understand if the model is useful for identifying and addressing the difficulties of evaluating and judging design projects in a context of sustainability.

This thesis will therefore contribute to the existing knowledge of design thinking particularly for design projects that focus on concerns of sustainability.

LAYOUT OF THESIS

The first chapter of this thesis will begin with a brief history of design thinking, theories methods and processes, in general, and then specifically for sustainable development. This is where the justification of exploring the precautionary principle for design in a context of sustainable development will be presented. Design in the first chapter will refer to the larger context of urban, landscape, architectural and industrial design.

The second chapter will explore the theoretical basis of the precautionary principle and present a reflection of its potential for design thinking in a context of sustainability. The preliminary theoretical model based on the precautionary principle will be constructed. This model will be supported by some underlying theories, methods and potential approaches of the precautionary principle as it has been described and adopted in the literature to-date. The definition of precaution adopted in this research is that by Ewald (1996) as this author presents a modern philosophical perspective of prudence and is supported by many other authors. This model will be further constructed in Chapter 3.

The third chapter will justify the architectural competition as the object of the empirical study. Therefore, the architectural competition is the concrete situation where observations will be made in order to enrich the theoretical model. This chapter will begin with describing architectural design in a context of sustainability. Since the theoretical model is based on the precautionary principle, we cannot escape the classical historical definition of prudence for architectural design. This will help position the theoretical model within architectural design principles. LEED will then be introduced and described as the privileged tool for addressing environmental sustainability for architectural projects in North America. This chapter will conclude with a presentation of a model that seeks to identify where evaluation tools like LEED reside within design thinking. This is where the relationship between technical rationality and reflection-in-action, as defined by Schön (1983), will help in the development and identification of potential tensions between design and the use of tools like LEED. The identification and observation of these tensions will be the focus of Chapter 4.

The fourth chapter comprises the methodological plan. The first part of this chapter presents the research corpus and sampling strategy. The second part of this chapter will present the research protocol by identifying the series of both practical and theoretical tensions that may reside between the actions of technical rationality and reflection-in-action. These tensions will be the focus of the observations in the architectural competitions selected for review. The results of the identification of these tensions for each of the competitions will conclude this chapter.

The interpretation and discussion of the collected data will comprise the fifth chapter. This is where the data will be analyzed and interpreted in relation to the theoretical framework. The pertinence of this research, the lessons learned from the analysis and any recommendations will also be presented in this chapter. This chapter will conclude with a return to the theoretical framework in order to confirm the significance of the proposed theoretical model for evaluation and judgment of design projects for sustainability. The theoretical model for design thinking in a context of sustainability based on a precautionary perspective will be further enriched through the empirical review of the competitions.

The conclusion will begin with a summary of the problematic and a review of the methodology. This is followed by a brief presentation of the main findings. Here the main elements of the theoretical model will be reviewed in light of the tensions observed in architectural competitions. It will also show how the enriched theoretical model contextualizes standard evaluation sustainability tools within design thinking by presenting how the observed tensions fit. This new model will be referred to as “reflective prudence”. The final part of this thesis will provide recommendations for future research.

CHAPTER ONE: DESIGN IN A CONTEXT OF SUSTAINABLE DEVELOPMENT AND THE NEED FOR A NEW WORLDVIEW

The promises of infinite growth, in particular after the Second World War, where mass production and consumption were imposed as the dominant social model, had, on the most part, dissipated by the middle of the '60's, as social and environmental problems began to surface (Flipo, 2008; Stern, 2007; Aubertin & Vivien, 2006; Max-Neef, 2005; Meadows, Randers & Meadows, 2004; Ehrlich & Holdren, 1971). Since then, the world's environment has continued to be devastated by the impacts of development.

According to the 2004 International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species, a total of 15,589 species face extinction[19]. Natural resources fundamental for a basic quality of life, such as water, air and soil, are degrading at an alarming rate affecting the quality of life of humans and therefore resulting in the degradation to society as well (Van Der Ryn & Cowan, 2007; Des Jardins, 1995). In addition, the world population has been on a steady increase; since 1990 world population has grown from approximately 5.2 billion to 6.7 billion[20]. This rise in population has and will continue to have significant negative impacts on natural resources.

However, it is not only the increase in population that is of concern, but the way in which humans consume as well, particularly humans in affluent societies (Durning, 1992). The developed countries must become conscience of their greater responsibility when compared to that of developing countries. For example, the United States, which constitutes approximately 4.5% of the earth's population, in 2005 accounted for 21.2 percent of the global total of carbon emissions[21], yet has rejected the Kyoto Protocol[22].

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19 Information obtained from URL=<http://www.iucn.org/themes/ssc/red_list_2004/main_EN.htm>.

20 Population figures were taken from URL=< http://www.ibiblio.org/lunarbin/worldpop>.

21 Calculated by Earth Policy Institute from U. S. Department of Energy, Energy Information Administration, International Energy Annual 2004 (Washington, DC: July 2006), at URL=<www.eia.doe.gov/emeu/iea>; BP, BP Statistical Review of World Energy (London: 2006).

It became evident that this type of economic growth, namely a progress spurred by an extreme capitalist dynamic (Boisvert & Vivien from Aubertin & Vivien, 2006; Meadows, Randers & Meadows, 2004), and its methods are no longer adequate.

Design has in recent history contributed to this type of growth. For example, the continued and often unquestioned demolishing and re-construction of older buildings, the need for increasingly larger family homes, introducing new artifacts to the market that acquire a status of obsolesce almost immediately, the notion of urban sprawl instead of the densification of urban space, all of which play a major role towards this infinite economic growth. Since design has been used to spur infinite growth and consequently, has contributed to the environmental and social crisis, then why is this research suggesting using design as a vehicle for sustainable development? There seems to be a paradox. However, the action of planning with the intent of improving an existing situation, according to Herbert A. Simon (1996a)[23] is the definition of design. He defines design as:

> *"Everyone designs who devises courses of action aimed at changing existing situations into preferred ones. The intellectual activity that produces material artifacts is no different fundamentally from the one that prescribes remedies for a sick patient or the one that devises a new sales plan for a company or a social welfare policy for a state. Design, so construed, is the core of all professional training: it is the principal mark that distinguishes the professions from the sciences. Schools of engineering, as well as schools of architecture, business, education, law, and medicine, are all centrally concerned with the process of design" (p.111).*

This definition of design is significant for sustainability since design is defined as a process that seeks to improve existing situations to preferred ones, implying that it can be used to develop unsustainable ways of living into sustainable ways of living. Therefore, design can contribute significantly towards the progress of sustainability through the consideration of various criteria; where the criteria is no longer limited to the scope of material, form

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22 This protocol is referred to as the Kyoto Protocol to the United Nations Framework Convention on Climate Change. Further information is available on URL=<http://unfccc.int/resource/docs/convkp/kpeng.html>.

23 There are various other definitions of design, for example Victor (Papanek, 1985) wrote: "All men are designers. All that we do, almost all the time, is design, for design is basic to all human activity. The planning and patterning of any act toward a desired foreseeable end constitutes a design process." (p. 3).

and process, but includes a diversity of considerations that may include political, environmental, economical, cultural and educational issues (Chapman & Gant, 2007; Charter & Clark, 2007; Van Der Ryn & Cowan, 2007; Thomas, 2006; Marchand, De Coninck & Walker, 2005; Madge, 1997).

This research is seeking to enrich the theory related to the evaluation and judgment of design projects when long-term goals of sustainability are sought. This implies that design in a context of sustainability is guided by not only technical solutions driven by performance optimizations needed to reach an efficiency threshold or accumulate points in a rating system, but by social and cultural concerns and solutions as well, that may not be as easy to quantify and compare.

The first part will begin with a brief introduction of design theory, methodologies, methods and models. This will be followed by a description of design in a context of sustainability and will conclude with a justification for introducing the precautionary principle for design in such a context.

Design Theory and Practice

Professional knowledge (of which the profession of design is a part of), has historically been embedded within the model of 'Technical Rationality'[24], which is essentially a rigorous problem-solving approach based on the application of scientific theory and technique (Schön, 1983; Jones, 1970; Alexander, 1964). Technical Rationality represents the positivist epistemology of practice (Schön, 1983).

Much of the academic literature related to design methods emerging at the beginning of the 1960's and 1970's was entrenched in the positivist doctrine[25] (Jones, 1970; Archer,

24 "From the point of view of the model of Technical Rationality institutionalized in the professional curriculum, real knowledge lies in the theories and techniques of basic and applied science" (Schön, 1983, p.27).

25 Positivism rests on the premise that the world is a given and predetermined where the scientific method is the best approach to uncover or discover the processes by which human or natural events occur (Guba & Lincoln, 1989).

1965; Alexander, 1964). For example, Jones' (1970) introduced two ideas regarding the way in which designers address design problems. The first was the notion of 'designers as glass boxes' which depicts designers as computers, where their main tasks are analysis, synthesis and evaluation of a given problem (Figure 1). This approach adopts a Cartesian approach, which seeks to reduce the problem into smaller sub-problems. This approach rests on the hypothesis that the design problem is a deterministic problem that can be broken down into smaller parts so that each sub-problem can be solved on their own (the divide and conquer approach proposed by Descartes). In this approach, the problem is given to the designer, and the designer seeks to solve the given problem using a variety of rigorous problem-solving approaches (Jones, 1970; Archer, 1965; Alexander, 1964).

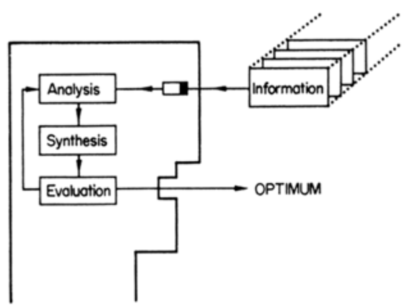

FIGURE 1: DESIGNER AS GLASS-BOX (SOURCE: JONES, 1970, P. 50)

Jones (1970) has also stated that the an important minority of design theorists in the 60's (namely Gordon, 1961, Broadbent, 1966, Osborn, 1963) claimed that the work of the designer is that which goes on in the designer's head, and partly out of reach of their conscious control. Here the designer is referred to as a magician (Jones, 1970), since the design method cannot be rationalized (Figure 2). Jones coined the term 'designers as black boxes' to refer to this design method. The idea of black box is in stark contrast to that of glass box. According to Jones (1970) each of these approaches had their own merit regarding the expansion of alternative solutions. However, the largest difficulty in both these approaches was that the designer generates too many alternatives for the human conscious to explore (Jones, 1970).

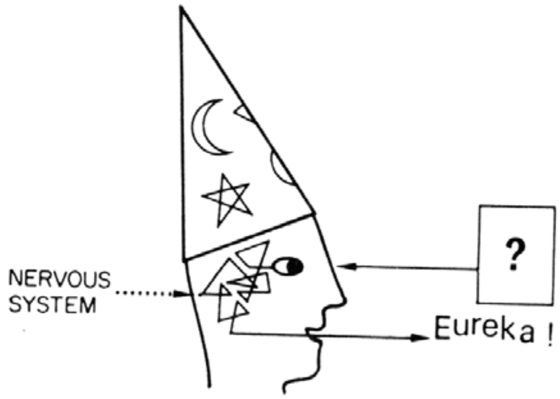

FIGURE 2: DESIGNER AS MAGICIAN (SOURCE: JONES, 1970, P. 46)

This is why Jones (1970) proposed the 'designer as a self-organizing system' (Figure 3) to address the dilemma faced by both the 'designer as glass box' and the 'designer as black box'. He proposed this new approach which he divided into two main parts: (1) the search for a suitable design; and (2) controlling and evaluating the pattern of search (Jones, 1970). The purpose of this new approach was to enable each member of the design team to see for himself which search actions produce an acceptable design. This is why he called it a self organizing system, since the designer seeks to understand the relationship between a strategy and the design situation.

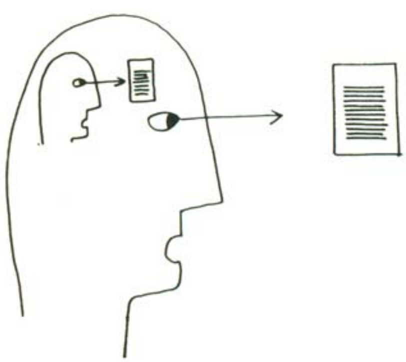

FIGURE 3: DESIGNER AS A SELF-ORGANIZING SYSTEM (SOURCE: JONES, 1970, P. 55)

These images had a great impact to the theorists of the time (Chupin, 1998). Accepting the existence of the black box meant that design research would become a concealed or hidden phenomena (Chupin, 1998). Yet ignoring it would mean that the phenomenon of design would be simplified and above all, the theoretical research would be isolated to concrete situations of design practice (Chupin, 1998).

The approach of design had previously been described in a hierarchical manner by Alexander (1964), in his book *Notes on the Synthesis of Form*. This author presented a top-down (hierarchical decomposition) approach for addressing the practical elements of design. The problem is restated using various distinct problem statements, so that the larger problem has been divided into manageable parts. Then these elements are related together to form a hierarchical tree (Alexander, 1964). This design method reflects to a large extent, the Cartesian approach, which constitutes still today the dominant method for evaluation and problem resolution. Figure 4 presents such a hierarchical tree.

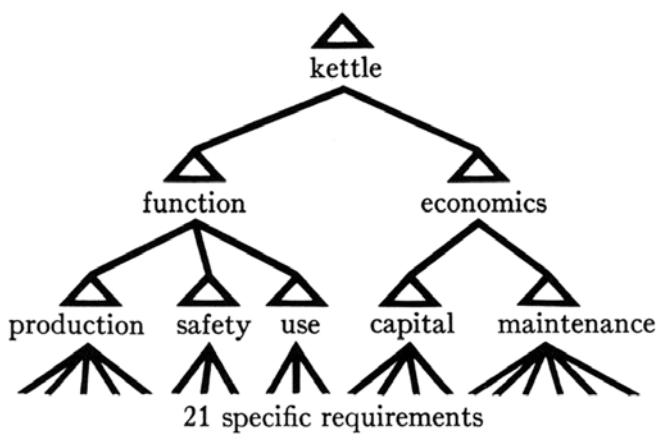

FIGURE 4: EXAMPLE OF CHRISTOPHER ALEXANDER'S HIERARCHICAL TREE (ALEXANDER, 1964, P. 64)

His approach was embedded within the technical rational doctrine adopting a rigorous problem-solving approach. Alexander later rejected this approach, realizing it was too limiting for design practice. Jones (1970), Archer and Best (Broadbent & Ward, 1969) also advocated design methods based on a Technical Rationality, even if this term was not used in their literature. However, there was an emerging awareness in the 1970's that design practice appeared as a puzzling anomaly in light of the positivist doctrines (Schön, 1983).

When Herbert Simon (1969) published his book, *The Sciences of the Artificial*, he sought to escape the limitations that a rigorous problem-solving approach imposed, by introducing ideas such as satisficing[26] and bounded rationality[27]. He wanted to address the specific design methods movement of the '60s and '70 by showing that some of the principles did not make sense in design practice. Yet, he still believed that the problem-solving approach necessary for design practice did not call for specific 'creative' processes that are any different from those in standard problem-solving settings (Visser, 2006). So Simon (1969) was on the border of both doctrines; he was embedded in some ways within the scientific traditions of the past, yet many of his theories were in opposition of those very traditions.

According to Coyne (2005), the article by Rittel and Webber in 1973 was an appropriate antidote to Herbert Simon's book, since they argued that the design process (or any professional task) was poorly understood in terms of goal setting, constraints, rules, and state-space search (Coyne, 2005). Rittel and Webber (1973) claimed that the skill of the professional was better expressed in the framing of the problem to be addressed, since they claimed that such professional problems are already 'solved' by the time that they are identified and defined. So problem-setting is then a dependent, troubled and often a consensual process for which there is no set of rules, criteria or method. This is because professional problems are not well-defined problems but rather wicked problems for which a machine like process will not suffice. This led to a crisis regarding the credibility of the professions (Coyne, 2005).

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26 This is a term coined by Simon (1969) It is a decision making strategy that comprises both the ideas of satisfactory and sufficient solution, in opposition to an optimized solution. This is what is referred to as a near optimal solution, which meets the criteria of adequacy.

27 This is a term coined by Simon (1969) According to this author, humans cannot know the probabilities of all outcomes, and can therefore seldom evaluate all outcomes with any kind of significant precision. He claimed that a more practical approach to rationality takes into account this limitation, which is referred to as bounded rationality.

DESIGN PROBLEMS ARE WICKED PROBLEMS

The problems that designers are given are often ill-defined problems (Dorst, 2006; Friedman, 2003; Cross, 2000; Rittel & Webber, 1973), in contrast to well-defined problems often found in natural sciences). There are many definitions of ill-defined problems (Cross, 2000, pp.14-15):

- No definitive formulation of a problem;
- Any formulation may embody inconsistencies;
- Formulations of the problem are solution dependant;
- Proposing solutions is a means of understanding the problem;
- There is no definitive solution to the problem.

Solving problems that are ill-defined requires methods that can deal them, since the logical deep analysis (often conducted by natural scientists) of the problem will not help designers arrive at the most satisfying solutions. Consequently, according to Rittel and Webber (1973), planning problems are wicked problems. This is because problems that planners deal with are societal problems, and rely on judgment for resolution (not solutions, since social problems according to these authors are never solved). Rittel and Webber (1973) have identified ten distinguishing properties of planning-type problems (wicked problems) that planners should be alerted to (pp. 161-167):

- There is no definitive formulation of a wicked problem;
- Wicked problems have no stopping rule;
- Solutions to wicked problems are not true-or-false, but good-or-bad;
- There is no immediate and no ultimate test of a solution to a wicked problems;
- Every solution to a wicked problem is a "one-shot operation"; because there is no opportunity to learn by trial-and-error, every attempt counts significantly;
- Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan;
- Every wicked problem is essentially unique;

- Every wicked problem can be considered to be a symptom of another problem;
- The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution;
- The planner has no right to be wrong.

According to Cross (2000), scientists problem solve by analysis, whereas, designers problem solve by synthesis. According to Schön (1983), making sketches of solution concepts is one way to help designers identify the consequences and to continue the exploration process; he refers to this as the 'reflective conversation with the situation'. In fact, Cross (2000) claims that sketches allow designers to address several layers of abstraction simultaneously, by tackling all levels of the design process simultaneously. Designers often think in general as well as detailed dimensions, making decisions on both levels at the same time (Cross, 2000).

Reflection, Criticism, Judgment, Emergence

A significant response to the problem of rationality regarding the professions came from the pragmatists such as Dewey (1980, from Coyne, 2005). In his book *Art as Experience*, Dewey (1980) argued that humans' capacity to criticize requires judgment, where judgments have the function of both discrimination and unification (Dewey, 1980). In this act, humans are constantly judging and evaluating based on personal likes, dislikes, preferences, inclinations, of any experience or situation (Dewey, 1980). Judgment therefore allows a clearer understanding of the components and to discover how these parts are related to form the whole. Theory uses the terms analysis and synthesis when referring to the execution of the functions of discrimination and unification. In fact, theory often refers to analysis and synthesis as separate tasks, yet they cannot be separated since when humans are executing one, they are inherently also doing the other (Dewey, 1980, p. 310). So according to Dewey (1980) in every act of synthesis there is analysis, and in every act of analysis there is synthesis.

Dewey (1980) also claims that discord, conflict, disagreement, or dissonance, induce reflection. Reflection is a moment where the subject of observation (the situation or experience) and of thought is made explicit (Dewey, 1980), and is therefore not only limited to the professional or the artist, but to the scientist as well. This is because when a problem that a scientist is seeking to solve is presented with some tension or resistance, then some form of evaluation and critique must be conducted – this is reflection. Therefore humans are constantly judging and evaluating, and therefore are also constantly in some form of reflection. Professional (or scientific) rationality cannot exist without a sense of reflection, and therefore a sense of judgment, which is inherently a subjective critique.

Schön's (1983) notion of reflection-in-action refers to the fact that in practice, situations are unique, complex and uncertain. This refers to when a practitioner describes his intuitive feelings through some form of description, however, requires that the practitioner has time to think and reflect on his action. The greatest difficulty however lies not in the complexity of the material that is made conscious to the practitioner, but in its representation (Schön, 1983). This implies that each case cannot be dealt with by applying standard theories or techniques (Schön, 1983). Instead, the practitioner must seek to re-frame the situation at hand, and therefore make new sense of the problematic situation. This is what Schön(1983) also refers to as problem-setting (Schön, 1983). More specifically,

> *"Problem-setting is a process in which, interactively, we name the things to which we will attend and frame the context in which we will attend to them" (Schön, 1983, p.40).*

Schön (1983), sought to understand the difference between supported theory and how design actually occurs in practice, just as many other theorists before him. His approach of 'reflection-in-action' moves away from the positivist approach, since it does not start with a given problem to be clarified and solved using algorithmic procedures, but instead with a problem to be identified and constructed adopting an interactive, iterative, and reflective approach. This is in contrast to Simon's approach (1969) for addressing design methods, which lie predominantly in a deterministic, Cartesian approach (Schön, 1983).

This echoes the ideas of Dewey (1980) regarding reflection and that discord, conflict, disagreement, or dissonance, in fact induce reflection of the situation, experience or object of observation. One cannot ignore the reflection necessary to comprehend this discord or uncertainty, and by doing so, can resist from oversimplifying the problem and therefore from adopting actions that may not have addressed the original discord presented. Consequently, Dewey (1980) states that judgment is criticism and that

> *"Judgment has to evoke a clearer consciousness of constituent parts and to discover how consistently these parts are related to form a whole. Theory gives the name of analysis and synthesis to the execution of these functions." (p.310)*

As mentioned previously, Dewey prefers to refer to these functions as discrimination and unification, and claims that the unifying phase is the creative response of the individual who judges. This represents insight, and so there can be no set of rigid rules that would enable this unifying function to become optimized since it is becomes itself an art (Dewey, 1980). So analysis and discrimination must result in unification if a judgment is to be reached or the emergence of new ideas is to be formed. He claims that without a unifying view, criticism (and therefore judgment or emergence) ends in the enumeration of details.

This is directly related to the current crisis of evaluation and judgment in the context of sustainability, where design projects or judgments of these projects are at times reduced to the enumerated checklists of optimizations needed to acquire a threshold of performance.

Rationality, Simplification, Mutilation

In the previous section we introduced the crisis of evaluation and judgment for design in a context of sustainability through an elaboration of the ideas of reflection, criticism, judgment and emergence. In this section another aspect that troubles evaluation and judgment in design will be discussed, that of instrumental rationality and simplification. In critical theory, instrumental rationality refers to a form of rationality that tends to focus on the *how* and not the *why* of an action. In other words, this type of rationality refers to finding the most efficient means to arrive at an end, without questioning the value of the end, where empirical science represents the method to arrive at such ends.

According to Levy (1991), the only methodology that scientific empiricists have is that they purposely and uniquely set out to control the objects of science and therefore none of the analytic methods consider science as the subject of the object of study. He states that

> *"Positivist science has created a methodology in which subjectivity and reflexivity have been expelled and, as a consequence, is determined by a mode of investigation without conscience" (Levy, 1991, p. 91).*

And therefore any investigation must therefore start from a framework based on the awareness of ignorance, uncertainty, doubt and contradiction (Levy, 1991). It is important to note here that the word *reflexivity* refers to a mirror-like analogy, in other words, a circular relationship. For example, when the object and the subject of a research study are reflected upon each other and cannot therefore be separated in the analysis, then this represents the notion of reflexivity. This is different from the word *reflective* used by Dewey and Schön, who were referring to a deep sense of contemplation and thought.

However, even if these two words (reflexivity and reflective) represent two very different ideas, they cannot be separated easily in the domain of design. The notion of reflexivity in design refers to when a designer (subject of the study) ponders on a design situation (object of the study), and his background and set of values will be inevitably reflected onto the object of study (the designed artefact). Yet, the designer is also constantly contemplating over the design situation and making new sense of the situation at each cycle of contemplation, therefore recursively building the knowledge needed to construct the solution. In this process, it seems rather obvious that the reflexivity of the object-subject dichotomy cannot be separated from reflective action itself. So both ideas are fundamental for design.

Consequently, Morin (1977) suggests that the circularity, and more importantly the recursive nature between the human and natural sciences should be maintained in order circumvent the mutilating effects of positivist science's methods of simplification. By accepting confusion and contradiction, then the mutilation resulting from a simplification of the object of study, the situation, or the experience, can be defied (Levy, 1991). Therefore, linear methods of problem-solving for the human sciences, of which design is one, may lead to analytic reduction. However, by accepting and adopting a recursive approach for the comprehension of uncertainty (Morin, 1977), may overcome the paradoxes faced when adopting such linear, non-iterative approaches for problem-solving, since these would exclude notions of discord, contradictions, doubt and uncertainty .

Moving beyond the notion of reflexivity and pragmatism, the notion of phenomenology explores how language can be used to give expression to methods of thinking beyond that of rationality (Coyne, 2005). Heidegger (1962) questions why humans are inclined to the technological imperative which involves the search for universal theories (Coyne, 2005).

So when trying to construct the problem based on a given situation, and trying to consider and integrate the uncertainty, contradictions, and doubts within these, these types of problems cannot then be considered as tame, because they cannot be formulated without actually considering solution scenarios. Therefore these are essentially wicked problems. It is important to note that when formulating such problems, their construction is socially driven since the vision of the professional is embedded in the solutions that emerge, and therefore the way in which the problem is formulated. If such problems are considered tame, then they could be solved using the same rigorous problem-solving methods adopted by natural scientists, where anomalies are considered as the exception and not the norm (Kuhn, 1970). Yet in solving problems in this manner would not allow the professional then to reflect, judge, or assess the contradictions and doubts, which is the norm and not the exception in most professional problems (Coyne, 2005). The solution would be based on a simplified problem definition, that would exclude these 'anomalies', and therefore, would inhibit the professional from the reflection needed to address these contradictions.

Therefore a rigorous problem-solving approach in design practice would exclude notions of uncertainty, instability, uniqueness and value conflict and is why practitioners bound to this doctrine are caught in a dilemma, similar to the dilemmas faced by practitioners adopting the glass-box framework (input/glass-box/output) proposed by Jones in 1970, because of its linear, sequential nature that simplifies rather than seeks to find the richness of the problems. This approach excludes phenomena central to their practice (Schön, 1983). According to Schön (1983) adopting a rigorous problem-solving approach may often be done at the expense of understanding the most important and challenging social or cultural problems. This does not eliminate the need to adopt rigor in the process of problem-solving, but a requirement for problem-setting where the practitioner addresses the important multi-dimensional challenges becomes equally essential.

In this section, we discussed various theories related to the action of designing, from the rigorous empirical approaches to the more reflective approaches. Based on such theories, there have been many depictions of design methods that have emerged since the 1960's that seek to formalize the design process so that it may be manageable and finite for practice. This will be the focus of the discussion in the next sub-sections.

DESIGN METHODOLOGIES

To begin this section, a definition of design methodology by Cross (1984, p. vii) presents a broad perspective

> *"(…) the study of principles, practices and procedures in a rather broad and general sense. Its central concern is with how designing both is and might be conducted".*

Cross (1984, p. x) claims that in the 20 years preceding the publication of his book, *Developments in Design Methodology*, attitudes and opinions regarding design and its methods have changed quite drastically, where protagonists have become antagonists. This author also states that design methodology has matured since, and hopes that this book would allow design to return to its origins, to the prescription of realistic ideals. His book is divided into four parts; prescription of an ideal process, description of the intrinsic nature of design, observation of the reality of design activity, and reflection of the fundamental concepts of design (Cross, 1984, p. x). This division in fact represents the maturation process of research in design activity and methods.

Simon (1996b; 1969) sought to differentiate design from the traditional sciences (such as natural sciences). He claimed that the action of synthesis is predominantly adopted by engineers, whereas the action of analysis is predominantly adopted by scientists. However, Jones (1970) sought to go beyond this dichotomy and proposed that design methods were based on three different types of action: divergent, convergent and transformational. Convergence is mostly addressed through analysis. Divergence and transformation are mostly addressed through synthesis.

In 1984, Jones stated in his article entitled *How My Thoughts about Design Methods have changed during the Years,* that black box methods, although not well understood, work well, yet glass box methods, which are logically clear do not work in practice. In addition, he accepted that instability in the design problem exists, that the problem and solution transform all in one mental act or process. In fact, he claimed that as more real life concerns are included into the problem, the more the problem becomes unstable, and *not* more stable. So according to Jones (1984), design is about uncertainty, and if people want certainty in design problems, he feels they will wreck the problem.

This according to Morin (1977) is what simplification does to human sciences. It mutilates the object of study by reducing it to a set of factors or variables, and therefore disconnecting it to the real world phenomena. In fact, even Archer (1984) in later reflections regarding design methodology, once an advocate of rationalistic, mathematical models to describe design activity, later claimed that design is not only a different process when compared to traditional scientific processes, but operates through a medium which he refers to as modelling, that may be compared to language and notation, yet is different.

In fact, Alexander (1984) during the 80's (20 years after writing *Notes on the Synthesis of Form* in 1964) claimed that research in design methodology had lost its focus during an interview with Max Jacobson. For Alexander, the intent of this research was to create well-defined procedures which would help people design better buildings. Yet he also said that design methodology cannot help since, for him, design depends on the depth of the insights that designers have, and any investigation before design is related to the need to deepen these insights (Alexander, 1984). So when designers are trying to fuse insights to create form, it is very distant from the numerical realm, a place where Alexander (1984) thinks design methodology research was headed in the 1960's. In fact, he had become an antagonist of the concept of methodology, since to him this was a barren concept.

Broadbent (1984), in his article *The Developments of Design Methods*, stated that research developed during the 1960's adopted Cartesian methods of design – considered first generation design methods. During the 70's a new approach emerged which was based on analysis, quantification, and computer aids (Broadbent, 1984) – still considered first generation. However, minimal real success (in terms of buildings built) was seen from these expert-knows-best approaches which stemmed from the societal importance of the computer for design (Broadbent, 1984). Second generation design methods according to Rittel (1972, in Broadbent, 1984) were based on the assumption that design expertise is distributed, and that planning process is an argumentative process, a process of deciding in favour or against various positions on each issue. Emerging third generation methodologies, according to Broadbent at the time (1984) should be based on combinations of each of these, as they each present limitations and benefits.

It is interesting that Hillier et al. (1972, in Broadbent, 1984) had drawn a parallel between the methodology of science (according to Karl Popper) and the methodology of design. If designers work within a functionalist approach (empirically based understanding of human behaviour, which is often based on quantification of observations), then they work from conjectures and tend to test these conjectures as rigorously as possible. So a third generation of design methods was taking on a

> *"Popperian view of designing whilst recognizing that within it there are people, <u>experts</u>, whose job it is to make the design conjectures" (Broadbent, 1984, p. 344, emphasis by Broadbent).*

However, unlike their predecessors, they did not know how people should live, but instead offered possibilities which people can accept or refuse (Broadbent, 1984).

Consequently, Roozenberg (1992) states that it is widely recognized that non-deductive, plausible inferences are fundamental in problem-solving in science and technology. These come in many forms: analogy, induction, statistical generalization and specification, abduction, etc. This implies that designers use conjectures to test their ideas, and then using a variety of methods, justify their decisions, even if the conclusions drawn from plausible inferences cannot be completely justified by the structure of the argument - as plausible inferences are logically invalid. Yet, they are very useful in innovation, since science and technology rests on these to a large extent (Roozenberg, 1992). Many designers agree with March (1976 in Roozenberg, 1992) that abduction is the key mode of reasoning in design. March however preferred to use the term productive reasoning.

DESIGN METHODS AND MODELS

Visser (2006) defines a design method as all action globally taking place during a design project. The activities within a design method can be coarsely separated into construction of representations, solution generation and solution evaluation (Visser, 2006). According to Perrin (2001, p.50) design methods refer to the various procedures, techniques and tools used by designers, where the goal is to contribute to some level of rationalization of the design process. The definition of design methods by Perrin (2001), represents a more traditional rational approach to design, who claims that design is the integration of intuition and experience on the one hand, and a rigorous problem-solving or logical treatment on the other hand. He separates design into two main phases: a synthesis of the problem on the one hand, and analysis and evaluation of the design problem on the other, where synthesis represents the creative thinking part of the process. So it is not far from Jones' 1970 definition, which included these three activities: analysis, synthesis and evaluation. However, as stated by Dewey (1980), analysis and synthesis cannot be separated; humans are constantly analysing and synthesising (or discriminating and unifying). Does Perrin's notion of design method limit the designer when trying to address the social realities of professional problems by consciously separating these activities?

There are many different categorizations of design methods. Visser (2006), Cross (2000) and Dixon (1987) categorize design methods into prescriptive[28] and descriptive[29]. Visser

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28 Predominantly linear and sequential methods, and offer an algorithmic procedure to follow (Visser, 2006; Cross, 2000) .

(2006) and Blessing (1992) add another categorization based on either stage[30] or process[31] methods. An example of a stage within a design method is '*embodiment phase*'. An example of a process is '*managing solutions*'. For example, in the case of the stage model, Herbert Simon (1969) proposes the two stage process; structuring the problem (if ill-structured), then problem-solving. Donald Schön (1983) proposes four stages; (1) naming and (2) framing the problem, (3) moving, and (4) evaluation. Cross (2000) adds another category called integrative[32]. Whereas Dixon (1987) adds the category of computational[33] design methods. The model proposed by Ulrich & Eppinger (2008) (as shown in Figure 5) can be considered to fall under the analysis-synthesis-evaluation cycle model.

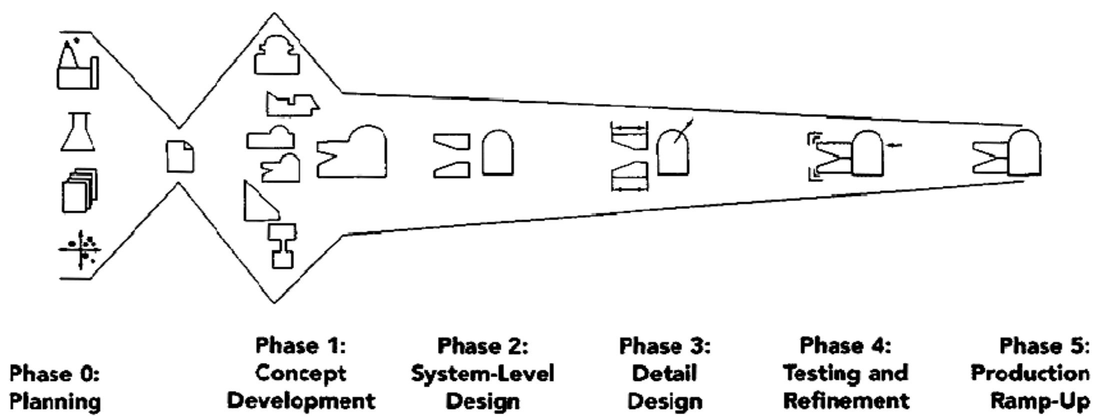

FIGURE 5 : THE GENERIC PRODUCT DEVELOPMENT PROCESS. SIX PHASES ARE SHOWN, INCLUDING TASKS AND RESPONSIBILITIES OF THE KEY FUNCTIONS OF THE ORGANIZATION FOR EACH PHASE (ULRICH & EPPINGER, 2008, P.14).

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29 These focus on generating the solution early on in the process, and is considered a heuristic process (Cross, 2000). Simon's (1996b) method is considered a descriptive method.

30 Stage models can be interpreted as input/output models, where the black box is the technique or tool used to transform the input into the output (Visser, 2006). Prescriptive models are often stage models, since they present a series of steps to follow. Another example of a task oriented (stage) method is the analysis, synthesis, evaluation (ASE) method introduced by Hamel (1995, from Visser, 2006).

31 Process models present activities or operations to be carried out by the designer, or other practitioner in order to complete the task (Visser, 2006). Blessing (1994) distinguishes three mains processes in most process models: problem definition; conceptual design; detail design.

32 This model allows the co-evolution of the problem and solution.

33 The methods integrate digital and qualitative techniques of artificial intelligence into the design process (Perrin, 2001).

According to Christiaans and Dorst (1992, p. 121),

> *"Characteristics for these methods is that the process is decomposed, rigidly and planned, in a subset of independent subproblems on a general level. The role of knowledge in the conceptual stages of designing – the most elusive ones – is hardly mentioned."*

There exist many others types of categorizations. The categorization that will be elaborated here has been proposed by Perrin (2001). Perrin (2001), uses a very different typology to characterize design methods. In fact, according to Perrin (2001), design methods allow designers to confront the specific situations and gives them the guidance to organize action. So design methods comprise a larger theory, which is that of action (Perrin, 2001). Perrin (2001) claims that design models (not methods) are representations, philosophies and strategies proposed to show what is design and how it can be implemented (Perrin, 2001, p.87). He categorizes them is the following manner:

- hierarchical succession of phases;
- iteration of an elementary design cycle;
- emergent phenomenon of auto-organization;
- cognitive process;
- form of communication and conversation.

Perrin (2001) argues that each of these five methods focus on one of three different design action logic: divergence, transformation or convergence. In the next sections, this classification of methods by Perrin (2001) and some of the associated models will be elaborated.

HIERARCHICAL SUCCESSION OF PHASES

The method proposed by Pahl and Beitz (1994) is exemplary in this category (Figure 6). This model adopts the logic of action based on convergence (Perrin, 2001), within the prescriptive category. These are still very widely used design methods. These are however mostly adopted by engineers because of their focus on problem-solving, and therefore seeking to define and resolve the problem through an identification of objectives to achieve (Visser, 2006). The norm AFNOR X50-127 developed in France also falls under the same category as that of the Pahl and Beitz (1994) model. In fact, this model was inspired by the Pahl and Beitz (1994) model.

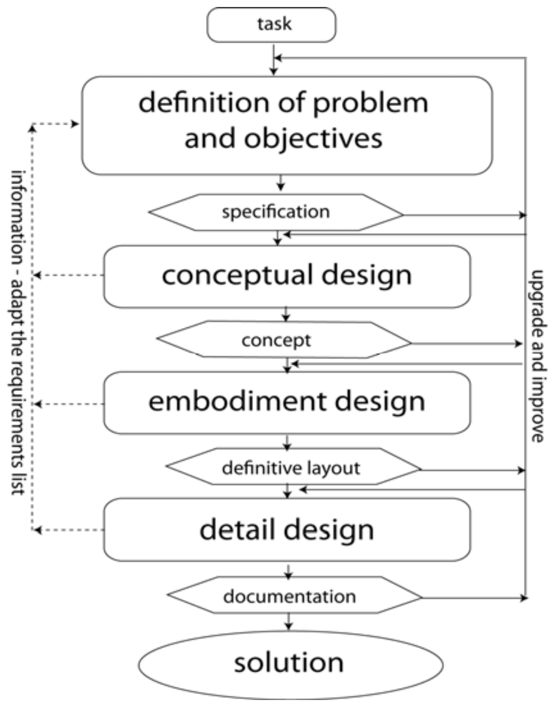

FIGURE 6: MODEL OF PAHL AND BEITZ (1985) DESIGN PROCESS (SOURCE: PERRIN, 2001, P.89).

The VDI 2221 method (Figure 7) was developed (in Germany by l'Association des ingénieurs allemands) because of the main critique of the Pahl and Beitz method which did not allow for any divergence. So this method adopts both a convergent and divergent logic of action (Perrin, 2001). The British Standard 7000 (BS7000) developed in Great Britain, also falls under this category.

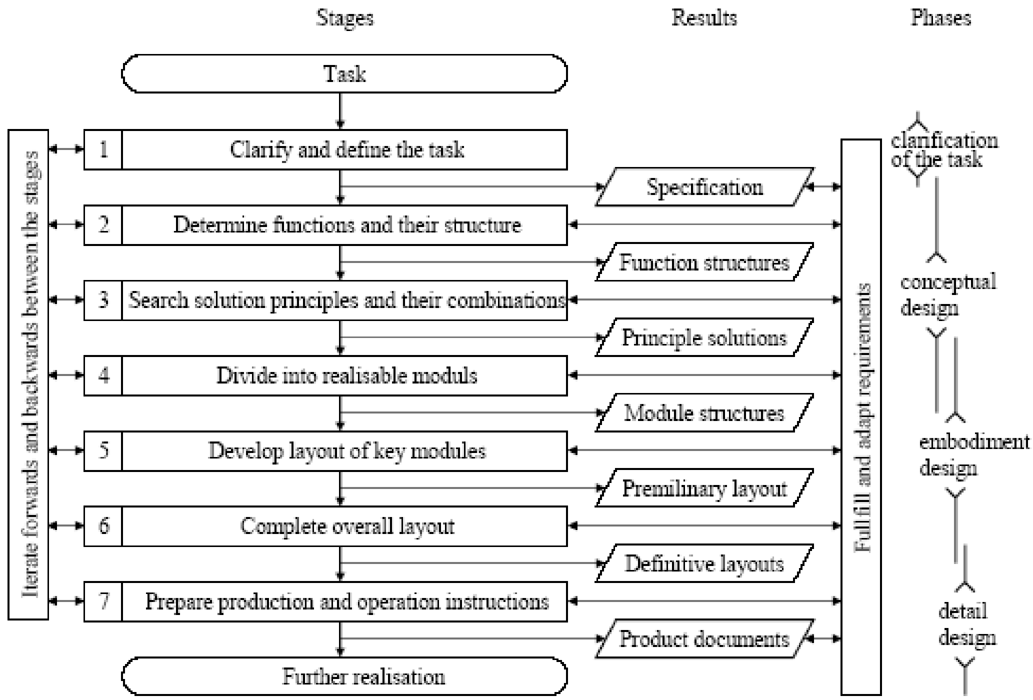

FIGURE 7: VDI-2221 (1985) GUIDELINE FOR MECHANICAL ENGINEERS COMPARED TO THE PHASES OF THE PAHL AND BEITZ (1985) METHOD (BASED ON: CROSS, 2000, P.39).

ITERATION OF AN ELEMENTARY DESIGN CYCLE

In this type of model, the methods are cycles of either phases (stages) or processes. An example is that of Roozenberg and Eckels (1995 in Perrin, 2001). At any one point in time, a set of specifications help determine one solution, which will be used in another cycle to help define a revised set of specifications. This is an evolutionary process where the specifications continue to be more precisely defined through each of the iterations of conception.

Another example of such a method, is the method proposed by March (1984 in Perrin, 2001). This method is inspired by Pierce by adopting three modes of inference: abduction (or production), deduction (predicts) and induction (evaluates) (Perrin, 2001). In this method, the designer starts from the production phase (see Figure 8), then the designer goes on to deduce the performance that is possible from the proposed solution, and finally through induction, the proposal can be evaluated (Perrin, 2001). This cycle restarts using either a revised set of characteristics, or based on a new solution proposal.

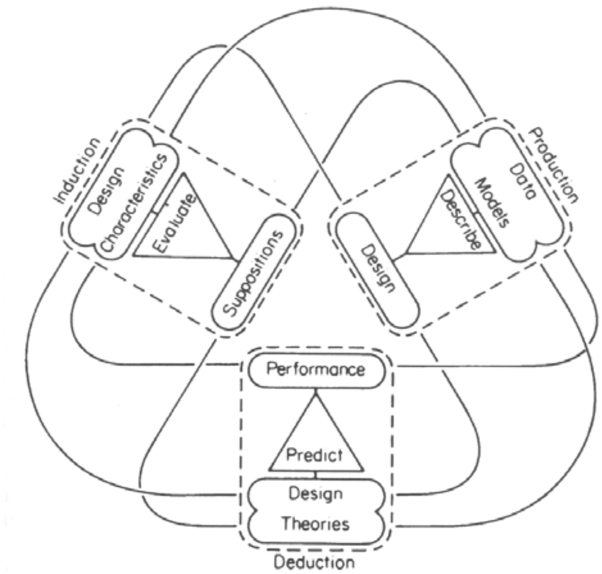

FIGURE 8: DESIGN CYCLE BY MARCH (1984), (SOURCE: PERRIN, 2001, P.95).

The methods presented in this section and in the previous section, are concerned with problem-resolution using a phased process approach which can be described using a computer. The main purpose of such systems is to progressively reduce the solution space which was initially very large. This is done by continually formulating and satisfying a set of constraints.

EMERGENT PHENOMENON OF AUTO-ORGANIZATION

Beyond methods that focus on the management of constraints (previous two methods), methods that take into account the different perspectives of the different stakeholders involved in the design process must be taken into consideration. For example, when a design project begins, all those involved in the project have their own perspective of the project. Marketing has a sales perspective; finance has a budget perspective; purchasing has a supplier perspective; manufacturing has a production perspective; etc.

In addition, the different fields within the design discipline itself also present various perspectives of the artefact (Perrin, 2001). For example, in a firm that designs automobiles, the mechanics don't have the same perspective as the electricians; the drivers don't have the same perspective as the body shop workers (Perrin, 2001). The various points of view of the same artefact reveal the fact that the design process becomes one where there is a research for a compromise of complementarities and of the different viewpoints, with the objective of arriving at a solution that is coherent and economically feasible for both the enterprise and the client (Perrin, 2001).

This process is one of assimilation, where each actor translates the constraints and orientations expressed by the other actors into their own perspectives, specific to their own environments, to accept these and use this to evolve their own points of view. This becomes a self-organizing project since each actor cooperates with every other actor to obtain their viewpoint regarding the constraints and orientations and use this to evolve their own viewpoints. In this process the intermediate objects such as sketches, maquettes, plans, and prototypes are very useful as a means for communication to the other actors (Perrin, 2001). The main logic of action here is one of divergence.

Cognitive Process

There are two separate paradigms that contribute to this vision of design methods: the artificial intelligence paradigm of design, and the natural intelligence paradigm of design (Perrin, 2001). Much of the research regarding this category (the natural intelligence paradigm) of design methods stems from the design conference in 1991, and where the results of this conference were published in the book *Research in Design Thinking* (Cross & Dorst, 1992). Contributors to this conference were Cross, Dorst, Christiaans, Roozenberg, Akin, Ullman, Blessing, etc.

The artificial intelligence paradigm is also referred to as the computational approach, where at the time, the construction of expert systems and artificial intelligent systems could be used as a means for the problem-solving phase (Perrin, 2001; Blessing, 1992). Blessing (1992), presents many obstacles encountered in this approach. For one, there are many possible solutions to any design problem, and that the decisions to select one of the many solutions are based on the intermediate choices and decisions made by the actors of the project, all based on the actors experience and knowledge, all very difficult, if not impossible to program in a computer (Blessing, 1992). Secondly, the transformation process from an initial problem to the final state is not an algorithmic process. There are iterations, where the decomposition of the problem is done in multiple stages, making it very difficult to program in a computer. Third, it is very difficult to define the boundaries of the problem; therefore programming this would be very difficult as well (Blessing, 1992).

The natural intelligence approach to design is based on the idea of problem exploration and resolution, where the problem is constructed and formulated, where the proposal of possible solutions contribute to the problem formulations. There is a co-emergence of the problem and the solution (Cross & Dorst, 1992).

FORM OF COMMUNICATION AND CONVERSATION

This type of design method is strongly influenced by the work of Donald Schön (Perrin, 2001). The design process based on Schön (1983), can be seen as a conversation with a situation and as an interpretation based on the reflection of the situation. The designer converses with the design situation, and through this reflection, restructures the courses of action based on the new-found appreciation of the situation (Schön, 1983).

In particular, in collaborative design projects, where many actors are involved in the conception process, each of the designers use their own perceptions, their own descriptions, and their own appreciation of the situations in elaborating the artefacts. According to Schön (1983), because designers construct the artefacts based on their own worldviews, and therefore the design project becomes one that is constructed from the collective view of each designer, then a constructivist epistemology is appropriate for the conception phase of a design project in this approach (Schon, 1983 in Perrin, 2001).

In addition, each of the views of each of the designers is in constant evolution, therefore is founded on ambiguity and uncertainty. The quality of the collective design rests on the quality of the communication among the designers or actors of the project (Schön, 1983 in Perrin, 2001). In addition the convergence towards a significant solution depends on the interpretive work, which is essentially one of constructing and testing the interpretation of the other actors. Perrin claims that hermeneutics *allows to formulate* interpretation based on three basic dimensions: the act of talking, the act of explaining, and the act of translating. These three modes of interpretation have major impacts on the development of products (Perrin, 2001).

In this research, the definition of design that will be adopted is that design is about that *which is not yet*, or that *which can be* (Boutinet, 2005; Nelson & Stolterman, 2003; Schön, 1983). This implies that the project perspective as defined by Boutinet (Boutinet, 2005) and the idea of design thinking as defined by Schön (1983) are at the basis. Design is therefore a project of intentions (Boutinet, 2005) that seeks to change a current situation into an improved and desired situation (Simon, 1996b), where a conscious effort of anticipation of uncertainties is done through the process of reflection-in-action that includes when necessary technical rationality as defined by Schön (1983).

Summary of Categorization of Design Methods and Models

These five categorizations illustrate the divergences of the design process that is manifest based on these varying models. From a very systematic approach to design based on a succession of design phases, to a hermeneutic and co-learning approach[34] to design that is founded on communication and communication. The differences among these models are important when considering the appropriate design approach to adopt in a context of sustainable development. In the next section design in a context of sustainable development will be presented.

34 A hermeneutic approach is one that is founded on learning and reflection through conversation and communication. This approach will be more fully described in Chapter 2.

DESIGN AND SUSTAINABLE DEVELOPMENT

This review of design theory, methodologies and methods enabled an understanding of some of the constraints and opportunities of the various approaches to design. Design approaches that consider the problem to be a given most often adopt rigorous problem-solving strategies at the expense of understanding the fundamental social challenges during the setting of the problem. Such design approaches may render these challenges obscure because the rigorous problem-solving process founded on a simplified problem definition, excludes 'anomalies' and may inhibit the professional from the reflection needed to address contradictions that arise during the problem definition phase. Kuhn (1970) refers to such anomalies as evidence that a scientific paradigm cannot address all the problems it encounters. A new scientific paradigm often emerges when the need to address an increasing number of anomalies is encountered (Kuhn, 1970). In fact, according to Kuhn (1970), the decision to adopt a new paradigm is based on the social acceptance of the new paradigm, and the social rejection of the old paradigm. The reason is because it will change the way that researchers look at their research problems, and the ways in which they will search for their solutions.

In a context of design for sustainable development, the problem situation must be constructed since it is very often based on uncertainty, instability, and doubt, and in addition, because a more macro-perspective is often necessary (Schaefer & Crane, 2005). Therefore, it no longer becomes a question of requirements clarification, but a question of what perspectives to include, what boundaries to set, the values and visions of each stakeholder, and how to communicate these to the other actors within the design project, so that each actor can integrate this new knowledge within their own perspectives. The social, cultural, environmental, economic and political challenges of the design problem are not often well known when the initial problem is identified in the brief. Specifically in a context of sustainability, when the issues are not clear, this lack of problem definition is even more prevalent.

A design method that may accommodate this lack of problem definition is one in which the design process is not a sequential linear process, but one that is a form of conversation and communication. Since it is based on communication, it is inherently based on interpretation and judgment (Schön, 1983; Dewey, 1933). The difficulty of such an approach is the way in which the various actors within a design project explain their views and interpret and integrate those of the other actors. Very often, actors cannot understand other actors' perspectives because they may adopt a very different worldview. In fact, in his article *Wicked Problems Revisited*, Coyne states that:

> *"In some cases we encounter what Kuhn describes as an incommensurability between frames. This is perhaps most obvious where researchers operating in one frame do not recognise or even hear the questions posed by researchers operating in another." (Coyne, 2005, p. 14)*

With the concerns of sustainability at the forefront of almost every project, and the emphasis on expert systems for identifying problem areas, designers are sometimes driven to the opposite direction of such communicative or reflective methods. With the focus on optimization, design situations may often become reduced to design problems with parameters directly related to rating or evaluation systems. This is one reason why still today, the predominant design methods adopted by designers in a context of sustainability are based on engineering methods (Lofthouse, 2004; Lye, Lee & Khoo, 2001). In these types of design methods, designers approach design problems much like problems in the natural science and adopt problem-solving approaches (Simon, 1996b; Schön, 1983). When adopting a problem-solving approach, the designer will seek to clarify the given set of requirements during the initial phase of design, in order to find solutions that can satisfy these requirements. There is little room for a contextualization of the problem, for an exploration of alternatives, or for any adjustment of the original intent and vision of the given problem (Nelson & Stolterman, 2003; Simon, 1996b; Schön, 1983). This represents a real paradox since it is in such complex real world problems that reflective and critical thinking becomes fundamental.

WHAT IS SUSTAINABLE DEVELOPMENT?

The most often cited definition of sustainable development is that stated in the report called, *Our Common Future.* This report was written in 1987 by the World Commission on Environment and Development (WCED). The committee responsible for this report was chaired by Gro Harlem Brundtland, and is why this document is often referred to as the Brundtland Report (Brundtland, 1987). In this report, sustainable development is defined as:

> *"Development which meets the needs of the present without compromising the ability of future generations to meet their own needs." (Brundtland, 1987p. 43).*

As development is at the basis of this definition, it inherently abides by a vision of economic growth. In other words, growth combined with the protection of the environment. This therefore subscribes to a vision where producing more efficiently is at the basis. Although this definition refers to the satisfaction of human needs, it remains confined within an economic perspective. Another definition for sustainable development that is often cited is the following:

> *"(...) improving the quality of human life while living within the carrying capacity of supporting eco-systems." (IUCN/UNEP/WWF, 1991)*

This already provides a more global vision since it does not only refer to human needs, but the totality of quality of life. It however relies on conservation as its main strategy as opposed to regeneration or the flourishing of life. There are many more definitions of the term sustainable development. However for many, this term is flawed at its core since the two terms present an oxymoron. One term (sustainable) cannot exist with the other (development) in perfect balance within an economic system that continues to valorize infinite growth. This is why the term sustainability has become increasingly adapted by many theorists of the current development crisis. A much broader and critical definition of sustainability by Ehrenfeld (2009) is:

> *(…) the possibility that humans and other life will flourish on Earth forever. Flourishing is the key to a vision of a sustainable future (p.6)*

For Ehrenfeld, the term sustainable development is flawed since at best, the sustainable strategies adopted today cannot keep up with the impetus of un-sustainability. This is why he chooses to define sustainability rather than the term sustainable development. This is the definition that will be adopted in this research.

Evolution of Design Approaches for Addressing the Developmental Crisis

Varying design methods have been developed over the years to guide designers in their design processes. As has been presented, design methods allow designers to confront the specific situations and give them guidance and provide ways to organize action.

As presented, design methods range from the very traditional engineering methods, to those that are based on communication and conversation. Traditional design methods based on engineering approaches are still very dominant (Lofthouse, 2004; Perrin, 2001; Cross, 2000) because they are systematic, there is a clear definition and separation of tasks, and they are oriented towards problem-solving. On the other hand, design methods that fall within the form of communication and conversation work on the premise that design has at its heart, uncertainty – these are less prevalent in practice.

Over and above an understanding of design methods, it is equally essential to understand the evolution of design approaches for addressing the current environmental and social crises. In particular, it is interesting how design methods and such design approaches have been congruent in their evolutions in terms of their worldviews.

Design approaches for dealing with the environmental and social crises have progressed enormously over the past 30 to 40 years. These approaches have evolved from short-term solutions (green design), to medium (eco-design) and just recently have begun to consider long-term, global solutions (sustainable design) (Madge, 1997). Even if these terms are often used interchangeably, they are distinct terms signifying very different approaches (refer to Table 2).

Green design

Green design is a preventive method that adopts an end-of-pipe approach. This entails a technological change or innovation to prevent pollution in the building or production phase (Birkeland, 2002). This represents a curative measure whereby it seeks to treat air, water or soil through de-pollution techniques, for example, the removal of contaminants from a waste stream as a last stage of a fabrication process (EnvironmentCanada, 2006). In this perspective, they provide relatively short-term solutions.

Eco-Design

Eco-design, or as it is also referred to as ecological design, is considered a front-of-pipe approach, because the concern is not only in reducing pollution at the end of a production phase, but the redesign of products, services, buildings, landscapes, etc.[35] (Stevels, 2001; Janin, 2000; Madge, 1997). Therefore, the environmental concerns are shifted to an earlier phase in the design process, into the development of the artefact itself. The goal is to reduce impacts of built or produced artefacts by using decision support tools that are based on the preventive principle[36]. In this approach, the idea of continual environmental improvement through design is at the base. The ISO 14040 norm (ISO, 2006) is an example of a standard that defines a framework for environmental management for organizations based on the principle of prevention.

Since eco-design focuses on the improvement of weaknesses in the objects, it is technology focused in its objective to reduce impacts. This approach can be related to Ehrlich's equation for understanding environmental impacts (Ehrlich & Holdren, 1971; Ehrlich, 1968). This author claims that:

Impacts (I) = Population (P) X Affluence (A) X Technology (T)

Even if this equation is reductive and simplifies the complexity of real world impacts, it remains significant in terms of what it communicates. If designers adopt an approach that focuses only on technology, the improvements with regards to the impacts cannot be significant since both population and affluence (or consumption habits) are on the rise. So when adopting an eco-design approach, the improvements are at best incremental. Transformational improvements are then possible when designers move beyond such optimization approaches based on technology and focus on providing or conceptualizing different modes of living.

The predominant tools in this approach are therefore technocratic, meaning they valorize objective, value-free empirical evidence that is on the most part, quantitative. However,

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35 The word 'product' shall be used to refer to any type of designed object in the built environment.

36 The principle of prevention states that any activity that may cause damage to the environment be prevented or controlled at an early stage (Principle 11, UNCED, 1992).This approach to risk evaluation is based on traditional risk assessment methods, where the probability, as well as the consequence of the risk are known.

the problem is that these tools cannot be as value-free as they claim to appear since the boundaries selected for defining their problem space and the selection of indicators to assess the impacts clearly involve value judgments. Consequently, the assessments of products using such tools are done using empirical data with estimated margins of error - a deterministic and statistical approach. Design solutions adopting such methods of assessment are mainly done through a strategy of performance optimization - either a redesign or reorganization of the functions already provided (Fletcher & Goggin, 2001). These tools are often used to reduce negative impacts and optimize positive impacts. Ecological efficiency is the predominant strategy in this approach. Examples of methods or tools in this approach are, Environmental Impact Assessment (EIA), Life Cycle Assessment (LCA), Leader in Energy and Environmental Design (LEED)[37], Social Impact Assessment (SIA), Social Life Cycle Assessment (sLCA), Cost-Benefit Analysis (COBA), Ecological Footprint, etc.

By looking for the optimal performance solutions, such tools help designers solve the design problem by adopting a technical perspective (*the how*), and not in the more global perspective (*the why or what can be*). This represents a dichotomy between *techne* and *phronesis* (Nelson & Stolterman, 2003). *Techne* has to do with order and about how to do things right – productive technical knowledge. Here there must be an understanding between the intention and its associated action (Nelson & Stolterman, 2003). *Phronesis* is about practical knowledge, and is what helps designers make design judgments and requires an appreciation of the wholeness of the design situation (Nelson & Stolterman, 2003).

Some of the limitations of these tools are based on their epistemological foundations. These tools are on the most part embedded within the traditional sciences and therefore present limitations when considering the uncertainties that result. Arnold Tukker (1999), an LCA expert, has concluded that the underlying weaknesses of the LCA method (a sustainability assessment tool based on a preventive approach) are too great to withstand skeptical scrutiny:

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37 The LEED green building rating system will be more fully described in Chapter 3 since it is the tool most often adopted in Canada by architectural competitions that define a sustainable development dimension in their brief.

> *"(…) it will never be possible to solve controversial discussions about products with an LCIA [life cycle inventory assessment] method that is based solely on mathematical relations between interventions and protection areas. There are simply too many uncertainties, there is too much ignorance, and they can only be overcome by all kinds of subjective, subtle, and basically value-laden choices" (Tukker, 1999, p.1).*

So, approaches like LEED, as they are predictive, diagnostic and/or prescriptive approaches with the aim of optimization, help guide the designer in doing the thing right. Yet it is important to state that just because LEED has the capacity to identify an area of improvement because of its prescriptive approach, this does not necessarily justify decisions taken based only on these premises. It can only provide some kind of guidance. In addition, tools like LEED are incremental improvement tools. In this sense, incremental tools may be more damaging than using no tools, since they appease the general public, and in turn enable governments and organizations to continue along a path that is far from the transformational improvements necessary for sustainability.

Another fundamental shortcoming of methods such as LEED or LCA is that these tools are laden with uncertainty. In such methods, uncertainty is dealt with using statistical methods for estimating the potential risk. However, when doing this,

> *"the introduction of subjective probabilities erases the distinction between uncertainty and risk, between risk and the risk of risk, between precaution and prevention" (Tallacchini, 2005, p.650).*

So tools such as LEED blur the distinction between risk and uncertainty. Risk assessment in such cases seeks to adopt a traditional scientific risk assessment approach, but in doing this, the complexity and lack of predictability of the situation is ignored.

Having said this, it is also important to mention that these tools remain an essential component of the design process. However, complementary methods are needed to support decisions on doing the right thing as well. And as this is based on value judgments, it is important then to expand this practical knowledge to a more participatory form of decision making.

Sustainable Design

Sustainable design and its practice are ambiguous terms since they are concepts that continue to be developed today. Therefore, many definitions exist. In this research, sustainable design will be defined as a global approach to design requiring a sense of inter-dependence among the stakeholders of a design project (beneficiaries, victims, agents[38]) and an understanding of the repercussions of the activities of the project on the stakeholders (social and cultural concerns) and the environment (Madge, 1997; Dewberry, 1995).

For this research, sustainable design, has its basis in the Ehrenfeld (2009) definition. Therefore, one of the main concerns is the flourishing of life on earth. However, this is a very general objective. In order to have any hope to reach such an objective, it is important to understand the basis of this activity. Sustainable design can therefore be described from the perspective of the four fields of knowledge: ontology, epistemology, methodology and teleology[39]. Table 1 presents this description.

Here the built environment becomes an area of protection to conserve and regenerate, just as environmental resources, humans and their communities. Sustainable design cannot ignore the cultural dimension or the cultural implications of design projects on humans, their communities, on society, and in the environment. In this approach, the designer may question the existence of current artefacts and/or their technologies. The designer may seek to re-discover other approaches for satisfying the needs addressed, so here defying the status quo is an option and encouraged.

38 This classification of stakeholders is borrowed from Guba and Lincoln's Fourth Generation Evaluation (1989)

39 The four terms of ontology, methodology, epistemology and teleology will be more fully described in Chapter 2.

TABLE 1: DESCRIPTION OF SUSTAINABLE DESIGN BASED ON THE FOUR FIELDS OF KNOWLEDGE.

Fields of Knowledge	**Sustainable Design**
Ontological What is the form of the perceived world? (what)	A global approach that considers environmental, social, cultural, economic, and ethical aspects. In this approach, the organization is no longer considered isolated in its environment, but is considered as a part of the system with the environment and society that surrounds it.
Epistemological What is the relation between the person that is constructing the knowledge and the perceived world? (values)	A global and systemic perspective of the situation since it requires a sense of inter-dependence among the organization and the artifact to design, those affected by the activities of the organization, the artifact to design, and the environment (built and natural). Therefore a complex vision and plurality of knowledge are at the base.
Methodological What methods are used to obtain the knowledge? (operational)	Projective and prospective[40], adaptive and heuristic evaluation methods, requires collective judgment because of the various domains that need to be integrated within a decision, adopts systemic conceptualization[41]
Teleological What is the intention of the researcher? (purpose)	The possibility that humans and other life will flourish on Earth forever (Ehrenfeld, 2009)

In fact, the designer may even try to introduce solutions that may help transform human habits and the ways in which humans relate to their world. Because the complexity of the design problems are significantly increased, design approaches founded on communication and conversation are necessary in this approach (as those based on the ideas of Schön, 1983), where reflective and critical thinking are fundamental. Table 2 presents a summary of these three design approaches.

40 Projection and prospectivity will be elaborated in Chapter 3

41 Adaptive and heuristic methods of evaluation, participative approaches and systemic conceptualization will be elaborated in Chapter 2

TABLE 2: VARIOUS APPROACHES TO DESIGN THAT CONSIDER ONE OR MORE OF: ENVIRONMENTAL, SOCIAL, CULTURAL, AND ECONOMICAL CRITERIA (SOURCE: CUCUZZELLA, 2007, P.35).

Name of Design Approach	Scale of Approach	Type of Approach	Organizational Strategy
Green Design An approach that responds to evolving laws – pollution prevention.	micro-level scope	**Process Approach** Industrial vision with short term solutions	An approach that comprises mostly of end-of-pipe solutions. Work is focused on reducing emissions of pollutants based on the process of fabrication. The motivation here is mostly abiding laws.
Eco-Design Approach to design that considers the environmental impacts based on a technocratic approach – eco-efficiency.	meso-level scope	**Process and Product Approach** (artifact to design) Global vision with essentially short and medium term solutions	A strategic approach that considers all the levels of the enterprise. All the potential environmental impacts of a product are taken into consideration and the actions taken are an integral part of the policies of the enterprise. The motivation here is for the enterprise to differentiate itself from other enterprises, as well as to follow expected laws and norms.
Sustainable Design Requires a sense of inter-dependence among the organization, those affected by the activities of the organization, and the environment (built and natural).	macro-level scope	**Global (temporal and spatial) Approach** More global vision with short, medium, long and very long-term solutions	A global approach that considers environmental, social, cultural, and ethical aspects. In this approach, the organization is no longer considered isolated in its environment, but is considered as a part of the system with the environment and society that surrounds it. The motivation here is a strong commitment to sustainable development.

Table 2 shows that green design operates on a micro-level scale, eco-design operates on a meso-level scale, and sustainable design operates on a macro-level scale. The spatial and temporal scope of the three design strategies differ significantly. As the design approaches evolve from green, to eco, to sustainable design, the extent of the environmental, social and cultural issues are increasingly better reflected. Therefore, as pertinent as eco-design is for the optimization of products alone, it cannot address the global and long-term nature of contemporary design projects.

LIMITS OF TRADITIONAL DESIGN METHODS AND APPROACHES FOR SUSTAINABILITY

As has been mentioned, when seeking goals of sustainability, design can play an important role. Brezet (1997) claims that re-thinking systems (interrelationships between artefact to design and the systems it is part of) will lead to greater sustainability when compared to product improvement through eco-efficiency optimizations alone. As shown in Figure 9 the potential for environmental benefits increases as innovation moves from product to system.

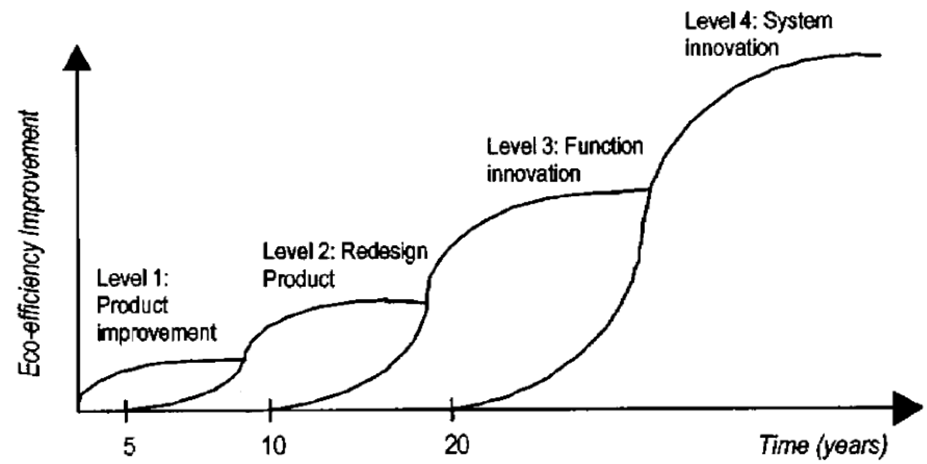

FIGURE 9: ECO-EFFICIENCY IMPROVEMENTS VS. TIME, 4-STAGE MODEL OF ECO-DESIGN INNOVATION (SOURCE: BREZET, 1997)

However, the difficulty of implementation also increases. In the first three levels depicted in Figure 9 the designer is essentially redesigning or reorganizing the functionality of the product (Fletcher & Goggin, 2001). And, the more we tend towards system innovation, the more it involves various actors, changes in the way things are done, reorganization and, modifications of potentially sensitive social and cultural practices and structures. In other words, the difficulty lies not only in the implementation of the innovation, but maybe more importantly on its acceptability, where the acceptability here may be axiological as well as normative.

In a context of sustainable development, as the issues cover environmental, social, cultural and economical concerns, then system level innovation is inevitable. The dominant traditional design methods and approaches present limits for attaining such goals because much of what designers contribute in these approaches is *operational* eco-design (Lofthouse, 2004). The design situations or projects are reduced (or simplified) to a set of indicators from which optimal solutions are sought and where the complexity inherent in the situation is compromised or overlooked, in order to find the most eco-efficient solution. So, many opportunities for sustainable development escape the design process, since the focus is on technical innovation at the expense of a complex comprehension and contextualization of the design problem (Herring & Roy, 2007; Hertwich, 2005; Schön, 1983).

Many tools for assessing impacts in a context of sustainability (such as LCA, LEED, etc.) are not easily adapted to the initial phase of the design project – a phase where contextualization, boundary setting and understanding constraints and opportunities are important. Their requirement for details renders such tools inaccessible to the designer, particularly at this point in the process. In addition, these tools lack the scope needed in a context of sustainability, as they only adopt only a narrow perspective, and neglect the multi-faceted system perspective. Decisions made by designers in this context reflect the perceived neutrality and narrow view of the evaluation methods used. These tools are both, too specific and too fragmented, and therefore are limiting for design. Yet, they reduce the design situation into a manageable problem where the solutions may be deduced and therefore may simplify the problem space - a problem-solving approach to design.

EXPERTISE, EXPERT KNOWLEDGE AND JUDGMENT FOR DESIGN FOR SUSTAINABILITY

When designers adopt a problem-solving approach, design procedures and scientific laws will guide them on how to proceed in an objective manner (Dorst & Dijkhuis, 1995). For example, design processes that adopt traditional engineering methods, also typically adopt traditional design approaches for dealing with environmental and social issues (Howard, 2004). In this perspective, the position of the expert is solidified relative to the general public since they are perceived to have the knowledge required to solve the problem (Bindé, 2000). In addition, even if values are involved in many of the decisions, they are portrayed as 'objective' if the experts are to appear credible (Howard, 2004).

Here, the designer takes the problem as a given and seeks to solve it as a natural systems problem, and may therefore not challenge: (1) the current product in question; (2) the criteria or objectives set in the brief for the design project; (3) the current social conditions as assumed in the brief; or (4) the current cultural habits as assumed in the brief; and therefore may not challenge the status quo (Van Der Ryn & Cowan, 2007; Brezet & Hemel, 1997; Madge, 1997). These are viewed as givens and therefore, decisions may be made without addressing the hidden assumptions or the more global perspective (Cooper, 2005; Hertwich, 2005; Schaefer & Crane, 2005; Howard, 2004; Reisch & Scherhorn, 1999; Hansen & Schrader, 1997). Within this framework, the designer is limited mainly to technical optimizations.

However, in a context of sustainable design, where the designer is expected to challenge the status quo, where transformational changes are sought regarding the ways in which humans relate to their world, optimization on its own does not go far enough when seeking sustainable solutions. The problems that designers face in this context are essentially unique problems that comprise of, not only technical, but also social and cultural considerations and therefore need to be addressed in a reflective manner by adopting a global vision (Margolin & Margolin, 2002; Papanek, 2000; Dorst & Dijkhuis, 1995). The inclusion of the value systems of those affected by the product is necessary. Traditional engineering methods fail here because social problems, and therefore design problems within a sustainable context cannot be assessed using only statistically based tools.

Many current design tools for addressing sustainability use a cause-effect approach - the identification of a weakness in some area(s) will cause a corresponding environmental impact. For example, Life Cycle Analysis (LCA), one of the most widely used tools, is based on the prevention principle. LCA invites a continual optimization process; either through the development of new indicators or through the optimization of current data or indicators in order to improve the quality of this analysis process. These tools are very advantageous for final decision making. With LCA, an interpretation of the results is ultimately necessary in order to evaluate a situation and make a decision. This interpretation is made by an expert. So, the interpretation is based on the value systems of the expert or experts that are interpreting the results. This process becomes increasingly problematic when data is diverging and findings are not conclusive. Adding more indicators will not fill in the gap that exists when decisions must be made in such situations.

For assessing social impacts, tools such as Social Life Cycle Assessment (sLCA) have recently become available (Andrews *et al.*, 2009). These tools are based on international conventions and codes of conduct. The acceptability of the identified risks is normatively based. However, in problematic situations, when the normative acceptability is itself questioned by some of the stakeholders (organizational, political, local community, etc.), then defining who is affected (directly or indirectly) and who will be involved is a critical boundary judgment (Midgley, 1997). As such situations present controversies, a methodology to assess who and what is included in the planning is a crucial requirement, since normative acceptability is problematic in such a context. An important first element regarding the social acceptability of any planning project is the definition of the boundaries of the situation and an identification of who is involved (Midgley, 1997).

This problem is similar for LEED, where the incremental improvements possible through the use of a checklist of indicators may help address some weak areas of the problem situation, but may also lead to contradictory results with respect to the whole project. Consequently, as LEED is based on a binary rating system, the level of uncertainty is elevated as there is little nuance in the results – either a credit is obtained or it is not. In addition, the threshold for obtaining the credit in such a binary rating system is not clear, so the results should be integrated within a final judgment with much care and at times, scepticism. However, having a LEED expert in a design team is often an important criterion for the credibility of an architectural design project since having such an expert is perceived as the ability to objectively assess the environmental sustainability of the project. This is evidenced by the fact that when LEED is a requirement for an architectural competition in Canada, a LEED expert is a paralleled requirement regarding the constitution of the design team[42].

42 A survey of architectural competitions on the web site, www.ccc.umontreal.ca, an archival site of contemporary architectural competitions, indicates that, to date, all Canadian architectural competitions that include a requirement for LEED certification also require a LEED expert on the design team.

So when adopting traditional approaches for assessing sustainability, experts seem to have the power to make decisions that in many cases have far-reaching effects. In this exclusive expertise school of thought, there is a belief among the experts that non-experts or less, lay-people do not have the capacity necessary to contribute to possible solutions or insights (Howard, 2004). Therefore, within this school of thought, non-experts or lay people knowledge seem to be neither necessary nor desirable since evaluation and therefore the related design solutions are approached within the realm of experts (Bonsiepe, 2006; Howard, 2004; Sclove, 1995). They are considered as a source of external pressure (Howard, 2004).

Another important school of thought, adopted by many authors, but most notably, Sclove (1995)[43] is that lay-people have the intrinsic knowledge of place and community thereby providing a point-of-view that is not available from the expert vision. According to this author, this type of knowledge is not only pertinent for the outcome of the project, but may also contribute to a co-learning process among experts and non-experts. In fact, when it comes time to judge a project for its sustainability potential, then the exclusive expertise school of thought can only provide a fragmented perceptive of the whole project (Tukker, 1999).

Designers in a context of sustainable development are therefore limited in their capacity to reflect on the given situation if they adopt and adhere tightly to the recommendations of technical solutions. Here an exploration of possible alternatives amongst the design team or those judging the project may be lacking since the focus is on obtaining a credit or reducing some potential impact. Design methods based on communication encourage a co-learning and co-conception approach (Cross, 2007 ; 2001; Perrin, 2001; Sclove, 1995) and may help develop a more intuitive sense of the project that can allow a broader vision since the communication process may help cross-fertilize the ideas of the various participants.

43 Other authors: (De Coninck & Cucuzzella, 2008; Toker, 2007; Commenne, 2006; Callon, 2004; Stirling, 2001; Rowe & Frewer, 2000; Cornwall, 1996).

STRATEGIES AND VISIONS FOR DESIGN FOR SUSTAINABILITY

Van Der Ryn and Cowan claim that (2007, p.24), "*In many ways, the environmental crisis is a design crisis*" since it is a consequence of how things are made, buildings are constructed and landscapes are used. Consequently, design is part of an industrial system and is one of the main sources of nourishment for the economy (Hawken, Lovins & Lovins, 2000). According to Hawken, Lovins and Lovins (2000), an economy needs four types of capital: human, financial, manufactured, and natural. However, according to these authors,

> *"Capitalism, as practiced, is a financially profitable, non-sustainable aberration in human development. What might be called "industrial capitalism" does not fully conform to its own accounting principles. It liquidates its capital and calls it income. It neglects to assign any value to the largest stocks of capital it employs – the natural resources and living systems, as well as the social and cultural systems that are the basis of human capital" (Hawken, Lovins & Lovins, 2000, p.5).*

In addition, for these authors, industrial capitalism and its systems have reached levels of success where the accumulation of financial capital has reached unprecedented levels, all at the expense of human, natural and manufactured capital – in other words, ignoring the social, environmental and cultural implications even if these are the necessary components for creating economic prosperity, yet are quickly declining. And even if an attitude of efficiency and prevention is adopted to seek to reduce environmental impacts, this approach alone will not provide long-term sustainability. Natural capitalism is a form of capitalism where all forms of capital are valorized: human, financial, manufactured and natural capital. This is unlike capitalism as practiced in western societies, where primarily financial capital is valorized. In this form of capitalism, the idea of efficiency is at its peak as it seeks to amass as much financial capital by liquidating all other forms of capital; so, the most output for the least input. This strategy alone, as will be elaborated, is insufficient for design in a context of sustainability.

The next subsections will present various strategies and visions that may be used by designers to address design problems in a context of sustainable development. As the majority of design solutions for sustainability are driven by technical innovations, the first subsection will address the theory of counter-productivity as defined by Ivan Illich (1978) in his book, *Towards a History of Needs*.

THESIS OF COUNTER-PRODUCTIVITY

It is important to highlight that many technical innovations are fundamental for the long-term well-being of humanity. But it is important to consider the consequences of technical innovations in light of the thesis of counter-productivity by Illich (1978). Here Illich seeks to highlight the unintended repercussions of technical innovations on the social, cultural, educational, political, etc., particularly when such innovations reach a certain threshold of use.

During the 60's, Ivan Illich introduced the idea of *counter-productivity*, a concept that Illich claimed loomed in the horizon at the time. There have been many other authors[44] that have criticized the technical project that characterizes industrial society. Specifically, Jacques Ellul in his seminal book entitled *La technique ou l'enjeu du siècle* (1954) claimed that:

> *"There is no technique possible with a free man (...) There is no autonomy of man facing possible technical autonomy"[45] (liberal translation, p.126).*

For Ellul (1954), technique did not refer to the machines in modern civilization alone, but to the set of all means that have the imperative of efficiency. Therefore, for him, it was not only a way of doing things, but also way of seeing the world and a way of being.

According to Illich (1978) counter-productivity results in paradoxical situations, meaning that the more that the production of a technical intervention (and its use) increases, the more it becomes an obstacle in the realization of the objectives it itself tries to accomplish. For example, medicine corrupts health; transport immobilizes;

44 (Pour un catastrophisme éclairé. Quand l'impossible est certain, Dupuy, 2002; Agir dans un monde incertain. Essai sur la démocratie technique, Callon, Lascoumes & Barthe, 2001; The Imperative of Responsibility: In Search of an Ethics for the Technological Age, Jonas, 1985; La technique ou l'enjeu du siècle, Ellul, 1954)

45 The original citation : « Il n'y a pas de technique possible avec un homme libre (…) Il n'y a pas d'autonomie de l'homme possible en face de l'autonomie technique » (Ellul, 1954, p.126)

communication renders humans deaf and mute; the flow of information destroys the sense of direction; the food industry poisons, etc.

Ivan Illich used the example of the predominant use of the car by Americans to illustrate this point. He claimed, in short that if you add up the number of extra hours needed to work to be able to afford a car, the time spent driving and in traffic jams, the time spent in hospitals because of car crashes, the time needed by the oil industry to fuel a car, etc., and divide this number by the number of kilometers travelled per year, then the speed of your car is at most 6 kilometers per hour – not what the car industry wants consumers to believe.

This implies that in some cases, technological innovations present consequences contrary to what was intended. By considering the thesis of counter-productivity by Illich (1978) when assessing innovations, a precautionary attitude is adopted because the long-term and potential global consequences are considered. Here, the threshold of use is a serious consideration, and therefore, the value of the usage of such technical innovations becomes a fundamental concern for the future of humanity (Dupuy, 2002; Gollier, Jullien & Treich, 2000; Jonas, 1985; Arendt, 1958).

The thesis of counter-productivity by Illich (1978) becomes increasingly relevant with the strategy of eco-efficiency – which is based on the principle of prevention. Eco-efficiency largely depends on technical innovations and on reducing the potential impacts of products (Reisch & Scherhorn, 1999). When using eco-efficiency as a strategy for reducing impacts, it is a convincing and operational approach for design. However, the eco-efficiency of a product is only a small picture of the bigger whole (Van Der Ryn & Cowan, 2007; Droz & Lavigne, 2006; Princen, 2005; McDonough & Braungart, 2002). Eco-efficiency may be an appropriate strategy for increasing economic growth and wealth; however, it is not clear how useful it is with regards to environmental improvements for the long-term (Mongeau, 2007).

An example that illustrates this contradiction of eco-efficiency is energy efficient technologies. By 2012, the amount of greenhouse gases per GDP dollar will be reduced by 18%, through energy efficient technologies. But by then, the GDP will increase by 35 to 40%, therein obliterating any hoped for sustainable gains (Latouche, 2006). In fact eco-efficiency may lead to an ever increasing resource use rather than less because of the ever-increasing potential for rebound effects based on the resulting cost savings that are eventually transferred to the consumer – this represents the Jevons paradox (Latouche, 2006). In the end, a strategy of eco-efficiency may impede long term economic growth because resource shortage will pervade technical change - a counter-productive effect. When assessing the impacts, it is important to consider the wider perspective of consumption so that other impacts are revealed, where the patterns on a macro scale can be observed, instead of only the details on a micro scale. This shows that when assessing a design problem through only a technical perspective, some consequences may escape this narrow field of vision.

Efficiency, Effectiveness, Sufficiency

Eco-efficiency essentially aims to render the western industrial system, which is clearly destructive to the environment, societies, and communities, a little less destructive (McDonough & Braungart, 2002). So, it becomes evident, that the current industrial mode of development is headed for eventual self-destruction; even it claims to be eco-efficient. This notion of efficiency which encourages a worldview of indefinite industrial expansion cannot continue on a finite planet where societies and communities continue to be stressed on many levels.

Yet, one of the main strategies adopted for design in a context of sustainability is efficiency – producing more with less - less energy, materials, money, manpower, time, land, etc. Efficiency is a word that connotes ideas of progress and improvement and largely depends on technical innovations (Princen, 2005). Yet, according to Princen (2005), as the throughput of products increases, their useful lifetime decreases. This implies that even if a product was produced using a strategy of eco-efficiency where the environmental impacts have been optimized, their useful lifetime continues to decrease, resulting in the ever increasing production of more and more products. For example adopting LEED for an architectural project, does not necessarily contribute to long-term sustainability of a building if the planned lifetime of the building is compromised because of lack of global vision for the project. In other words, even if the building was LEED certified and for example (1) the material choices have resulted in a shortened life span, or (2) the design of the building restricts access to some people of the community, or (3) the experiential element of the building was not fully considered and therefore the building is not usable or not used, and eventually abandoned, etc, then the building cannot be considered sustainable. With regards to judging architectural projects for sustainability within a context of competitions, it becomes increasingly clear that it is not evident how jurors can consider these concerns. This demonstrates that there are many other considerations in architectural projects in a context of sustainability that do not fall within the constraints of LEED efficiency solutions.

The paradox is that efficiency has been a guiding principle for social behavior at least since Taylorism; perhaps a product of modernization (Princen, 2005). In a rhetorical sense, efficiency is a way to claim value: more output for less input, therefore can only be countered by another claim of improved efficiency (Princen, 2005). Efficiency sits within the epistemology of dominant science and technology and is therefore value neutral. In fact it is exploitative and expansionary and therefore opens the door to abuse that is hidden in its ratios of 'reductions'. Under conditions of global constraint, efficiency cannot be the only guiding principle. This is because of efficiency's limitation. In particular, efficiency's susceptibility to be manipulated to mean whatever its user wants it to demonstrate. This exposes the inherent contradiction of efficiency with respect to ecological, social and cultural conditions necessary for long-term sustainability (Princen, 2005).

In addition to the strategy of eco-efficiency, a design strategy that is important to consider in a context of sustainable development is that of eco-effectivess as defined by McDonough and Braungart (2002). For these authors,

> *"Eco-effectiveness seeks to design industrial systems that emulate the healthy abundance of nature. The central design principle of eco-effectiveness is waste equals food" (McDonough Braungart Design Chemistry, 2010).*

Eco-effectiveness is inspired by the cyclical processes in nature itself, where the output of one species becomes the nourishment for another. Consequently, the behavior related to the careful maintenance of a community resource, a garden for example, where the community enriches the soil, watches for pests, waters and weeds it to maintain its natural abundance, so that the garden can continue to feed the community also represents a cyclical process representative of the idea of effectiveness. That is why McDonough and Braungart propose the idea of *waste equals food* as a new mode of industrial development. They define the next industrial revolution as:

> *"(...) the next industrial revolution is the emerging transformation of human industry from a system that takes, makes, and wastes to one that celebrates natural, economic, and cultural abundance" (McDonough Braungart Design Chemistry, 2010).*

Van Der Ryn and Cowan (2007) refer to this as stewardship. However, even in a world where waste equals food, where the toxins in the environment are completely eliminated as a result of the way things are produced or built or used, degradation can come in other forms, such as the degradation of cultural heritage, cultural diversity, social cohesion, etc. So, eco-efficiency and eco-effectiveness are only two dimensions of possibly a variety of strategies for addressing sustainable design. This implies that beyond an efficient approach for designing products, and an effective strategy for industrialization, questions regarding the repercussions of mass consumption on social and cultural milieus must also be considered in a context of sustainability.

In fact, as early as 1970, in his book entitled *La société de consommation, ses mythes, ses structures*, Baudrillard (1970) recognized that humans were at a point where consumption has grasped all aspects of their lives, and that the idea of economic growth was actually a function of social inequality – a necessary condition to maintain social order, so that the structure of the privileged is maintained. In this book, Baudrillard (1970) states that affluence (the possession of ever more goods) has been accompanied by what he terms '*environmental nuisances*' which are a consequence of the industrial development and technical progress, as well as the very structures of consumption. He also refers to a term 'cultural nuisance' as the effect that is caused by both the technical and cultural effects of rationalization and mass production, and of which the effects are incalculable. He gives the example of the impossibility to objectively characterize the '*nuisance effect'* of a bleak housing project, whereas an estimate can be given to the '*nuisance effect'* of water pollution[46]. In the recent example, the nuisance is a cultural one, in the latter it is an environmental. As affluence rates increase, Baudrillard claims that so do rates of 'nuisance *effects'*. The problem according to Baudrillard (1970) is that growth, as it is so valorized in western capitalistic societies, is not related to affluence[47], yet affluence causes all types of nuisances, such as environmental and cultural nuisances[48].

From a material perspective however, material consumption must be considered in light of its environmental repercussions and is why Princen (2005) has proposed the strategy of sufficiency to address the perverse effects that result when the strategy of efficiency is adopted on its own. Princen (2005) claims that the transition from an over-consuming society to a sustainable society; from an economy founded on efficiency gains to an economy premised on social equity and ecological integrity is necessarily based on a consideration of a sense of 'enoughness' (a strategy of sufficiency). Sufficiency relies more on individual behavioral changes as well as on social innovation (Reisch & Scherhorn, 1999). According to Strahel (2001), sufficiency refers to "doing the right thing", while efficiency refers to "doing things right". In this perspective a few social organizing principles make good common sense; principles such as precaution, reverse onus, polluter pays and restraint and respite (Princen, 2005).

Sufficiency may be construed as negative because it connotes ideas of frugality, which are considered to imply denial or abstinence. However, in this research, sufficiency is based on the definition of fundamental human needs as defined by Max-Neef (1991)[49]. This author divides fundamental human needs into four existential categories of being, doing,

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46 This is an important claim because there are many international groups seeking to "objectify and calculate" the social and cultural impacts of products based on international norms and conventions.

47 "(…) growth neither takes us further from, nor brings us closer to, affluence. It is logically separated from it by the whole social structure which is here, the determining instance." (liberal translation, Baudrillard, 1970, p.66).

48 So the consumption society and therefore mass-consumption does not only result in environmental degradation, but also in social and cultural degradation, yet the entire world wants to adopt this mode of living. It is also important to highlight that the consumption society represents the way in which contemporary society communicates and that the only objective reality of consumption is the idea of consumption itself, which is a reflexive and discursive configuration (Baudrillard, 1970). It is through a daily and intellectual discourse with the images of consumption that this indefinite process had taken on the force of common sense. So consumption is more than just the act of accumulating, devouring, and digesting, otherwise it would not constitute a myth. It represents a global interpretive system, a mirror, where one can reflect in an anticipative way, and therefore has the potential to integrate society (Baudrillard, 1970). This is why consumption has to be understood from both an environmental and a cultural perspective, where the impacts (or nuisances – as Baudrillard refers to these), may be in tension, and this represents a great difficulty when assessing the sustainability of products, as products are the raw material of the consumption society (both materially and symbolically).

49 Refer to Appendix 1 for further details regarding Max-Neef's (1991) definition of fundamental human needs.

having and interacting. So, sufficiency in this context refers to the idea of 'enoughness'. Here, an improved quality of life can be experienced with as little material acquisition (having) as possible, but where the symbolic (being) or experiential (doing) consumption need not be limited, and in fact may be abundant, and where community enhancement and social cohesion (interacting) become infinitely important. Therefore, there is a complementarity between the sufficient consumption of material goods for achieving a state of well-being that is complemented by the abundant consumption of the experiential or symbolic elements[50]. Therefore, in this sense, sufficiency can help designers think differently in terms of how they conceptualize solutions, since the needs are not only addressed through the characteristic of "having".

In fact, abundance is related to the idea of diversity, where diversity is the key to vitality, resilience and innovative capacity. Diversity can be seen (among others) in the cultural, biological or economic domains (Cavanagh *et al.*, 2002). According to these authors, cultural diversity spurs innovation towards higher levels of intellectual and social accomplishments through a rich variety of human experiences. Economic diversity encourages the stabilization of local economies. And bio-diversity is essential for the complex self-generating processes of the ecosystem (Cavanagh *et al.*, 2002). Yet the idea of diversity is characterized by both inefficiency and uncertainty, and therefore is in contradiction with the worldview of prevention, which valorizes both efficiency and a certainty of knowledge.

The strategy of sufficiency then can be seen to be a catalyst for cultural diversity since the *having* is not as important as the *being*, the *doing or the interacting*. How can the repercussions of a strategy of sufficiency be assessed, since many are social and cultural impacts, of which Baudrillard deems incalculable? The worldview of prevention fails here. An approach that is more intuitive and critical instead of the more traditional, deductive approach for assessing the repercussions is suggested here, as scientific proof is scarce or non-existent for much of these types of repercussions.

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50 The experiential and symbolic elements of the consumption process are part of the growth society related to material acquisition (Baudrillard, 1970). Experiential and symbolic are suggested here in the context of promoting human experiences and developing human potential through the rich experiences of cultural diversity (Cavanagh *et al.*, 2002).

So the three strategies of efficiency, effectiveness and sufficiency are in many ways, complementary strategies for design in a context of sustainable development. In addition to these three strategies, three basic visions for sustainability have been identified as important for design thinking: conservation, regeneration and stewardship. These will be described in the next section.

CONSERVATION, REGENERATION, STEWARDSHIP

Van Der Ryn and Cowan (2007) claim that current design epistemologies are incompatible with nature and therefore they are flawed when seeking to find methods for moving towards sustainability. According to these authors, ecological design is "*the effective adaptation to and integration with nature's processes*" (p.34) and offer three visions for addressing the natural capital depletion: conservation, regeneration and stewardship.

Conservation is incomplete on its own because it is not radical enough – it encourages a deceleration of the rate at which resources are depleted and so scarce resources can be stretched further (Van Der Ryn & Cowan, 2007). Some examples of measures are recycling, building denser communities to reduce land use, fuel efficient cars, insulating homes to retain temperature, etc. This represents a preventive approach primarily based on a strategy of efficiency.

Regeneration is "*an expansion of natural capital through the active restoration of degraded ecosystems and communities*" (Van Der Ryn & Cowan, 2007, p.37). Regeneration preserves, protects, and restores, therefore adopts a long-term perspective. This represents a form of renewal that seeks to harmonize the rich possibilities of culture with nature (Van Der Ryn & Cowan, 2007). Therefore, it seeks an effective integration of society and the environment. The idea of promoting diversity and abundance (biological, cultural and economic) are at its core. A design strategy of sufficiency, where the focus is on the doing and being, and not the having is suggested here.

Stewardship *"(...) is a particular quality of care in our relations with other living creatures and with the landscape. It is a process of steady commitment informed by constant feedback*" (Van Der Ryn & Cowan, 2007, p.38). A sense of stewardship is directly related with the strategy of effectiveness – where the '*waste equals food*' strategy represents the steady commitment to care which is informed by a constant feedback. Here there is a sense of responsibility towards the cyclical dimension of the environment.

However, we cannot speak of design for sustainability without considering the cultural dimension as a fundamental fourth pillar. Particularly, in a sustainable design perspective, the cultural impetus of projects constitutes an area of concern equally important to the other three pillars. Cultural impetus is hardly ever considered as an issue for sustainability, but if cultural diversity, creativity or heritage of projects are not considered, then the potential for long-term sustainability on a local as well as a global level may be compromised. So the three visions (stewardship, conservation and regeneration) for addressing the depletion of natural capital by Van Der Ryn and Cowan (2007) can also be used to address the capital related to the natural and built environment and communities.

In fact, design projects can become a cultural impetus for not only catalyzing a culture of sustainability, but encouraging cultural diversity, creativity and the consideration of the historical and regional context. This is where design can recursively change the way in which humans relate to their world. Figure 10 presents these four pillars. Increasingly, architectural projects are used as a way to encourage cultural diversity, social revitalization, ecological regeneration, social equity, etc. (Fisher, 2008). So culture and nature are intimately linked with the local, the local skill sets, etc.

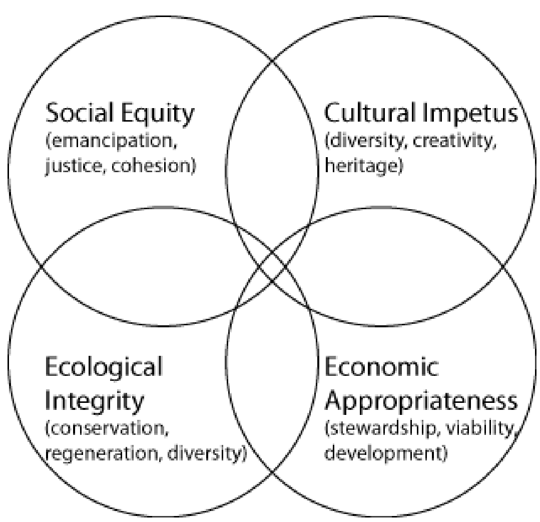

FIGURE 10: THE FOUR PILLARS OF SUSTAINABLE DEVELOPMENT IN A CONTEXT OF DESIGN

These visions are a reminder that sustainability is not only about technical solutions (conservation), for addressing environmental degradation (regeneration) but also that the human dimension is prevalent in both the decision process of solutions (stewardship) and the solutions themselves. Van Der Ryn & Cowan (2007) question the benefit of technological sustainability alone. They challenge the idea that this approach for sustainability may actually be "*simply a kinder, gentler form of reductionism in which we do a more efficient job of using up, accounting for and managing nature*" (p.21).

WHY THE PRECAUTIONARY PRINCIPLE FOR DESIGN IN A CONTEXT OF SUSTAINABILITY

Sustainable design is an approach that seeks to adopt an ethic of the future (Van Der Ryn & Cowan, 2007; Bindé, 2000; Birnbacher, 1994; Brundtland, 1987; Jonas, 1985). This implies that the vision of solutions is based on a temporality and spatial perspective that is predominantly long-term.

As mentioned, design is about that *which is not yet*, or that *which can be* (Boutinet, 2005; Nelson & Stolterman, 2003). Consequently, Simon's (1996a) definition of design emphasizes the idea of changing existing situations to preferred ones, implying that design has the potential to result in, *that which is desired to be* or *that which ought to be* (Nelson & Stolterman, 2003). So design is a project of intentions (Boutinet, 2005; Nelson & Stolterman, 2003; Schön, 1983). Since projects are characterized by their ambivalent nature, then a conscious effort to anticipate the repercussions of these intentions is critical, especially when the focus is on long-term solutions, as in the context of sustainability. As not all intentions result in good actions, and in turn, good consequences[51] (Arendt, 1958), then how can these intentions be evaluated in design projects?

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51 Here we are referring to the notion of *ecology of action* as explored by Hannah Arendt in her seminal book The Human Condition (1958), specifically in Chapter V, entitled *Action*. She explains that the strength of the action process is never exhausted and in fact grows while its consequences multiply because action has no end. This idea is relevant for design, in that the decisions designers have to take in their design solutions have often unintended consequences.

Specifically, in technology-heavy design projects where the contradictions and controversies regarding the intentions of projects do not stay within the domain from which the uncertainty originated, but tend to cross domains (Whiteside, 2006; Dupuy & Grinbaum, 2005; Dupuy, 2002; Jonas, 1985). Yet the methods that designers have for evaluating the sustainability of their projects are very rigid. So designers in a context of sustainability are increasingly confronted with the need to adopt a new vision that will enable a more global and long-term perspective of projects where the uncertainties related to their projects may be exposed and addressed. Adopting traditional methods of evaluation in a context of sustainability may narrow their field of vision and compromise their solutions by compelling them to focus on only those elements related to the system of evaluation.

This implies that a blind faith in techno-science alone to solve current problems is inadequate (Latouche, 2006; Whiteside, 2006; Cavanagh *et al.*, 2002; Harremoës *et al.*, 2001). The precautionary principle presents a basis and orientation for an evaluation approach for design that does not rely on such rigid methods of evaluation (Cucuzzella, 2007). And is why this research suggests the precautionary principle as an approach for addressing sustainability in design projects.

With its aim to address problems in a more encompassing perspective, design approaches adopting a precautionary attitude therefore seek to be more contextual than preventive evaluation approaches, focus on regeneration and not only on conservation, adopt a rich deliberation in the design process, and not rely mainly on the formal evaluation systems for guidance, are focused on the cultural and social implications of the solutions proposed (where uncertainties are immeasurable), and not only on the environmental (better adapted to measurement), and therefore rely on intuitive thinking as much as on analytical thinking. The precautionary principle fits into those design methods based on communication and conversation, allowing stakeholders of design projects to contribute to the recursive evolution of solutions. Therefore, this research is suggesting that the precautionary principle may complement existing preventive approaches for evaluation.

The difference in epistemological stances represents the core discrepancy when describing the divergences between prevention and precaution approaches (Tallacchini, 2005). The epistemological position of sustainable design is coincident with the precautionary principle; just as the epistemology of green and eco-design is similar to that of the prevention principle (Figure 11). In a precautionary approach, a decision making process that allows a pluralistic, non-neutral position is required (Droz & Lavigne, 2006); this is in contrast to a preventive approach, which adopts a universal and neutral position of knowledge.

A precautionary approach will allow an emergence of various points of view; a way to construct solutions from the diversity of knowledge, values, and concerns. To embrace the complexity of situations from the perspective of precaution requires: (1) a commitment to justice and fairness; (2) a participative method to allow the emergence of the issues among participants; (3) a commitment to comprehending the value systems of each participant; and (4) a commitment to search for alternative solutions that will avoid the shift of impacts from one domain to the next (from the environmental domain to the cultural for example).

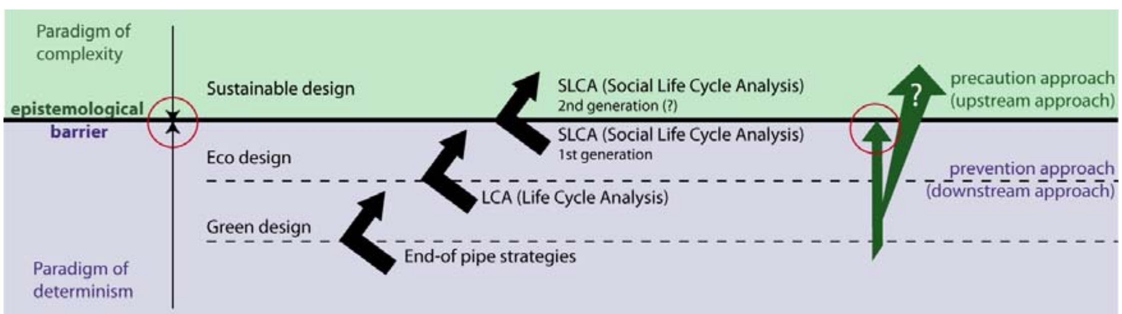

FIGURE 11: TOWARDS A GLOBAL AND SYSTEMIC APPROACH IN THE ESTABLISHMENT OF SOCIAL INDICATORS: A THEORETICAL RESULT OF ADOPTING A PRECAUTIONARY APPROACH TO DECISION MAKING. © CUCUZZELLA, C., DE CONINCK, P., 2007

In a precautionary approach, the domain of inquiry is not limited to the ecological domain (such as tools like LEED), but may allow a consideration of cultural, social and economic aspects too. Assessment tools such as Social Life Cycle Assessment (sLCA), that address social impacts and therefore social problems, can aptly be embedded within this approach. However, very little research is currently done on sLCA within this less rigid worldview; most research in sLCA is firmly embedded within a deterministic paradigm using quantitative methods[52] where the indicators considered are necessarily measurable and impacts predictable. The main problem with using only quantitative methods for assessing social (or cultural) impacts is that much of the data available is not measurable and therefore difficult to fit into such an approach. Yet, the attraction of using deterministic quantitative methods is that they have predictive powers where decisions based on computable data are simpler to rationalize; humans are very comfortable with this type of support for decision making (Stirling, 2007a; 2006; Dupuy & Grinbaum, 2005; Beck, 2004; Giddens, 2004; Dupuy, 2002; Stirling, 1999; Dewey, 1930). There is a difficulty in moving beyond a deterministic approach; instead there is a greater tendency to rely on statistical probabilities to support decision making in cases of uncertainty (Dupuy & Grinbaum, 2005; Ellul, 1987).

In the next chapter, an exploration of the theoretical foundation of the precautionary principle will be explored, so that a richer understanding of the benefits and limits of this principle can emerge for design for sustainability.

52 For example GaBi developed by L. Barthel, and J. Pflieger from the University of Stuttgart - www.gabi-software.com

CHAPTER TWO: THE UNDERLYING THEORIES OF THE PRECAUTIONARY PRINCIPLE FOR MODELING THE JUDGMENT PROCESS FOR DESIGN FOR SUSTAINABILITY

This chapter comprises four main parts. The first part begins with an exploration of the ontology and teleology of the precautionary principle. The second part explores the epistemological basis of this principle. The third part presents precaution within the encompassing framework and ethics of prudence and proposes a preliminary theoretical model for sustainable design inquiry based on this modern notion of prudence. The fourth part adopts the theories underlying the framework of prudence as the basis for a model of participatory judgment needed for a systems approach for design inquiry.

THE PRECAUTIONARY PRINCIPLE

The applications of the precautionary principle with respect to environmental risks and their uncertainties only began to surface as a clearly and logically expressed concept within environmental science during the 1970's, with the environmental movement in Germany (Harremoës *et al.*, 2001; Kriebel *et al.*, 2001). Since then, this principle has been incorporated into various regional, national and international declarations and conventions.[53]

The precautionary principle originated from the initial German formulation *Vorsorgeprinzip*, which essentially translates more appropriately to 'forward looking

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53 Some examples of the use of the precautionary principle in national or international conventions or declarations: (1) The declaration from the international conference on the protection of the North Sea (London, 1987); (2) the 1987 Montreal Protocol; (3) the 1992 Rio Declaration on the Environment and Development (Principle 15); (4) The Barnier Law of February 2, 1995 on the protection of the environment in France; (5) European Commission DG XXIV in December 1998 on consumption and health; (6) 1999 Canadian Environmental Protection Act; and (7) in the Charter of the Environment in 2005, at the level of fundamental values of the Republic (France). San Francisco was the first North American city to adopt this principle at a regional level with their 2003 Precautionary Principle Ordinance.

caution principle' or 'foresight principle' (Kriebel *et al.*, 2001). This principle was a general rule of public policy action that was to be used in cases of irreversible threats to health or the environment; where potential hazards were to be reduced before there was a strong proof of harm.

The international event that caused the precautionary principle to come into prominence was the Bovine spongiform encephalopathy (BSE), commonly known as *mad-cow* disease incident in the 1980's in the UK. Other applications of this principle have been in environmental policy decisions (chemical contamination), in socio-economic decisions (fisheries, quotas), in technology issues (Y2K), and economics (inflation regulation) (DeFur & Kaszuba, 2002). The precautionary principle has become, in European regulation of science and technology, a general principle for the protection of the health of human beings, animals, plants, and the environment (Tallacchini, 2005). So this principle has had applications in a variety of domains, and even if the varying perspectives may have different dimensions, they are not contradictory nor exclusive (Ewald, Gollier & Sadeleer, 2001). Precaution constitutes a new phase in the extension of social norms and laws for promoting the prevention of risks – it is part of a new normative category: rules with indeterminate content (Ewald, Gollier & Sadeleer, 2001; Godard, 1997).

There are varying perspectives of this principle based on varying levels of perceived strictness. So it is not surprising that this principle, just like the idea of sustainable development, has had much resistance, particularly because of its ambiguous definition resulting in multiple interpretations. According to Ewald, Gollier, and Sadeleer (2001) the strictness of this principle covers a broad range. For example, there are those who believe that this principle hinders innovations because it seeks a zero-risk.[54] On the other end of the spectrum, this principle represents a general philosophy of responsibility that is

54 Opponents of this principle are concerned that it is too easily manipulated by public opinion and feel innovation would be constantly paralyzed in research since innovation lies in a universe of risk (Sunstein, 2002). In his 2002 book, *Risk and Reason: Safety, Law, and the Environment*, Sunstein cites a definition of the precautionary principle that is extremely prudent which may in fact may lead to paralysis. Sunstein has trouble admitting that there are situations where an incomplete set of data, or immeasurable risks exist and therefore suggests that all risks can be calculated using a cost-benefit approach; as if all risks were clear enough to be calculated. However, in his 2005 book entitled *Laws of Fear: Beyond the Precautionary Principle*, Sunstein introduced a 'reconstruction' of the precautionary principle, calling it the Anti-Catastrophe principle. He claims that this new principle can be adopted when citizens face "*catastrophic risks where probabilities cannot be assigned*" (Sunstein, 2005, p.109). He builds this new principle based on three dimensions of the original precautionary principle cited in the Rio Declaration of Environment and Development (UNCED, 1992) which he criticizes: catastrophic risks, irreversible harm, and margins of safety.

imposed by all those who may incur risks on others. And somewhere in-between, there are those that believe that this principle is less a principle of abstinence and more a principle of action and innovation, but where the rules are yet to be defined.

The varying perceptions of this principle are very different from an ontological, methodological and epistemological point of view. In fact, methods for adopting this principle have similarly resided on a wide spectrum: from the adoption of Bayesian techniques (subjective probabilities), to participative community engagement where the co-construction of knowledge with experts and non-experts is required in order that the long-term repercussions of situations may be assessed.[55]

In this thesis, the perspective of the precautionary principle that will be adopted is the view that this principle represents a principle of action, where innovation is encouraged and not inhibited. In this perspective, there are four main components to this principle (Kriebel *et al.*, 2001):

- taking preventive action in the face of uncertainty (a second order risk);
- shifting the burden of proof to the proponents of the activity;
- exploring a wide range of alternatives to possible harmful actions; and
- increasing public participation in decision making.

It is understood here that a precautionary approach entails an anticipatory action, the right to know, alternative exploration and assessment, the collection of expert knowledge where available, and the use of tacit knowledge through some form of participatory decision process.

An alternative exploration and assessment approach is the model that is typically used in scenarios that deal with environment, health or human quality of life (Tickner & Geiser,

55 There are two main perspectives of the interpretation of the precautionary principle: risk analysis framed in a Bayesian (subjective statistical) framework; and social heuristic concepts that are declared valid by public European and domestic institutions (Gollier, Jullien & Treich, 2000). However, the precautionary principle, as a new social norm, cannot be reduced to an exercise in applied economics. It has a substance and complexity of its own in resolving policy issues related to uncertainty.

2004)[56]. The justifications for the use of an alternative assessment approach are according to Tickner and Geiser (2004): (1) focuses on solutions rather than problems; (2) stimulates innovation and prevention; (3) multi-risk reduction; and (4) greater public participation and burden shifting.

So the implementation of the precautionary principle challenges the risk assessment methods because instead of focusing on the risk potential, it focuses on the exploration and assessment of alternatives in cases where uncertainty is an inadequate reason to avoid acting on threats to the public, society, community or the ecosystem.

In order to more fully understand the precautionary principle, and how it fits into the wider scope of risk, evaluation, assessment and judgment, it is important to understand the system in which it resides. This will be done through an exploration of this principle based on the four fields of knowledge: ontology, epistemology, methodology, and teleology, which will create in some sense, a system. These terms will be defined in the next sections.

Modernity, Risk and the Precautionary Principle

The idea of risk emerged in contemporary society with the development of probabilistic and statistical thinking. With this, the idea of individual responsibility was challenged towards a collective strategy for dealing with undesired events – the aim was the prevention of measurable collective risks (Werner, 2005; Ewald, 1996). Precaution was a later development (in the 1970’s) for dealing with undesired events (Werner, 2005; Harremoës *et al.*, 2001; Ewald, 1996).

Precaution developed in response to the modern conditions of technology and uncertainty, which Ulrich Beck (2004) terms as “*conditions of reflexive modernity*”. Here reflexive refers to the recursive relationships between modern society and the process of modernization itself (Werner, 2005). In other words, society is increasingly threatened

56 The steps involved in an alternative assessment approach are: (1) examination/understanding of impacts and purpose of the activity; (2) identification of a wide range of alternatives; (3) comparative analysis of alternatives; and (4) implementing the best option (including no action), with feedback to ensure that the best decision was made (Tickner & Geiser, 2004).

by potential risks that are a result of the modernization process itself (Werner, 2005; Beck, 2004; Giddens, 2004; Ewald, 1996; Jonas, 1985). In fact, Giddens (2004) has stated that the modern understanding of risk was supposed to help humans control their future, to normalize it. Yet according to Giddens (2004) and Beck (2004) things have not turned out that way, and that our attempts to control the future have in fact led to the realization that humans need different methods for relating with uncertainty. The emerging relevance of the precautionary principle rests on the failure of traditional scientific approaches to deal with such uncertainty, but more importantly, on the myth of scientific progress which reduces the world to produced artefacts driven by the efficiency of technology (Latouche, 2006; Larceneux & Boutelet, 2005). Consequently, according to Ellul (1954) the paradox is that technology drives intention and so individuals have become the slaves of the technologic society – "*the multiplicity of means is reduced to one: the most efficient"* (Ellul, 1964, p.21). And yet,

> *"(...) the individual participates only to the degree that he is subordinate to the search for efficiency, to the degree that he resists all the currents today considered secondary, such as aesthetics, ethics, fantasy. Insofar as the individual represents this abstract tendency, he is permitted to participate in the technical creation, which is increasingly independent of him and increasingly linked to its own mathematical law." (Ellul, 1964, p.74)*

For this author, the search for efficiency has overwhelmed the individual's ability to consider other ways of thinking, such as aesthetics, ethics, etc. impoverishing humanity's ability for creativity and reflection. The principle of prevention becomes a main protagonist of this impoverishment.

According to Philippe Icard (in Larceneux & Boutelet, 2005), the precautionary principle has emerged as a normative procedural rule that requires a considerable reflection regarding the choices that a society must make for its future. So, we can say, that intention and the reflection of consequences is once again in the hands of the individual and not on technology. The recurrence of unpredictable events has obliged humans to rethink the way in which such consequences can be assessed. These can no longer be ignored as beyond the scope of the problems faced because of human's inability to assess them. Instead, humans must now look at such situations as the systemic consequences of the functioning of society itself (Larceneux & Boutelet, 2005).

According to Lascoumes (1996), the emergence and formalization of the precautionary principle have revealed several shifts in our comprehension of uncertainty and risks. First, decisions cannot be taken only with current knowledge; an attempt must be made to project into the future any long-term effects that may appear to be probabilities of risk. Second, the scientific model of risk assessment is no longer viable; the reality of risk is not limited to an objective rationalization since, for example, risks on society and culture cannot easily be predicted. Preventing known risks is not sufficient, it is necessary now to integrate the notion of acceptability of risks. Third, the consequences in terms of attribution of responsibility demonstrate another shift. And fourth, a shift in the management of risks and the forms of cooperation that deal with the assumption of responsibility (Lascoumes, 1996).

Therefore, the effects of industrialization on society and the environment can no longer be doubted. The solutions cannot come from technology alone but from changes in collective human behavior (Van Der Ryn & Cowan, 2007; Larceneux & Boutelet, 2005; Princen, 2005). The precautionary principle can help increase the awareness of risks and help modify the behavior of decision-makers, citizens and of the entire population through the democracy of knowledge, which is the "cultural condition"[57].

TRADITIONAL SCIENCES AND THE DIFFICULTY WITH THE PRECAUTIONARY PRINCIPLE

A common characterization of the precautionary principle comprises: (1) the threat dimension; (2) the uncertainty dimension; (3) the action dimension; and (4) the command dimension (Sandin, 2004; Haag & Kaupenjohann, 2001; Sandin, 1999; O'Riordan & Jordan, 1995b). According to Sandin (1999, p.891),

> *"(1) the threat dimension concerns the possible threat, (2) the uncertainty dimension concerns the limits of knowledge, (3) the action dimension concerns the response to the threat, and (4) the command dimension concerns the way in which the action is prescribed."*

57 (Theys, 2003) identifies three other conditions: *methodological* (render the procedures of governance more credible); *political* (rebalance the forces of power); and *institutional* (redefine the lines between "participatory governance" and "representative government").

Haag *et al.* (2001, p.53) state that traditional science is not capable of addressing the four characteristics of the precautionary principle because it:

> *"(a) excludes values and thus threats from its realm; (b) trains for the exclusion of uncertainty by establishing closed systems but not for communicating and managing uncertainty in open systems; and (c) has no code/distinctions for the selection of action nor (d) for their justification."*

Therefore adopting a precautionary approach challenges the established power of traditional science (Whiteside, 2006; van Griethuysen, 2004; Ewald, Gollier & Sadeleer, 2001; Haag & Kaupenjohann, 2001; Kourilsky & Viney, 2000; Ewald, 1996; Guba & Lincoln, 1989).

The uncertainty dimension can be characterized in several ways[58]. A predominant classification of uncertainty is: data unavailability, ignorance or indeterminacy (Haag & Kaupenjohann, 2001; O'Riordan & Jordan, 1995b). Another classification of uncertainty that is pertinent for this research is: technical, methodological and epistemic (Funtowicz & Ravetz, 1994; 1993). Technical or methodological uncertainties revolve around the question of an improved understanding or better methods for achieving true knowledge. These are often based on data unavailability or ignorance, but not indeterminacy (Haag & Kaupenjohann, 2001) and remain within the doctrines of positivism and post-positivism. However for epistemic uncertainty, it is not the *truth* that is in question but the *plausibility* of the conflicting knowledge that is the basis of this type of uncertainty (Haag & Kaupenjohann, 2001). Epistemic uncertainty may be characterised as knowledge that is indeterminate.

Traditional scientific approaches cannot address such epistemic uncertainty because: (1) they are based on a positivist or post-positivist epistemology which values universal

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58 Harremoës (2003) identifies the levels of uncertainty as: (1) determinism – rare but ideal; (2) risk – a rational approach to describing variation; (3) uncertainty – can be expressed statistically and incorporate in risk analysis; (4) indeterminacy – chaotic properties make predictions impossible – too many parameters; and (5) ignorance – do not know essential functional relationship. According to Tickner, Raffensperger, and Myers (1998) uncertainty can be characterized in the following ways: (1) parameter uncertainty; (2) model uncertainty; (3) systemic or epistemic uncertainty; (4) politically induced uncertainty; (5) indeterminacy; and (6) ignorance. According to Van Griethuysen (2004), uncertainty is characterized by: risk, uncertainty and Ignorance. According to Proske (2008), uncertainty is characterized by: non-specification, uncertainty, dissonance, and confusion. So it is evident that the categorization of this notion varies. There are classifications by other authors (Stirling, 2007b; Mayumi & Giampietro, 2006; Stirling, 2006; Whiteside, 2006; Godard, 2005; Tallacchini, 2005; Haag & Kaupenjohann, 2001; Harremoës *et al.*, 2001; Funtowicz & Ravetz, 1994; 1993).

knowledge; (2) they rely on a single objective scientific truth; (3) they rely on statistical probability, repeatability of results, and this is not possible since epistemic probability is based on diverging claims and issues; (4) there is a reliance on instrumental rationality which is in contradiction with a constructivist approach for acquiring new knowledge; (5) the problems are not considered wicked problems; (6) risk is scientifically (statistically) calculated and not socially constructed; (7) the methods of evaluation are established and universal, instead of context specific and driven by the situation; and (8) they are incapable of non-trivial predictions yet impose instrumental rationality instead of a participatory decision process (van der Sluijs, 2007; Mayumi & Giampietro, 2006; Stirling, 2006; Tallacchini, 2005; Haag & Kaupenjohann, 2001; Funtowicz & Ravetz, 1994; Guba & Lincoln, 1989).

The precautionary principle, as defined by several authors can address the limitations presented by traditional scientific methodologies (van der Sluijs, 2007; Stirling, 2006; Whiteside, 2006; Godard, 2005; Tallacchini, 2005; Ravetz, 2004; Sandin, 2004; Tickner & Geiser, 2004; van Griethuysen, 2004; Bourg & Schlegel, 2001; Lascoumes, 1996; O'Riordan & Jordan, 1995a). It represents a framework of reference from which to organize and give direction to action where non-predictable uncertainty exists (Stirling, 2007b; Whiteside, 2006; Larceneux & Boutelet, 2005; van Griethuysen, 2004; Kourilsky & Viney, 2000; Ewald, 1996). This is why it is a principle of action and not one of inaction.

THE PRECAUTIONARY PRINCIPLE AS A MODEL FOR ANTICIPATIVE COLLECTIVE ACTION

A precautionary approach can be seen as a model for upstream thinking (Raffensperger & Tickner, 1999; Ewald, 1996). It represents a shift in the assessment of risks - from the collection of knowledge to the anticipation of action. A precautionary approach entails the cooperation of experts as well as non-experts, because of the inherent unknowns, doubts, antagonisms, contentions and potential risks in many contemporary problems (Harremoës, 2003). The precautionary principle

> *"(…) encourages individuals and states to think of themselves not only as competitive, self-interest-maximizing consumers (as in the liberal model), but as citizens whose vigilance protects common good" (Whiteside, 2006, p.87).*

Citizen participation can greatly nourish a decision making process because of their views of well-being and their creative insights based on unacceptable conditions of existing situations (Callon, Lascoumes & Barthe, 2001; Ewald, Gollier & Sadeleer, 2001; Sclove, 1995). This approach would ideally allow a consideration of the values of those affected by the situation or project so that a decision based on an understanding of the common-good may be reached. Yet it may not always be possible to have citizen participation in the decision process of projects. What is important is that a participatory approach to decision making is made possible in projects affecting communities – and where the public has the opportunity to be involved through a participatory process.[59]

The precautionary principle has largely been ignored in decision support tools as it is not evident how it can be operationalized; it is based on fundamental uncertainties and therefore inherently relies on some form of participation in order that alternatives may be explored and that decisions may be justified (Stirling, 2007a; 2006; Whiteside, 2006; van Griethuysen, 2004; Bourg & Schlegel, 2001; Callon, Lascoumes & Barthe, 2001; Kourilsky & Viney, 2000; Raffensperger & Tickner, 1999; Tickner, Raffensperger & Myers, 1998; Ewald, 1996; Lascoumes, 1996; Jonas, 1985). Therefore methods to go from diversity of opinions to a practical concrete decision are necessary, which can be a daunting task (Callon, Lascoumes & Barthe, 2001; Sclove, 1995). Yet, as this may seem a difficulty, it also represents a strength in that it may help discover the value systems of participants, expose and confront them, so that they can contribute to the search for innovative solutions towards sustainability (Droz & Lavigne, 2006). A shift in attitude from prevention to precaution, introduces a parallel shift from a paradigm of determinism towards the paradigm of complexity.

59 A spectrum of participatory processes and how they may contribute to an exploration of alternatives will be discussed in the section *Participatory Processes* of this paper.

The Precautionary Principle and a Complex Worldview

A complex worldview can contribute to the comprehension of the organization of the ambiguity, uncertainty, and disorder, so that it becomes intelligible – all this without reducing the phenomena into a mutilated simplified model that cannot reflect its complexity (Morin, 2005).

In order to understand the necessity of a complex worldview for a precautionary approach for design, it is important to emphasise that sustainable design by its very nature is a discipline that must consider a variety of implications within its solutions; social, cultural, economical and environmental. However, the continued specialization of environmental and social tools for design in a context of sustainability without the integration of these through an open dialogue has made it difficult to understand the larger picture of design situations. A disjunction and compartmentalization of knowledge occurs when the specialists of such tools work in isolation (Morin, 2005; Le Moigne, 1999b; Le Moigne, 1995). For many types of problems, such a disciplinary approach may be adequate. However, a single discipline cannot adequately address the contemporary complex issues that designers face. A complex worldview is fundamental for a global vision because it allows a comprehension of the interrelationships among the various domains and may provide new perspectives for problems that cannot be easily addressed within a single domain.

In fact, the vision of ecology of the mind as described by Gregory Bateson in his book Steps Towards an Ecology of Mind (1972) represents an systems perspective of how humans think about the world around them. In particular, Part V: Epistemology and Ecology of this book he describes how all these dimensions (social, cultural, environmental and economical) are deeply interconnected.

> *"Consciousness (...) is organized in terms of purpose. (...) On the one hand we have the systemic nature of the individual human being, the systemic nature of the culture in which he lives, and the systemic nature of the biological, ecological system around him; and, on the other hand, the curious twist in the systemic nature of the individual man whereby consciousness is, almost of necessity, blinded to the systemic nature of the man himself. Purposive consciousness pulls out, from the total mind, sequences which do not have the loop structure which is characteristic of the whole system structure." (Bateson, 1972, pp.433-434)*

By adopting Bateson's perspective, blind spots may be revealed because this vision seeks to interconnect the various dimensions of the world around us and understand the loop structure that connects them. However, Bateson claims that humans are limited in their capacity for adopting such a vision particularly when purposive consciousness takes hold of the mind instead of the more exploratory form of consciousness which is that of creative experience (Bateson, 1972).

This limitation to which Bateson refers is directly related to the purposive nature of tools like LEED or LCA that lie within a preventive form of assessment. In other words, their focus on hotspot identification and universal type technical solutions used to address the identified weak spots limits the vision of the situation since the more exploratory form of thinking was circumscribed for a purposive form of thinking.

In essence then, each of these principles, precaution and prevention, fall into different epistemological frameworks. The prevention principle is dealt with using a first generation system's approach; a system's analysis approach which works within a system that is structured, deterministic, and closed. This approach falls within a neo-mechanist epistemology. The precaution principle, on the other hand is dealt with using a second generation systems approach; this is a constructivist approach where the system is assumed open and dynamic. It adheres to the framework of complexity.

Therefore the types of problems that the precaution and prevention principles seek to solve are intrinsically different. In a preventive approach, the problems are well-defined and well suited to the deterministic approach it abides by because the objective is to optimize a product or service system based on available data. In a precaution approach, the problems are considered ill-defined and therefore a deterministic approach is not suitable. Because of the inherent uncertainty of knowledge regarding potential catastrophic danger in a precautionary situation, impacts cannot be assessed based on expert knowledge alone. This is because the experts disagree on the consequences of the technology, and therefore knowledge and values beyond the 'knowledge producers' becomes fundamental when searching for possible sustainable solutions. According to Bachelard (1938), science has progressed against the notion of common-sense and ordinary knowledge; this has become a source of epistemological obstacles to the advancement of science. The realization that an epistemological barrier exists as decisions shift from a preventive approach to a precautionary approach is fundamental in comprehending an operationalization of the precautionary principle.

CONSTRUCTIVISM AND THE PRECAUTIONARY PRINCIPLE

Constructivism is an epistemology that can contribute to the intelligibility of complex phenomena (Le Moigne, 1995). Constructivists oppose the perspective of a predetermined and ordered world; they believe that knowledge emerges from a human process of continual construction and reconstruction (Le Moigne, 1995).

This implies that in a constructivist paradigm, the epistemology is pluralist, subjective and pragmatic; which signifies that the observer is non-neutral (Piaget, 1967). A subjectivist epistemology is a primary position in a constructivist paradigm, since the observer's experience in the process of construction of knowledge is at the basis of this paradigm. Knowledge takes shape from within the interaction among the subjects, the objects, and the projects (Le Moigne, 1995; Levy, 1991). A constructivist methodology uses an interpretive approach (or often referred to as a hermeneutic approach) that is based in practise of associations and relations among subjects, objects and projects (Le Moigne, 1995; Levy, 1991; Piaget, 1967). Since the knowledge is constructed through the interaction between the subject and the objects, a recursive process of change (assimilation of knowledge) occurs.

PROJECT EPISTEMOLOGY AND THE PRECAUTIONARY PRINCIPLE

An important notion in a constructivist approach is the idea of project. The idea of project implies a vision based on a future temporal and spatial perspective (Boutinet, 2005). So a teleological perspective is fundamental within a constructivist paradigm since the goals of the knowledge direct the inquiry and the knowledge exchange. According to Bachelard (1934), all objects of study through the mediation of the subject, take on the form of a project, because they are based on a teleological perspective. As early as 1934, Bachelard claimed that

> *« Au-dessus du sujet, au delà de l'objet immédiat, la science moderne fonde sur le projet. Dans la pensée scientifique, la médiation de l'objet par le sujet prend toujours forme du projet. » (1934, p.15).*

This is similar to Herbert Simon's (1969) perspective of object-subject relation. He claims that each time an object is described in terms of some identifiable teleological aspiration within a given context; the object can then also be described through a project. In this case, the object is then constructed through the mediation of the subject, based on some identifiable goal within some context. With regards to the process of conception, Nelson and Stolterman (2003, p.163) refer to such a goal (for a project of conception) as the ultimate particular.

Simon (1996b; 1969) also claims that it is possible to design without a final goal. However, the clarification of this idea is that, the final goal is consistently changing throughout the various phases of development of the project; so the initial goal identified keeps shifting with the newly acquired knowledge (Simon, 1996b; 1969). Simon states that

> *"Making complex designs that are implemented over a long period of time and continually modified in the course of implementation has much in common with painting in oil. (...) The painting process is a process of cyclical interaction between painter and canvas in which current goals lead to new application of paint, while the gradually changing pattern suggests new goals." (Simon, 1996b, p.163).*

Complexity here refers to the way in which the observer relates to and observes the object of study. Constructivism allows a researcher adopting a complex worldview to conceptualize an intelligible interpretation of this worldview (Le Moigne, 1995). In a constructivist approach, the subject is a very important component of the result of the research since the subject is continually building their interpretation and re-interpretation of a situation, a hermeneutic process (Piaget, 1967). So the subject (or researcher) is not an outside observer, but is part of the knowledge that is constructed (Morin, 1977).

RECURSIVE, DIALOGIC, AND HOLOGRAMMIC PRINCIPLES FOR A COMPLEX WORLDVIEW

An understanding of the implications of a reductionist approach is therefore important to consider in light of complex world problems. Reductionism refers to an approach for describing systems by breaking them down into smaller sub-systems and describing these, while ignoring the relationship among the sub-systems (Morin, 2005; Le Moigne, 1999a). So reductionism contributes to the simplification of phenomena in order to discover and explain characteristics of the phenomena (Le Moigne, 1999a). Such a reductionist approach has made it difficult, if not impossible to place knowledge within a larger context. In fact, it becomes difficult to organize and articulate information about the world (Morin, 2005; Le Moigne, 1999a). By using a worldview of complexity, a broader perspective can ground natural sciences with social sciences within a culture, a history and humanity (Morin, 2005).

In addition, in order to render intelligible a complex system, Morin (2005) has identified three principles: recursive, dialogic, hologrammic. *Recursivity* is represented by the fact that each actor assimilates the knowledge of each of the other actors into their own vision in order to contribute to a global vision, which is a result of the deliberation of each. The recursive principle rests on the idea of movement and processes (organization), and their relations. Recursivity can be used to construct the design problem using the notion of auto-eco-re-organization[60] (Morin, 2005; Le Moigne, 1999a; 1994; Morin, 1982; 1977).

The *dialogic* principle rests on the idea of communication, in particular, antagonisms, and their relations, which often results in recursive logic. This is where uncertainty and contradictory elements are explored (Whiteside, 2006; Morin, 2005; Dupuy, 2002; Le Moigne, 1999a; 1994; Morin, 1982; 1977). Some examples of dialectical concepts are: vulnerability-resilience; degradation-regeneration; individualism-solidarity; conservation–regeneration; and efficiency–sufficiency.

60 (1999a) states that auto-eco-re-organization refers to, respectively (1) autonomy of systems (auto); (2) the open relation with the environment (eco); (3) the transformative property (re).

The hologrammic principle refers to the auto-eco-organization of wholes and parts, since not only is the parts within the whole, but the whole is within the parts (Morin, 2005) (Pinson, Demailly & Favre, 1985). An example Morin provides is that the individual is part of society, but society is also a part of all individuals, they are co-dependent and co-determining (Morin, 2005). Another example of this principle is that the designer helps construct the design problem with the members of the design team, but the evolving design problem can also be seen to construct the knowledge of each of the members of the design team, the knowledge is co-determined.

A complex worldview does not imply the ability to know everything; on the contrary, it is a position that is based on uncertainty, in other words, exposing what is not known in order that it can be addressed. Morin (2005) suggests that it is impossible to know everything about an object, but, what he advocates is not the knowing of everything, but an understanding of the key problems, which cannot be done when the problems are separated into their disciplinary parts, and when there is little or no communication among these parts.

FOUR FIELDS OF KNOWLEDGE WITHIN A CONSTRUCTIVIST PARADIGM

Therefore, the paradigm of constructivism will form the basis for the knowledge creation of this research. According to Levy (1992, in De Coninck, 2005), a constructivist approach is based on four poles of knowledge. The four poles are interdependent: epistemology, ontology, methodology, and teleology.

Epistemology is the study of knowledge. The epistemological pole represents the way in which the knowledge is acquired, the nature of the knowledge and the limitations of the knowledge. This is the 'motor' of investigation (Lessard-Hébert, Goyette & Boutin, 1996). In a constructivist approach, the epistemology will be subjectivist and pragmatic.

Ontology is the nature of the knowledge – the entities that exist, how these entities are grouped and their relations. The ontological pole then represents the main elements of the knowledge that will be constructed. In a constructivist approach, because of the multitude of the perspectives, the ontology will necessarily be pluralist. In a pluralist ontology, the there is a recognition of the existence of multiple experienced worlds rather than an independent, pre-existing and ordered reality based on natural laws that are immutable (Gendron, 2001).

Methodology is the means used to construct the knowledge. The methodological pole in a constructivist approach then is representative of multitude and complementary methodologies (Gendron, 2001). For example, phenomenology may be used to study and comprehend the multiple perceptions of the experienced world. A hermeneutic methodology can be used to develop an intelligible comprehension of the object of study (Guba & Lincoln, 1989). Reflexive and dialectical methodologies can be used to allow an emergence of knowledge through the interactions and transactions of the subject in the world (Guba & Lincoln, 1989; Dewey, 1933). The subjects are engaged in a process of auto-eco-re-organization as defined by Morin (2005) so that they appropriate the perceptions of others within their own perceptions and experiences to conceptualize multiple representations of reality. These multiple representations will allow them to recursively develop the knowledge, as well as to transform their perspectives of reality. Therefore, the development of knowledge is intimately linked with the transformation of perspectives (Gendron, 2001).

Teleology represents the doctrine where phenomena are explained by their ends or purposes. The teleological pole in a constructivist approach is fundamental because of the pluralistic ontology; without a perceived end in mind, the pluralist views of the subjects will make it difficult to co-construct the knowledge since each subject will have their own vision, objectives, intentions or purposes. In a constructivist approach, the project is a fundamental element. The project, which is a projection of intentions (Boutinet, 2005), represents the teleological pole in a constructivist paradigm. The project allows the shared knowledge to emerge and the transformation of the intentions to be manifest.

These four categories of knowledge for a constructivist paradigm will be used to describe the precautionary principle and its relation to prevention. But before providing this definition, a deeper understanding of precaution and its relation to prevention and prudence will be presented in the next sections.

Prudence and the Precautionary Principle for Design

According to Jonas (1985), the precautionary principle opens up the question of ethics. Jonas (1985) claims that the greatest moral duty in the technological age is that humankind cannot put its survival at risk for the sole purpose of the continued growth of technological progress. In fact, as early as 1954, when Jacques Ellul published the book *La technique ou l'enjeu du siècle*, he realized that

> *"The interval which traditionally separates scientific discovery and its application in everyday life has been shortened (…) The discovery enters the public domain before anyone has had a chance to reckon all the consequences or to recognize its full import" (from the English version published 10 years later, Ellul, 1964, p.10)*

This author was already aware of the potential of unintended consequences in contemporary society, where scientific discoveries occur faster than human's ability to understand their consequences. With this, human responsibility has shifted as Jonas (1985) proposes an important rupture with respect to the sense of responsibility. Traditionally responsibility was linked to past actions, but now responsibility carries with it the future. According to Jonas, the precautionary principle is inspired by an ethic based on the relationship between humans to their environment (biological, social, cultural, educational, etc.), to risk, and to life. This is founded on a sense of responsibility (Ewald, Gollier & Sadeleer, 2001), which is inspired by an ethics of the future[61]; the future must become the major object of concern and this concern must start from a philosophical perspective (Jonas, 1985).

From a philosophical perspective, the precautionary principle is not as much concerned with uncertainties as it is with the necessity to take into account the long-term perspective (Ewald, Gollier & Sadeleer, 2001; Ewald, 1996). In fact, the precautionary principle does not valorize ignorance, or uncertainty. Instead it assumes an infinite requirement for knowledge, both in *knowing what we know*, and in *knowing what we don't know* (Ewald, 1996). Therefore a precautionary attitude will not seek to ignore

61 An ethic of the future is a term that refers to the idea that the future of humanity cannot be compromised by meeting the needs of present generations. This refers to both inter and intra generational equity (Carter, 2001).

uncertainties, but will seek to expose those areas that have diverging views, those areas where there are doubts, or where controversies have emerged and seek to contextualize them within the situation. These may also be referred to as tensions[62].

PRUDENCE AND ITS RELATION TO ETHICS, MORALS, AND ETHICAL ACTION

A brief distinction between moral, ethics and ethical and their relation to the concept of prudence is needed to categorize the various tools for sustainability in terms of their ethical inclination.

Morals refer to normative concepts for defining action. Normative ethics is the study of ethics concerned with classifying actions as right and wrong without bias. Normative ethics regards ethics as a set of norms related to actions. Descriptive ethics deals with what the population *believes to be right and wrong,* while normative ethics deals with what the population *should believe to be right and wrong.* For example, '*killing one's children is wrong'*, is a normative ethical claim, whereas '*this society believes that killing children is wrong'*, is a descriptive ethical claim. Normative ethics examines standards for the rightness and wrongness of actions.

Moral and *ethical* refer to the same concept; both are normative and refer to the set of principles that govern acceptable human conduct. The main difference between moral and ethical is their origin; *moral* is a word of Latin origin, whereas *ethical* is a word of Greek origin (Weinstock, 2006). Therefore when an action is considered ethical (or moral) it is considered this way because of normative thinking.

Ethics is the study of morals, or a meta-moral. If moral (or ethical) is normative that defines the ideas of good and bad, then ethic is different, not because it is not in some way normative, but because it is *adaptive*. Ethic is normative in the context that it offers markers in the form of fundamental shared values that guide the ethical reflection, without being imposed. Ethic can be thought of an analysis of the deconstruction of morals. The place of ethics is in the process of interrogation.

62 The idea of tensions as a way to address the epistemological barrier between prevention and precaution will be presented in Chapter 3.

Consequently, morals are closed; ethics are open and resist closure. Morals imply obligation and duty; whereas ethics allows a reflection on of the limits of morals, in particular when its limits are put into question. Ethics is therefore based on defining an action when the problem encountered presents moral contradictions; whereas morals are based on rules that relate to the concepts of good and bad.

There are four main forms of ethical theory: utilitarian, deontological and contractarianism and virtue. Utilitarian, deontological and contractarianism are examples of primarily normative ethics. They are based on an understanding of what is considered right or wrong. Virtue ethics (Aristotle, 2002) also a normative form of ethics is different because every moral dilemma must be re-evaluated for every situation. So it is founded on being rather than in doing, in other words, on the individual's virtues rather than on the reflection of actions. The individual will use the particular situation to decide what is good. Virtues are tied to a particular time and place and so virtues emanate from the character of a community – this is what is termed ethos, the origin of the modern word ethics. So virtue ethics allows individuals to grow based on personal experiences, by resolving moral dilemmas. Virtue ethics is tied to practical wisdom or knowledge, where practical wisdom or knowledge, according to Aristotle, is referred to as prudence (Aristotle, 2002). Table 3 presents a brief description of each of these ethical theories.

Prevention, precaution and foresight, all dimensions of prudence fall into different forms of ethical theories. However, it is important to state that there are elements of every ethical theory in each of these dimensions of prudence. Prevention is primarily based on a deontological or utilitarian ethical theory, whereas precaution and foresight are primarily based on virtue and contractarianism ethical theories. However, one cannot dispute that precaution and foresight also have elements of utilitarian or deontological ethics.

TABLE 3: ETHICAL THEORIES: VARIOUS WAYS TO HELP DEFINE AN ACTION (BASED ON: CUCUZZELLA, 2007, P.102)

	Deontological	Utilitarian	Virtue	Contractarianism
Main protagonists	Immanuel Kant	John Stuart Mill, Jeremy Bentham	Aristotle and Plato	Thomas Hobbes, Jean-Jacques Rousseau, John Locke
How to define what is good and just?	Set of universal laws imposed on individuals.	Action must result in the greatest good (benefit the majority of individuals).	Individual will use the particular situation to decide what is good.	Enforced moral code used to make a good decision. If individual wants to benefit from society then must enter social contract.
Limits to theory	Consequences of actions are often unknown; therefore the action may result in a consequence that is not good.	Consequences of actions are often unknown; therefore it is not known if the decision will result in the greatest good.	Every moral dilemma must be re-evaluated for every situation; and consequences of decisions are often unknown.	When decisions are made outside the moral code, then decision is considered bad by society, even if it may not be.
Benefits of theory	The action or decision taken will be universally good; since consequences are often uncertain, the action is the only certainty of being good.	When the consequences are near certain, then this decision will benefit a greater number of people.	Allows individuals to grow through the personal experience of resolving moral dilemmas.	Facilitates social living when making decisions within moral code.
Basic assumptions of theory	Reciprocity; individuals are humane; individuals have a sense of duty to others and self	Greatest good	Individual growth; individuals seek excellence, are prudent, and have practical knowledge	Individuals are self-interested; similar to liberalism

It can be seen that most evaluative tools available to designers for sustainability are deontological, based on a set of rules and categories of imperatives, and therefore in practice are often unchallenged even if their premises may at times be misguided, out of context or outdated. A precautionary form of inquiry cannot abide by a strict deontological rule, as the judgment to make rests on unknowns. This is why virtue ethics, which emphasises individual virtues, seems the most appropriate form of ethics for a precautionary form of inquiry. It can help address the plurality of issues and concerns, since in a context of sustainability, this has to be seriously considered.

With regards to the worldview of a precautionary form of inquiry, it cannot be based on a cause-effect, deterministic approach, since this is in direct contradiction to its original purpose. Since the whole purpose of the precautionary principle is to address diverging views, tensions and contradictions of a situation and its potential consequences, then a complex worldview is suggested.

FORESIGHT, PREVENTION AND PRECAUTION: EWALD'S DIMENSIONS OF PRUDENCE

The work of sociologist François Ewald (1996) has been instrumental for defining the theoretical foundations of the precautionary principle. Ewald (1996) claims that historically there have been three concepts for defining action regarding undesired future events, these are: foresight[63], prevention, and precaution. He claims that these three approaches fall into the general concept of prudence, which he defines as the behaviour of humans when confronted with undesired future events (Ewald, 1996). Bruno Latour (2000) has stated that the precautionary principle does not bring anything new if its only concern is distinguishing between decision and expertise, between the management of risks and their evaluation and to better articulate one over the other. The innovation that the precautionary principle brings is the type of knowledge that must be taken into account to make decisions – knowledge that is uncertain, diverging, doubtful, incomplete, weak, in a world where action is driven by the quest for certainty. According to Latour (2000) an appropriate synonym of the precautionary principle is "collective experimental science".

According to Ewald (1996), Aristotle's notion of 'phronesis', translated as prudence or practical wisdom is a precursor to precaution. Phronesis requires a gathering of empirical knowledge as well as tacit knowledge for making judgments (Aristotle, 2002). The definition of prudence by Aristotle refers to the ability to discover and carry out the proper goals of human life; it is one of four cardinal virtues (prudence, temperance, justice, and fortitude) which operate in an integrated manner. It is a practical wisdom

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63 (1996)uses the French term 'prévoyance'. We have selected the word 'foresight' as an appropriate translation. There are some authors that have used the term 'responsibility' as a translation. The word foresight seems more appropriate in this context as the word responsibility is far too general.

rather than a theoretical wisdom – meaning it is concerned with how to act in particular situations and not universal truths. A prudent person makes thoughtful judgments and decides on actions by reconciling the most important issues with the most pressing issues (Kane & Patapan, 2006). It is a deliberative exploration of possible actions to consider for reaching some intended goal (Aristotle et al., 2002).

Ewald is not alone in tying precaution with prudence. Kourilsky and Viney (2000) have also defined prudence in a contemporary societal context where prevention and precaution are the two constituent parts. The definitions of prudence that will be adopted in this research are primarily those by Ewald (1996) and Kourilsky and Viney (2000).

On the one hand, Ewald's (1996) definition will be used to clearly identify the epistemological, ontological, methodological and teleological differences between the three dimensions in his typology of prudence. In the final analysis however, as the risks in design are collective, the definition that will be adopted is that of Kourilsky and Viney (2000), as they have included the two dimensions (prevention and precaution) that are concerned with collective risks.

Ewald (1996) defines *foresight* as a way for providing carefully for the future. It is a liability plan that is based in fault. It is founded in an ethics of virtue; linked to chance or fate. Foresight encourages the integration of the future with the present on an individual level, and is therefore not concerned with collective risks. It is not aware of future risks, meaning that action is initiated by seeking to avoid random future events (Ewald, 1996).

This author defines *prevention* as a solidarity plan based on known collective risks (Ewald, 1996). Prevention developed from a certainty of risk through dominant scientific analysis. It is a rational behavior that traditional science could objectify and quantify in the face of a risk (Tallacchini, 2005; Kourilsky, 2002; Kourilsky & Viney, 2000).

Ewald (1996) defines *precaution* as a process of protection based on the notion of potential collective risks (second order risks). Precaution, as it is emerging currently, deals with another type of uncertainty; it is the uncertainty of science itself (Ewald, Gollier & Sadeleer, 2001; Ewald, 1996). According to Ewald (1996), societies are threatened with risks; introduced in an act that itself tries to reduce such risks. The act of precaution starts when a decision must be made in the context of scientific uncertainty; not in a context of certainty, but in a context of doubt, suspicion, defiance, concern, fear, mistrust, etc. (Ewald, 1996; Lascoumes, 1996).

So precaution can deal with the more global idea of human and environmental wellbeing (the threats that are dealt with by precaution cannot be proven or quantified), in contrast to prevention which deals with known potential risks which are measurable (Tallacchini, 2005; Kourilsky, 2002; Kourilsky & Viney, 2000). Precaution is therefore caught in a kind of suspension and shift between the requirements of action and the certainty of knowledge (Ewald, 1996). Therefore, precaution refers to conditions that are not covered by either foresight or prevention (Table 4 on page 95).

As can be observed, Table 4 compares the three dimensions of prudence from an ontological, epistemological, methodological and teleological viewpoint, based on the typology of Ewald (1996) and from the philosophical perspectives of Ewald (1996), Jonas (1985), Lascoumes (1996) and Dupuy (2002); and the practical perspectives of Kourilsky and Viney (2000), Harremoes et al. (2001), Tallacchini (2005), and Whiteside (2006).

A deconstruction of three basic attitudes of prudence was conducted to help reveal their limits and benefits, demonstrating the gaps and overlaps that exist among the three attitudes. By elaborating on the three dimensions of prudence, the role of precaution, prevention and foresight for design in a context of sustainable development can now be explored.

TABLE 4: A COMPARISON OF FORESIGHT, PREVENTION AND PRECAUTION WITH RESPECT TO THEIR ONTOLOGICAL, EPISTEMOLOGICAL, METHODOLOGICAL, AND TELEOLOGICAL PERSPECTIVES (BASED ON: CUCUZZELLA, 2007, P.117).

	Foresight (prévoyance)	**Prevention**	**Precaution**
Ontological What is the form of the perceived world? (what)	Individual concern	Collective (expert) concern	Collective (stakeholders – experts and lay people) concern
	Based in ethics of virtue, integrates the future with present actions	Based on quantifiable, objective data, (deterministic)	Based in ethics of responsibility of the future and on the uncertainty of science (non-deterministic)
	Based on the randomness of future events that have local and finite consequences	Known risks having harmful consequences vary in time and space	Potential risks may have global and infinite harmful consequences
Epistemological What is the relation between the person that is constructing the knowledge and the perceived world? (values)	Consideration for the reversibility of action	Reversibility of action is not a consideration	Consideration for the reversibility of action
	Cautionary, decision based on an imaginable fate	Objective, rational, measurable decision	Anticipative, subjective decision
	Based on individual need	Based on single truth	Based on multiple visions of the truth
	Virtuous attitude (Axiological)	Prescriptive attitude (Deontological)	Heuristic attitude (Axiological)
	Based on randomness of events in the future	Based on a cause-effect chain of events (deterministic)	Based on a complex vision of the world
	Valorization of future needs for individual	Valorization of needs for current generations	Valorization of needs for current and future generations
Methodological What methods are used to obtain the knowledge? (operational)	Adaptive approach	Normative	Adaptive approach, but requires basic statistical norms
	Need based approach	Problem based approach, notion of efficiency	Solution (result) based approach, notion of sufficiency
	Strategic tool	Tactic tool	Projection tool
	Protective	Reactive and proactive	Prospective and projective
	Future necessity is defined by individual condition	Risk defined by experts collectively	Levels of acceptability defined by stakeholders collectively in a ongoing basis as new facts become available.
	Decision made in situations without potential or known risks	Decisions made in situations of known risks	Decision made in situation of potential risks
Teleological What is the intention of the researcher? (purpose)	No real requirement of action; probability of random future events initiates course of action	Requirement of action based on known danger	Requirement of action based on potential danger
	Private decision	Expert decision	Public decision
	Liability plan (providing a better future for individual)	Solidarity plan (reduce or avoid consequences of known risks)	Safety process (reduce or avoid potential harm from uncertain situations)
	Individual plan for an inevitable imagined fate	Collective is involved in the implementation of preventive measures	Collective is involved in the definition of the levels of acceptability to be used as markers to help reveal potential problems

In the next section, the characteristics of each dimension of prudence combined with the strategies and visions for design for sustainability presented in Chapter 1 will be combined in a preliminary theoretical model representing the main values and goals for design for sustainability within a framework of prudence.

EWALD'S TYPOLOGY OF PRUDENCE FOR DESIGN FOR SUSTAINABILITY

An evaluation framework based on the notion of prudence (includes foresight, prevention and precaution) may allow the designer to traverse from an attitude of *resolution* (problem-solving) to an attitude of *exploration and resolution* (problem-setting) in a context of sustainability since it no longer treats the design problem as a problem in the natural sciences, but instead is as a wicked problem. This is because prudence may extend the evaluation framework for design by embedding the anticipatory nature of precaution in the design process in complement to the traditional preventive methods. Figure 12 presents a model of the main values and goals for design in a context of sustainability within a framework of prudence.

These values and goals are a result of a literature synthesis that was presented in this chapter as well as in Chapter 1. The ideas and concepts come from various authors. For example, in a mode of precaution, as uncertainty is dealt with in a discursive and conceptual manner and not in a statistical manner, then instead of focusing on optimization mechanisms such as efficiency or effectiveness, the focus is on the generation of alternative solutions so efficiency nor efficiency go far enough as strategies to guide this dimension. In addition, goals of conservation and stewardship also do not go far enough for a precautionary approach to design. This is why the idea of sufficiency as defined by Princen (2005) is adopted as a main strategy for precaution and where the idea of regeneration (i.e. cultural, ecological) is adopted as the main goal.

As is shown in Figure 12, the approach to decision making within the *preventive* dimension requires tools that can assure the predictability of risks associated with products using a strategy of efficiency with the goal of conservation[64]. Many tools for supporting decision making are available within this dimension. For example, some tools adopting an eco-efficiency strategy are: Life Cycle Assessment, Substance Flow Analysis, Environmental Impact Assessment, Leadership in Energy and Environmental Design, Ecological Footprint, among others. The tools available for socio-efficiency are the various Social Life Cycle Assessment approaches. And tools available for economic efficiency are Life Cycle Costing and Cost-Benefit Analysis. Cultural tool in this dimension have not been developed since cultural issues are difficult if not impossible to quantify and render predictable or repeatable. In summary, this dimension considers short and medium term solutions because the uncertainties are far too great to justify since very long-term predictions with such tools are not reliable. The risks in a preventive dimension are collective risks.

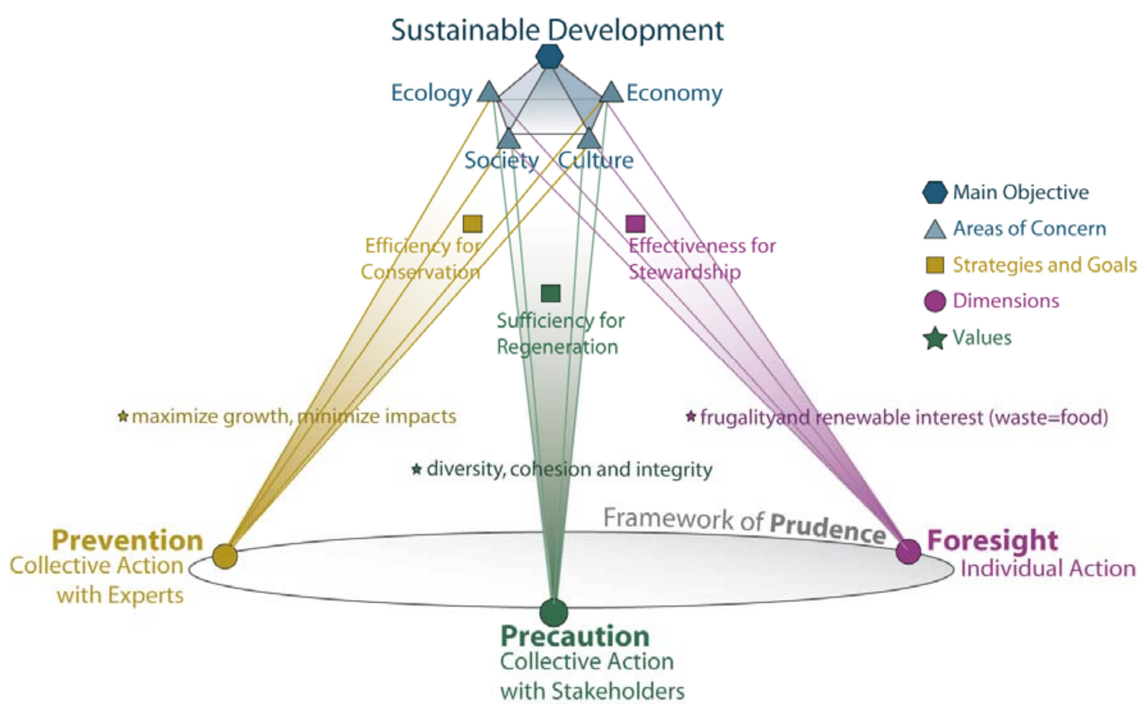

FIGURE 12 : SPECIFIC VALUES AND GOALS WITHIN A PRUDENT FRAMEWORK FOR SUSTAINABLE DEVELOPMENT (BASED ON: CUCUZZELLA, 2009A, P.253).

64 Van Der Ryn and Cowan (2007) claim that conservation is one of three visions for sustainable design, the other two are regeneration and stewardship.

The dimension of *foresight* addresses risks and responsibilities on an individual level (Ewald, 1996) where the strategy of effectiveness is adopted with the vision of stewardship. So, it is based on an individual ontology. The decisions in this dimension will be based on a fundamental desire to respect the limits of environment and the well-being of society. According to Thiers (from Ewald, Gollier & Sadeleer, 2001, p.274), *"one person cannot transfer the burdens of what happens to him"*. In this dimension, the individual seeks to make anticipative decisions that will ensure their survival at the least and at best, improve their quality of life while being respectful towards the environment and the society in which they belong. Existing predictable decision tools may be used to help the individual make choices, but the strength of this dimension is that it is a more systemic approach to decision making in terms of ensuring that the environment and society have been considered by each individual.

In the case of the *precaution* dimension, the goal is regeneration, predominantly long term and very long term perspectives. The possible approaches to decision making can be participatory design, new forms of governance, participatory decision making processes, where the possibility of alternative exploration and assessment is made possible on a collective basis since the risks are themselves collective. The main strategy in this dimension is sufficiency[65]. Sufficiency here is considered from the perspective of Max-Neef's (1991) notion of fundamental human needs for wellbeing[66]. As sufficiency addresses the notion of wellbeing, then the concern is to think of the existential categories of being, doing, interacting and having for addressing the axiological categories of wellbeing (subsistence, protection, affection, understanding, participation, leisure, creation, identity, and freedom). In the precautionary dimension then, the concerns will be based on the context and specific to the situation of design. The predictability of outcomes based on generic indicators is not as valorized as the anticipative collective

65 As a reminder, the strategy of sufficiency is defined as the approach to design that seeks to address the most human needs by using the least material solutions. In this case it becomes a very pertinent strategy for architectural design. For example, cultural diversity, social invigoration of place, densification in order to build a tighter community (among many other concerns according to Max-Neef) are considered in this strategy.

66 *Appendix 1 - Wellbeing According to Max-Neef* of this document presents a basic explanation of Max-Neef's classification for wellbeing and how the existential categories can be used to address the axiological categories through social and cultural impetuses and not only through material artifacts.

approach to addressing uncertainty and risk. This is why the collective alternative generation and assessment approaches needed for a precautionary approach become complementary and to the predictable and reductive approaches of prevention.

These three dimensions of prudence comprise a system of complementary strategies, goals and values that may be useful for designers in a context of sustainability.

In the next section a reflection of why the precautionary principle is important for design is presented. This argument and justification is based on the exploration of the underlying theoretical basis of this principle. As a reminder, this principle has not been adopted in a context of design, but predominantly in a context of policy making. So, the justification is made from the perspective of a designer and its pertinence for the design project which includes conceptualization, evaluation and judgment.

WHY THE PRECAUTIONARY PRINCIPLE FOR DESIGN IN A CONTEXT OF SUSTAINABILITY?

MAIN BENEFITS

Based on the underlying theory supporting the precautionary principle presented in the previous sections, the main benefit it engenders is that it supports a more reflexive approach (in contrast to primarily an analytical approach), for conception, evaluation and judgment of design projects for sustainability. A precautionary approach loosens the constraints that a preventive approach to design provides (which confines the vision to disciplinary domains) by allowing the designers to reflect on the interdependencies amongst the various elements by opening up a dialogue amongst the team. Unlike current tools for assisting designers in a context of sustainability, such as LEED, which are primarily prescriptive for addressing sustainability, a precautionary approach is more in line with the uncertainty and instability of the designer's environment and context and therefore the results are more descriptive based on conversation.

Second, the design problem perspective is expanded when a precautionary approach is adopted. The space seeks to include the sub-systems necessary to help comprehend how a sustainable solution can be adopted and not only an eco-efficient performance-based solution. In addition, the system from which an understanding of the problem is sought is not a closed system. It is open and flexible based on the interrelations to the environment. If the system boundary must take into account the interrelationships of some element in the environment, then in this approach, it can be done. The system space is flexible enough to include the interactions with the environment in which the problem is embedded.

Third, a precautionary approach would ideally require a set of indicators to assess, not only product related elements, but an assessment of the way in which the assessment took place would help the design team understand how well it took into consideration the views of the stakeholders, or how they assimilated the considerations of the stakeholders in their own reflections. This set of indicators therefore represents a meta-evaluation of the design evaluation process. Here, a methodology that is based on norms is necessary, so that the evaluation of the indicators can be done through a deliberation among the stakeholders. The indicators need not be based on norms but on axiological perspectives. Therefore, the indicators, the stakeholders, and the level of participation necessary would be selected on a case-by-case approach – but the method would remain fixed.

Fourth, tools such as LCA or LEED are diagnostic and/or prescriptive. This has several implications: (1) the design resolution process adopts a linear problem-solving process; (2) the boundaries of the design problem are set early on; (3) the focus is optimization and efficiency; (4) they may constrain the imaginary space of the project to the indicators proposed, etc. This is somewhat disconnected from a design approach that is inherently constructivist, open and chaotic, therefore very different in its essence. Design is typically a heuristic process and such tools although helpful in understanding some elements, and so necessary, are insufficient for sustainable design. So the methods of evaluation adopted by tools such as LCA or RA present a gap.

And finally, complex design projects have far reaching cultural and social implications, in addition to their ecological implications, it is equally important to consider these when considering their sustainability. Designers have historically been concerned with all these considerations, but an over-emphasis on quantifiable sustainable tools may be compromising these complex considerations. As an example, an architecture project that is optimally ecological but banal in form and envelope and fails to provide the cultural impetus it had intended cannot be considered sustainable. How can cultural impetus be measured? How can social revitalization be assessed? This is where quantifiable tools may fall short for design projects.

MAIN LIMITS

There are limits associated with a precautionary approach to design in a context of sustainable development. *First*, it is a principle that is not easily operationalized because of its epistemic uncertainties. There is an aversion to addressing uncertainties of an epistemic nature (Dupuy & Grinbaum, 2005; Dupuy, 2002).

Second, design in a context of sustainability lies predominantly within a paradigm that is post-positivist. Members of a design team therefore often operate within a tight disciplinary frame to attain performance objectives, and if their work does cut across disciplines, it does this by adopting a multi-disciplinary approach – no understanding of the relationships amongst the disciplines, but instead, a compartmentalized understanding of the various disciplines. This renders the precautionary principle an idealist approach for sustainable design by advocates of such design methods.

Third, because of the plurality of views and visions that such an approach requires, it can be confrontational and adversarial, if proper methods for participation are not adopted. Each situation would have to be assessed for the most appropriate level of participation. So, in fact, this makes it difficult to rely on generalizations and in determining what level of precaution (and in turn, participation) should be adopted for a design problem, and which solutions can work anywhere.

Fourth, it is not always feasible to reach consensus, and is the reason why it is important to deliberate which level of participation affords the most promising results.

Finally, for the precautionary principle to be embedded within design projects, both organizational and social innovations are necessary. This is difficult since it requires fundamental changes in social and organizational structures and processes, as well as in human behavior.

A point of departure for this research was the realization that the status quo is no longer possible because of the current global crisis. It is necessary to move beyond a mode of analysis; into a mode of action for establishing solutions that are more integrative of the complexity of sustainable implications of projects. This implies that relying on scientific certainty alone for defining actions is insufficient, and that the consequences of not taking anticipative measures early enough could be irreversible. Such early and precautionary measures are the reason why the 1992 Rio Earth Summit adopted the *Rio Declaration on Environment and Development* containing Principle 15, the precautionary principle. The pertinence of this form of evaluation and innovation in a context of sustainable design is that decision makers will develop and exploit new areas of insight and influence through the cross-fertilization resulting from open dialogue.

PREVENTION AND PRECAUTION AS COMPLEMENTARY FORMS OF DESIGN INQUIRY

One of the most important aspects of using the precautionary principle is its catalytic capacity for generating alternative solutions (Tickner & Geiser, 2004). So, the focus is on the '*what can be*' and not only on the '*what is*' (Simon, 1996b; Schön, 1983), as is done using traditional preventive methods of evaluation. What this implies is that a reactive approach (prevention) must go hand in hand with a constructive one (precaution), where precaution becomes a catalyst for innovation (Bindé, 2000). In this sense, preventive and precautionary forms of inquiry are very different and may complement one another, particularly for design for sustainability. Table 5 on page 103 presents some of the main distinctions between design inquiry approaches that are founded on each of these principles (prevention and precaution).

TABLE 5: GENERAL DISTINCTION BETWEEN PREVENTIVE AND PRECAUTIONARY DESIGN INQUIRY APPROACHES (BASED ON, AMONG MANY OTHER AUTHORS: FISHER, 2008; VAN DER SLUIJS, 2007; WHITESIDE, 2006; BOUTINET, 2005; LARCENEUX & BOUTELET, 2005; LAVELLE, 2005; TALLACCHINI, 2005; PEEL, 2004; BYERS, 2001; EWALD, GOLLIER & SADELEER, 2001; SPECTOR, 2001; GUY & FARMER, 2000; KOURILSKY & VINEY, 2000; PULTAR, 2000; SANDIN, 1999; EWALD, 1996; JONAS, 1985; ARENDT, 1958)

	Preventive Approach for Sustainable Design Inquiry	**Precautionary Approach for Sustainable Design Inquiry**
Purpose of evaluation process	Optimization – regarding the improvement of designs - collecting evidence for optimization	Exploratory - regarding the transformation of practice and structures - generate diverging alternative solutions defying the status quo
Way the knowledge is constructed	Statistically	Socially (cooperatively)
Type of knowledge that will nourish process of inquiry	Known level of certainty of knowledge will be used to make decisions	Addressing uncertainty and contradictions nourish process
Types of uncertainty that can be addressed	Technical, methodological (data unavailability, method inadequacies)	Epistemological (indeterminate, incommensurable)
Type of repercussions addressed	Predictable, repeatable outcomes considered	Prospective intents, so the uncertainties are of epistemic nature and may be of a non-linear, non-substitutional, recursive nature.
Elements of concern (risks)	Resource and planet preservation, social-economic fairness, and cost-benefit analysis (normative and technical)	Ecological integrity, place identity and the individual, well-being, social cohesion, cultural and community life, transformative behaviour - (ethical, aesthetic and technical)
Type of inquiry	Sequential inquiry	Recursive co-learning taking place within team
Time frame/pace	Matches corporate pace	Matches nature's (civilization) pace
Consideration of space	Functional and flexible	Organic, fluid, context specific, tactile, sensory, pluralistic
Type of innovation sought	Technical innovation (efficiency – doing it right)	Technical, social, cultural, educational, and organizational innovation (ethical – doing the right thing)
Design strategy	Reduce energy, reduce social injustice, and reduce footprint, conservation of resources and environment and social structures	Express nature, contextual, living building/artefact, create identity, community and cultural revitalization, environmental regeneration
Worldview	Deterministic (causal effects) worldview	Complex (dynamic and interconnected) worldview
Methodology	Systematic thinking (using tools such as, LCA, SLCA, EIA, SIA, LEED, Ecological Footprint)	Systemic thinking and modeling (using approaches that are collective, exploratory, emancipatory, and therefore participatory decision processes

Therefore, when adopting the precautionary principle, decision makers must draw on a broader range of methods than are not reductive. In fact, the more the process of assessment or problem-solving is disconnected from the complex real world phenomena, the larger the extent of interrelationships within this complex problem which are ignored in developing alternatives (Whiteside, 2006; Morin, 2005; Voss & Kemp, 2005).

In a preventive design inquiry approach, the main purpose of the evaluation is for collecting evidence for optimization, whereas in a precautionary approach of design inquiry, the main purpose is exploration in an attempt to defy the status quo for transforming social or cultural practices. Consequently, this in turn implies that the knowledge in a preventive approach is statistically constructed, whereas in a precautionary approach it is socially constructed.

The types of design repercussions addressed in a preventive approach are predictable, repeatable outcomes. In a precautionary approach, the main purpose is to address uncertainties, so the repercussions are invented through a prospective approach for defining intentions of a project – a diametrically different approach for addressing uncertainty when compared to a preventive approach. In a preventive approach, the consideration of space is functional and flexible, whereas in a precautionary approach, it is considered as a tactile, sensorial, context specific organic space – as it seeks relevance in its proposal, and no only a solution based on the rigour of its analysis. In seeking this, a main difference between preventive and precautionary resides in the type of innovations sought – preventive seeks primarily technical innovations whereas precaution seeks innovations on a variety of domains: social, cultural, organizational, political, environmental, etc.

Prudence as a Model for a Participatory Judgment Process for Systems Design

If the precautionary principle is to be manifest within the evaluation and/or innovation frameworks of sustainable design projects, it is important to understand which theories are congruent with and can support such an implementation. Here, several methods, approaches or theories are presented. The suggestion is that each these approaches have a particular significance for design for sustainability based on an exploration of the precautionary principle and its theoretical foundation. An understanding of their compatibilities can provide a coherent view of this envisioned operationalization.

The next few sections will therefore present: (1) theory of communicative action; (2) participatory processes; (3) fourth generation evaluation and its relations to judgment; and (4) global and systemic worldview. These will be presented in light of their significance for design for sustainability. Theory of communicative action as defined by Habermas (1984) will be presented as a way to understand the communicative process in the participative design environments. Participatory processes reflect the collective approach to knowledge creation that is inherent in a precautionary approach to assessment. A few basic participatory models will be presented followed by some formats specific for design, such as the Integrated Design Process (IDP) and the design competition format. Fourth generation evaluation and its relationship to judgment reflect the need to move beyond positivist doctrines for evaluation in a context of design for sustainability. A global and systemic worldview becomes the underlying vision and approach regarding the way in which the knowledge for assessing and judging design projects in a context of sustainability will be created. An elaboration of the ways in which these theories can be combined for sustainable design practice and the benefits for the combined approach will conclude chapter.

The Theory of Communicative Action

For sustainable design, when varying views and visions among stakeholders must be considered and assimilated for the purpose of constructing a common view of the design problem, it is especially important that communication can take place in a context where there is no coercion. In particular it is essential that those in power, just like those without the power, will affect the final decision through the force of their arguments and not through the power of their (political, financial, etc.) positions. So a theory of communicative action that can address this form of communication must be considered, if a fair and just participatory process is sought for addressing sustainable design problems.

The theory of communicative action as developed by Habermas (1984) can be used as the main theoretical framework for understanding and evaluating the form of communication for design. This theory is compatible with the ways in which members of a design team should ideally interact during the process of evaluating or conceptualizing solutions. This theory represents an approach where participants can come to a shared understanding of the design problem through communication. Habermas (1984, p. 286) states that

> *"(...) participants are not primarily oriented to their own individual successes; they pursue their individual goals under the condition that they can harmonize their plans of action on the basis of common situation definitions."*

Habermas (1984, pp. 285-286) defines communicative action as a form of communication where *"the actions of the agents involved are coordinated not through egocentric calculations of success but through acts of reaching understanding."* In this perspective, communicative action is a two-sided communication amongst the members of a team, rather than a one-sided coercive form of communication.

In addition, according to Habermas (1984), the "ideal speech situation" is one where there is an absence of coercion and where influence is possible through the strongest argument and not the most powerful actor (based on wealth or political position). So an ideal speech situation is representative of a situation that is fair and just, and where the members of the design team are free to express their views. In addition, based on the strength of the arguments, these views will be seriously considered in the common definition of the design problem. So an ideal speech situation, as defined by Habermas, is essential when a design team must share, exchange and assimilate others' knowledge to construct a common view of the design problem. Habermas (1984) refers to this collective constructed view as 'common situation definition'.

Communicative action is also a teleological action since the individuals in such an approach seek to pursue their goals while harmonizing these with the common situation definitions. So it is also emancipatory. And since all teleological action is intent driven, then communicative action can be said to be related to Boutinet's (2005) definition of project.

The theory of communicative action then is an interesting lens from which to understand the interactions of design team members and assess where they rest within the ladder of participatory forms. Habermas claims that *"the negotiation of definitions of the situation is an essential element of the interpretive accomplishments required for communicative action"* (1984, p.286).

In addition, the outcome of communicative action rests on whether *"the participants can come to an agreement among themselves on an <u>inter-subjectively valid</u> appraisal of their relations to the world"* (Habermas, 1984, p.106, emphasis by Habermas). The idea of empowerment is inherent in this theory since the participants engage in processes of reaching common situation definitions through a reflection of their own intentions and worldviews.

The strength of Habermas's theory of communicative action lies in the fact that it prescribes a process for communicative action based on learning and deciding (Innes, 1995). His theory includes characteristics such as making sure that all major points of view are represented, creating conditions such that the force of the argument, and not the power of the individual, has the deciding power (Wilson & Boehland, 2005; Innes, 1995; Habermas, 1984).

According to Forester (1980), Habermas's theory can help a planning process, both practically and ethically, in terms of helping to reveal true alternatives, to encourage inquiry and learning, and for encouraging participation resulting in self-determination. It is a democratizing process (Forester, 1980), which is essential for planning practice.

Therefore, the theory of communicative action can help understand how the actions within a design team are established through the cooperative processes of communication. In particular, the process of evaluation adopted in design teams, in a context of sustainable development deals with complex inter-related issues, claims and concerns, of not only fields of knowledge (e.g. economic, environment and social), but professions as well (architects, engineers, water experts, lighting experts, etc.). These varying forms of knowledge have to be reconciled in order to arrive at a common situation definition.

Therefore this theory provides a basis for the participatory processes within the design team for arriving at a common situation definition under ideal speech situations. It is important to emphasize that community here does not only refer to local (regional) communities only, but rather, to any form of community, including the community of design, such as a design team.

In the next section, some basic models of participatory processes will be presented followed by a reflection of their main benefits and limitations for design.

Participatory Processes

There exist many models representing the levels of participation within groups. For example, Arnstein (1969) opened the discussion in the late 1960's with regards to the distribution of power for citizen participation. This author developed a ladder representing the various levels of participation and the associated citizen power. According to Arnstein (1969), there are three main categories of citizen involvement: nonparticipation, degrees of tokenism, and degrees of citizen power. As one moves up the ladder, effective forms of communication become increasingly important. In the upper-most section of this ladder, as participants have deciding power, participants must be able to build strong arguments and to express views clearly so that they can be understood and contribute to some form of agreement.

Figure 13 presents an example of another participatory method, based on the means and the recommended ends (Cornwall, 1996). Cornwall claims that participatory methods are essential for opening up dialogue and facilitating co-learning, and bringing about critical awareness and self-confidence among the participants (Cornwall, 1996). Community participation is in fact a teleological activity since the process is oriented toward some intended collective understanding and action.

Mode of participation	Involvement of local people	Relationship of research and action to local people
Cooption	token; representatives are chosen, but no real input or power	on
Compliance	tasks are assigned, with incentives; outsiders decide agenda and direct the process	for
Consultation	local opinions asked, outsiders analyse and decided on a course of action	for/with
Cooperation	local people work together with outsiders to determine priorities, responsibility remains with outsiders for directing the process	with
Co-learning	local people and outsiders share their knowledge, to create new understanding, and work together to form action plans, with outsider facilitation	with/by
Collective action	local people set their own agenda and mobilize to carry it out, in the absence of outside initiators and facilitators	by

FIGURE 13: PARTICIPATORY METHODS: MEANS AND ENDS (SOURCE: CORNWALL, 1996, P.2).

In general, there are three main distinctions in most participatory models. First, there are the participatory methods where the participants are simply given information (one-sided communication). Second, there are methods where the participants are asked their views, but there are no guarantees that these views are considered in final decisions (two-sided communication but no collective knowledge construction). And finally, there are participatory methods where the participants exchange knowledge in an effort to build a common view of the issue (two-sided with collective knowledge construction). Struggles of power or coercion may affect the quality of knowledge exchange among participants, so it is infinitely important that the situation within which the communication occurs is fair and just. Finally, participatory approaches provide the framework to

> *“create new forms of knowledge through a creative synthesis of the different knowledges and experiences of those taking part” (Cornwall, 1996, p.2).*

In a general context then, participatory processes aim at constructing knowledge from varying disciplines with the aim towards a common view. This represents a teleological activity based on the diverging visions (potential uncertainties and contradictions) of the participating group.

In Cornwall's model (Figure 13, the participants are either local people, outsiders and/or facilitators, where local people often have the least power in the decision making process, and outsiders have the most. In other words, the outsiders are considered the experts and the local people are considered the lay-people.

Many authors have researched the benefits of participatory processes in design and development projects. For example, according to Sclove (1995), there are several reasons for a greater public participation in research, development and design:

- a larger number and more diverse range of participants increase the chance that someone will come up with a creative insight;
- a more diverse range of social needs and concerns are reflected in the design process;
- can provide enhanced opportunities for rich cross-fertilization of ideas;
- a broadened participation will allow an improved response from markets to the needs of everyone; not only the wealthy, but also the economically deprived.

Tickner and Geiser (2004) claim that, the benefits for public participation in assessing alternative solutions in a context of sustainable development are:

- those who may be adversely affected can provide potentially better solutions;
- will draw on a wide set of 'experts' and sources of experience;
- public becomes aware that environmental impacts are not inevitable, but that there are choices.

And according to Droz and Lavigne (2006), the benefits to stakeholder engagement for sustainable development projects are:

- generates negative outcomes, necessary so that the issues can be exposed;
- reveals under represented stakeholders;
- reveals lack of clarity or certitude of claims, issues or concerns;
- generates disputes and a more diverse range of knowledge and therefore becomes pertinent for social change.

There are various common threads among the range of benefits or usefulness of participatory approaches for planning or design projects in a context of sustainability, particularly where different issues are important for different contexts and therefore universal solutions are not appropriate or acceptable. Three main axes of benefits emerge:

1. Justification axis: The justification of a decision in a context of uncertainty, cannot be done in isolation, and therefore as a result will also shift the burden of the decision to the participating actors; a way to justify the decision. What may seem appropriate or acceptable to one person may not be to someone else, so a participatory process may help expose and address this.

2. Social co-learning axis: A participative approach allows actors to become aware; empowered to make choices with respect to the social, cultural, or environmental impacts of design projects within their communities, and in the process each one benefits from the knowledge and values of the other.

3. Generating alternatives axis: A broadened range of possible insights as a result of the various perspectives of the actors nourishes the creative process.

In contrast to the benefits presented regarding stakeholder participation, the main limitation of participatory processes for design is that public participation may not always be possible in the manner that involves all the citizens affected by a project. The primary reason is time and budget. Therefore, in some cases, participation of the variety of experts involved in the project may be sufficient to come to an acceptable judgment without the participation of non-experts. In other cases, a larger scope of stakeholders may be necessary.

For design, the IDP and the design competition format are two complementary participatory processes. The IDP is used in order to address the complexity of architectural projects adopting an integrated approach. The design competition format is used to select the best project among a jury of experts. Both can contribute to design for sustainability within a precautionary approach because of their potential of co-learning and collective decision making. In the next two sections, both these participatory processes will be described.

Participatory Processes for Design: The Integrated Design Process (IDP)

IDP is a relatively new approach to design. So the definitions of the IDP are varied (Busby, Perkins & Will, 2007a; Sustainability.Solutions.Group, 2007; Zimmerman, 2006; Hansen & Knudstrup, 2005; Larsson, 2004; Lôhnert, Dalkowski & Sutter, 2003). However, common threads exist.

One of the main differences between traditional design teams and IDP teams is their organizational structure. A conventional design team adopts a hierarchical organization, whereas an integrated design team adopts an interlinked team (Busby, Perkins & Will, 2007a). Because of the fundamental organizational differences between traditional and integrated design processes, the involvement of the stakeholders also differs significantly, as Figure 14 illustrates. In an IDP, the stakeholders of a design project are ideally involved throughout the design process. This is in contrast to traditional design processes, where each stakeholder works individually, so that the entire process is optimized.

In general, the IDP is based on the facilitation of dialogue among stakeholders who bring different insights to bear on complex issues in a design project (Zimmerman, 2006). It allows the issues to be exposed, and provides a space for dialogue among stakeholders so as to avoid irreversible decisions with incomplete information. The main characteristics of an IDP are (Zimmerman, 2006):

- Iterative
- Flexible
- Cooperative Approach
- Ongoing Learning
- Place-based
- Transdisciplinary
- Multi-stakeholder engagement
- Process and outcome driven

The benefits of adopting an IDP range from, project cost savings and high functioning of the design team because of the high collaborative approach, to a better understanding of the project by the various stakeholder groups (Busby, Perkins & Will, 2007a; Sustainability Solutions Group, 2007; Lôhnert, Dalkowski & Sutter, 2003). Consequently, the IDP is a flexible approach that can be applied to most types of design or decision making processes (Busby, Perkins & Will, 2007a).

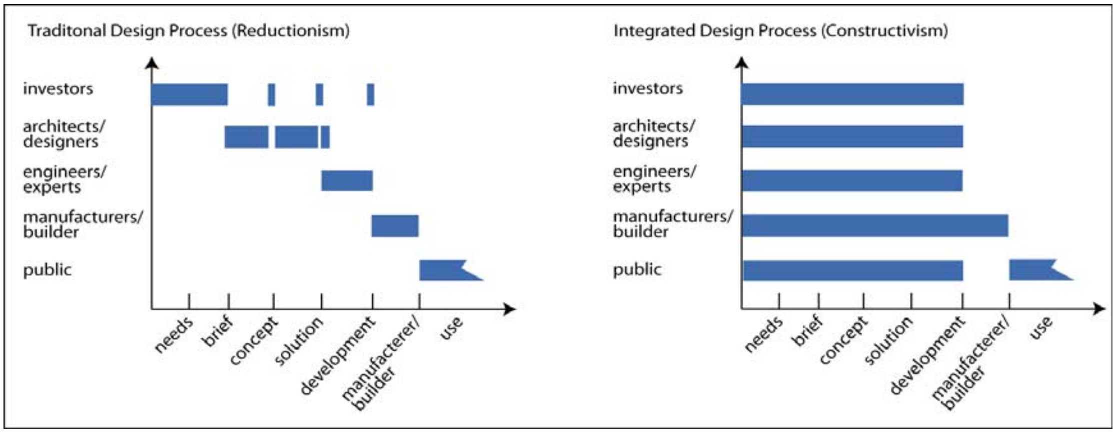

FIGURE 14: COMPARISON BETWEEN THE LEVEL OF INVOLVEMENT OF STAKEHOLDERS IN TRADITIONAL AND INTEGRATED DESIGN PROCESSES (BASED ON: BUSBY, PERKINS & WILL, 2007A; B; ZIMMERMAN, 2006; SYLVESTER-BRADLEY, 2003).

The IDP is a goal oriented (teleological) process, where the members of the design team are confronted with the same problem, but where the perspective of the problem is different for each member of the team. The result of an IDP is the construction of a common situation definition - as defined by Habermas (1984), ideally based on a process of communication as described by the ideal speech situation, through the process of co-learning and co-creation.

In fact, Van Der Ryn and Cowan (2007) claim that the most powerful technique available for sustainable design is an IDP since it brings together project participants and therefore presents a shift from compromise to collaboration.

Participatory Processes for Design: The Competition

The design competition format is a public conception and judgment process where the goal is to select the best project based on a set of criteria, objectives, constraints and opportunities among the proposal submitted (Strong, 1996). Therefore it is a public participatory process as it makes a public call for proposals and where the selection is made through a collective deliberation process (Strong, 1996). In addition, as the design competition format represents a space where a variety of potential ideas for design projects are proposed, it represents the privileged space for a precautionary approach for design for sustainability. The main reason for this is because alternative generation and assessment[67] are one of the main components of this approach to conception and evaluation.

The competition presents many benefits for the various stakeholders involved. For example, because of its public process, it seems appropriate for the development of public spaces or buildings, as it encourages the dissemination of knowledge regarding the planning of public spaces thorough its open call. Consequently, it has the benefit of not only generating numerous creative and innovative alternatives, but it may also help sensitize the public to the issues and concerns of the public project. However, for it to be a credible and respected public process, it must also provide an open space for debate and reflection on the technical, aesthetic and ethical directions of public space that is transparent and fair.

The design competition format is therefore an interesting approach for generating a wide set of alternatives, a fundamental component for a precautionary approach for design. In addition, as the selection of the best project is made collectively among experts, client representatives and at times, community representatives, it represents an approach of co-learning and co-creation, when the deliberation process is fair, open and transparent.

Participatory Processes and the Precautionary Principle

For both the IDP and the competition process, there is a need to articulate and interpret the multidimensional character of knowledge through the interaction of the subjects involved – to understand the diverse value systems, cultures, issues, and concerns. This represents a recursive process of assimilation of knowledge so that the capacity to act is reinforced by the new knowledge acquired through interaction (Dewey, 1980; 1933). This is where the inherent pragmatic nature of a constructivist paradigm lends itself to this research. The communicative interaction of the members of either, a design team in an

67 Kriebel, D., J. Tickner, et al. (2001) state that alternative generation and assessment are one of the four main components for the precautionary principle.

IDP or the jury in a competition process, will likely result in varying types of knowledge, and this is what Morin (1986) qualifies as the multi-dimensional character of knowledge.

With regards to design for sustainability, this interaction is primordial as the fundamental concerns of the design project must be considered in light of the four pillars of sustainability. However, a limitation of current methods for achieving sustainability in design projects is that there is an interest in technique. Technique is based in instrumental rationality and seeks formal knowledge with the goal of mastering the world around us. Yet, as progress in technological innovations increases (with seemingly beneficial outcomes), it seems that human capacity to understand the consequences of these innovations decreases (Ellul, 1987; Jonas, 1985; Arendt, 1958; Ellul, 1954). So, in order to decide on courses of action, it is important to combine, in a constructive hermeneutic cycle, both instrumental and its complementary, communicational rationality (Habermas, 1989; Morin, 1986) resulting in explanation and comprehension respectively. Here action recursively nourishes the conceptualization process inherent in explanation and comprehension (Gendron, 2001). Therefore, in an IDP just as in a jury process, both technical as well as communicative approaches can complement each other, where the theory of communicative action can be adopted to deal with instrumentality rationality.

Therefore, complementary to positivist and post-positivist scientific approaches, methods of rationality based on communicative action (explanation, comprehension, interpretation, assimilation and action) amongst members of the design team become fundamental for sustainable design practice. The theory of communicative action by Habermas (1989) may provide this complementary method of rationality which comprises practical and emancipatory forms of knowledge.

Consequently, if participatory processes as defined in this section are important for a precautionary approach to design in a context of sustainability, then the form of evaluation and the way in which a final judgment is reached must be able to accommodate the plurality of the values and visions of the participants, whether the participants are design team members or jury members. In the next section fourth generation evaluation, as defined by Guba and Lincoln (Guba & Lincoln, 1989) and how it relates to judgment and critique will be presented.

FOURTH GENERATION EVALUATION AND THE PRECAUTIONARY PRINCIPLE

This section is based on the seminal book by Guba and Lincoln, *Fourth Generation Evaluation*, published in 1989. Guba and Lincoln (1989) have defined four generations of evaluation. The intent of this book was to define an emergent approach to evaluation (FGE) that moves beyond mere *facts* to include a multitude of elements such as social, cultural, political, contextual and human (Guba & Lincoln, 1989).

In order to understand the purpose of fourth generation evaluation, it is important to briefly introduce the first three generations. First generation is measurement oriented. Here, the evaluator is technical and the instruments are quantitatively based. This approach valorized impartiality, accuracy and objectivity. Second generation evaluation is objective oriented. Here the evaluator described the strengths and weaknesses of an evaluand. Third generation evaluation is judgment oriented. The main question in this approach was whether the objectives were worthwhile, and not so much were the objectives achieved (Morse, 1994; Guba & Lincoln, 1989). The role of the evaluator was to render judgment on the basis of standards and models (Morse, 1994; Guba & Lincoln, 1989).

The main limitations of the first three generations of evaluations are: (1) a tendency towards managerialism (may be disempowering and unfair for the stakeholders); (2) a failure to accommodate value pluralism (there is only one perspective, that of the evaluator, and is seen as an objective perspective); and (3) are overcommitted to the positivist scientific paradigm of inquiry (the subjective values and visions of those involved in the evaluation cannot be integrated) (Guba & Lincoln, 1989). Fourth generation evaluation is negotiation oriented, and is meant to address the limitations of the first three generations.

A RESPONSIVE (ADAPTIVE) AND CONSTRUCTIVE (HERMENEUTIC) METHOD

Fourth generation evaluation represents a shift in epistemological positions, from a predominantly positivist to a constructivist paradigm (Morse, 1994; Guba & Lincoln, 1989). There are two main phases of a constructivist evaluation; discovery and assimilation. The discovery phase is the phase where the evaluator describes 'what is going on here' – meaning the process, program, person, etc. that is being evaluated. The assimilation phase is where the evaluator incorporates the new discoveries into his/her existing knowledge regarding the object to evaluate.

Fourth generation evaluation is based on three basic assumptions: ontological, epistemological and methodological (Guba & Lincoln, 1989). The basic ontological assumption is relativism – sense making that organizes experience so that it is comprehensible and explainable (Guba & Lincoln, 1989). There is no 'objective' truth in this ontology – only local and specific constructed realities. The epistemological assumption is transactional subjectivism (Guba & Lincoln, 1989). This refers to the fact that the realities are co-created and that truth is derived from the sense-meaning drawn from experiences based on the level of sophistication available to each of the individuals engaged (Guba & Lincoln, 1989). The methodological assumption is a hermeneutic/dialectical process. This refers to a process where each individual involved must first uncover and find meaning from each of the other presented perspectives, and then compare, contrast and confront each of these to define courses of action (Morse, 1994; Guba & Lincoln, 1989).

There is an interpretivist, emergent quality in this methodology (Huebner & Betts, 1999; Lehoux, Levy & Rodrigue, 1995; Guba & Lincoln, 1989). The main goal of such an evaluation approach is an understanding and reconstruction of plural views, aiming toward open-ended consensus and/or action (Guba & Lincoln, 1989).

One of the most important characteristics of fourth generation evaluation is its capacity to adopt courses of action based on the formulation of constructions. In particular, this represents an approach where the group of stakeholders sees the adequacy, the relevance and the continued modifiability of such actions. So the evaluations are more socially and politically sensitive (Guba & Lincoln, 1989).

This generation of evaluation methods can be seen to fall into what Trochin (2006) refers to as qualitative/anthropological models and participant-oriented models. Participant-oriented models underline the importance of the evaluation participants and the value of their knowledge, especially clients and users of the object to evaluate. Qualitative/anthropological models emphasize the significance of observation, the need to maintain the phenomenological aspect of the evaluation context, and the value of subjective human interpretation (Trochim, 2006).

The basic process of fourth generation evaluation can be defined as (Huebner & Betts, 1999; Guba & Lincoln, 1989): (1) the identification of stakeholders; (2) understanding and comprehending stakeholders' claims, issues and concerns about the construct of the problem to evaluate; and (3) seeking consensus among stakeholders via discussion, negotiation, and exchange. It is during the last phase where the opportunities for co-learning and co-creation arise.

It is important to emphasize that claims, concerns and issues reflect the particular circumstances, experiences and values of each stakeholder group (Guba & Lincoln, 1989). This complicates the evaluation process, yet as it may seem impractical, this represents FGE's greatest strength (Guba & Lincoln, 1989). The inquirers must iterate the variety of constructions (sense-making), analyse these constructions so that they are communicable to others, solicit critiques of the constructions from others, reiterate the constructions, reanalyse, and so on to consensus – or as close to consensus as can be managed (Guba & Lincoln, 1989). The result is co-learning, rapid change and if it does not lead to consensus, then at least exposes the conflicting ideas clearly.

Fourth generation evaluation is defined by Guba and Lincoln (1989) as a responsive and constructive evaluation method. *Responsive* refers to the fact that boundaries and parameters are not set *a priori*. Responsive evaluation determines parameters and boundaries through an interactive negotiated process that involves stakeholders and requires a considerable amount of time and resources. *Constructive* refers to the methodology employed in the evaluation. This can also be referred to as an interpretive or a hermeneutic methodology. So the new evaluation approach that Guba and Lincoln (1989) had proposed is based on a responsive mode of focusing and a constructivist mode of doing. A fourth generation evaluation can then be summarized as a (Guba & Lincoln, 1989, p.184):

> *"marriage of responsive focusing – using the claims, concerns and issues of stakeholders as the organizing elements – and constructivist methodology – aiming to develop judgment consensus among*

stakeholders who earlier held different, perhaps conflicting, emic constructions."

This form of evaluation is both educational and empowering. The claims, concerns and issues represent the core of the constructions for the common view.

In addition, a responsive evaluation approach not only seeks out different stakeholders, but stakeholders with different constructions of the claims, concerns and issues (Guba & Lincoln, 1989). A major task of the evaluator is to ensure that each group of stakeholders confront and deal with the constructions of all the others. As each group deals with the constructions posed by others, their own constructions evolve by becoming better informed in this process.

Therefore, the involvement of stakeholders requires more than just an identification of the claims, concerns and issues of each stakeholder group. The most important part of fourth generation evaluation is that each is required to confront and take account of the inputs from others. This is where the co-learning and co-creation takes place. Ideally consensus is sought, but is rarely possible. The conflicts that remain will require additional information; this is the evaluator's task to obtain. The evaluator then prepares the agenda for negotiation; the setting up and moderating a negotiation session (Guba & Lincoln, 1989). Here, conclusions and recommendations are made jointly amongst stakeholders. Outstanding items remain as points of contention, but at least each stakeholder is aware of the open conflicts and the position of each stakeholder regarding these.

Fourth Generation Evaluation and its Relation to Judgment and Critique

Before relating fourth generation evaluation to judgment and critique, it is important to understand the differences between evaluation and judgment, and distinguish the actions related to each. According to Guba and Lincoln (1989) evaluation refers to a form of inquiry whose focus is either some program, process, organization, or person and which results in the determination of its merit and/or worth. Evaluation is then the systematic acquisition and assessment of information to provide useful feedback about some object

(Trochim, 2006). According to Stake and Schwandt (2006) the main purpose of evaluating any program is to ascertain its quality by elaborating a judgment. It is based on a set of standards from which there is at least a benchmark to assess and make a comparison (Osborne, 1973). Judgment is the appraisal regarding the evaluation (merit and worth) of a program through a comparison of the findings and their interpretations against a set of one or more standards (Hurteau, Houle & Mongiat, 2009). In his 1933 book, How We Think, Dewey (p.119) defines the action of judging as:

> *"(…) the act of selecting and weighing the bearing of facts and suggestions as they present themselves, as well as of deciding whether the alleged facts are really facts and whether the idea used is a sound idea or merely a fancy".*

So, the main difference between evaluation and judgment is that evaluation focuses on analysis, whereas, judgment entails the synthesis and integration of evaluation results into a final value judgment (Dewey, 1933). In addition, according to Dewey (1933) there are three main features of judgment: (1) a controversy, consisting of opposite claims; (2) a process for defining and elaborating claims and of sifting through facts; and (3) a final decision, therefore arriving at closure – a consensus. A judgment therefore arises only when there are different meanings, rival interpretations, points of contention regarding some matter at stake - so when there is doubt and controversy (Dewey, 1933).

There are other ways of looking at evaluation, critique and judgment. Harold Osborne (1973) distinguishes between descriptive criticism and evaluative criticism, particularly for aesthetic judgment. Descriptive criticism seeks to critique the whole in contrast to the aggregated set of isolated criteria, whereas evaluative criticism is based on the fragmented and isolated set of criteria (Osborne, 1973). Descriptive criticism is then closer to a synthetic assessment, and is by definition qualitative. Whereas evaluative criticism can be seen to be an analytic assessment, that can be quantitative or technical depending on the set of criteria to evaluate.

In summary, evaluation is a form of analysis whereas judgment is critique and synthesis of a whole. Since fourth generation evaluation represents a form of evaluation based on negotiation, where the knowledge is collectively constructed and adopts a hermeneutic methodological approach, it is unlike traditional evaluation methods based on positivist doctrines that provide recommendations based on measurement. As fourth generation evaluation is negotiation based, it can be said to bridge the gap between the first three generation evaluation methods that adopt a positivist doctrine and the encompassing reflective activity of judgment. With regards to a design competition format, fourth generation evaluation is an activity that all jurors in a design competition engage in as they are in constant negotiation with others regarding the qualitative dimensions of the projects to judge.

In trying to relate fourth generation evaluation with the precautionary principle, it can be said that fourth generation evaluation characterizes an approach that allows the interrelationships of the claims, issues and concerns among the various participants in the evaluation to be made explicit through a collective co-learning process. This represents a global vision. In the next section, a description of a global and systemic vision will be presented.

Global and Systemic Vision for Design

According to Morin (2005; 1977), adopting a complex worldview does not disregard the deterministic approaches, but in fact welcomes the varying perspectives of the problem. This is the real strength of a complex worldview. This implies that both relevance (through rich discourse and synthesis) and rigour (through comparability and analysis) must be reconciled in the design process. A systems thinking approach allows designers to understand the relationships of the entities within the system, to each other, and to the whole (Morin, 2005; Le Moigne, 1999a; Durand, 1996; Morin, 1982; 1977). This approach to thinking about design and the evaluation and conception of possible solutions permits a comprehension of the unity of the system and how it is integrated based on this set of relationships (Morin, 2005; Pirotton, 2005; Nelson & Stolterman, 2003).

In fact, Nelson and Stolterman (2003) have introduced a systems approach for design where the designer can render explicit the interconnections between the system (of the project), its elements and its interrelationships through the use of grids. It represents an operational method for a systems approach for design that is based on intentional change. The grids proposed by these authors may seem prescriptive, but on the contrary, are an impetus for the designer to think in terms of interconnections and not in terms of indicators.

This systems approach to design is not only a documentation tool, but also a learning tool as the designer must reflect on how each of the elements within the system are interconnected. This is directly related to the concept by Le Moigne (1999a) called auto-eco-re-organization, where the process of organization regarding the organization of a project is a learning process.

A methodology based on hermeneutics, on the transformation of human perceptions along the way (recursive principle), on how the changing views of the stakeholders are adopted in the problem construction (hologrammic principle), and how the diverging views (dialogic principle) of the design problem are explored is a fertile approach for sustainable design. These (recursive, hologrammic and dialogic principles) are the essence of a global and systemic vision (Le Moigne, 2006; Morin, 2005; 1977).

The complexity of design problems based on these three principles can then be modelled and therefore help deliberate possible futures (Le Moigne, 1999a). Such an approach is inherently different from the traditional 'what is' approach (of rigorous analytic approaches), and shifts the thinking into a 'what can be' approach (Boutinet, 2005; Nelson & Stolterman, 2003; Simon, 1996b; Schön, 1983) – a teleological perspective.

This is why a paradigmatic framework that adopts the principles of recursivity, dialogic and hologrammic regarding the ways in which to construct and interpret the problem space and its solution, where the systems operate in an auto-eco-re-organizing approach, are important for designers and decision makers so that they can begin to question the direction of their projects.

Consequently, the systems design approach proposed by Nelson and Stolterman (2003) may appear as a checklist at first glance. However, the process of filling up each square in the grid with an understanding of the interconnections between the identified systems and subsystems and the varying types of inquiry proposed, is in and of itself a recursive process where the dialogical poles have to be considered and reconsidered (Figure 15). In other words, the recursive, hologrammic and dialogic principles as defined by le Moigne and Morin (Le Moigne, 2006; Morin, 2005; 1977), should be at the basis of the reflection when constructing these grids.

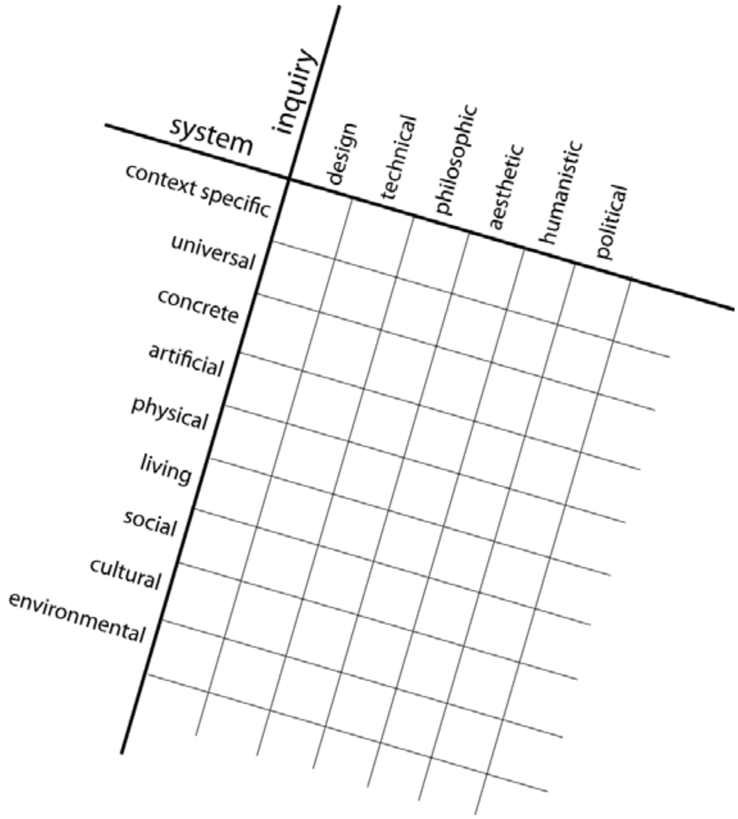

FIGURE 15: EXAMPLE OF A SYSTEMS DESIGN GRID BASED ON NELSON AND STOLTERMAN (2003).

Consequently, design tools to evaluate environmental impacts, such as LEED, help identify impacts using the perspective of one pillar of sustainable development without looking at the interface among the other pillars. If a global and systemic vision were adopted, then the interrelationships among the disciplines can be exposed. For example, if an element in the design problem has positive impacts in one pillar, and this same element may have negative impacts in another pillar, then by understanding the interrelationships, there is a better understanding of the problem from a broader perspective. And in addition, understanding the essence of the interrelationships among disciplines in turn enriches the knowledge within the disciplines themselves. A global and systemic approach may help reveal this phenomena, that otherwise would not be revealed when looking at the pillars individually.

As sustainable design is concerned with designing solutions that consider short, medium, long and very long term solutions (Madge, 1997), it becomes an explicit project of intentions – seeking the goal that current and future generations can meet their needs. However, much uncertainty lies in projecting future solutions. Therefore, a problem that designers face in a context of sustainable development is the uncertainty, doubt, and contradictions regarding the risks on humanity, society, on culture, and the environment (Adam, 2004; Jonas, 1985; Arendt, 1958). The acceptability of such risks is difficult to assess with traditional evaluation tools because these tools are based on international norms, which are useful in many contexts, but insufficient when dealing with epistemic uncertainties and context specific situations. At times, clients of design projects believe that fundamental uncertainties in their design projects are either considered outside the realm of their project or that time constraints may not allow a proper reflection (Korten, 2006; Cavanagh *et al.*, 2002; Orr, 2002). A global vision may help organize the views related to these uncertainties so that they can be exposed and deliberated.

Another advantage for adopting a global vision and systemic modeling is that it may help sensitize the stakeholders to an alternative mode of interpreting the visions of others (Lehoux, Levy & Rodrigue, 1995). The process of collaborative modelling of the various perspectives amongst a group of actors is an exercise that may help expose the arguments, help confront the diverging visions, and harmonize similar perspectives in order to plan courses of action that have been established in collaboration (Lehoux, Levy & Rodrigue, 1995).

A global and systemic vision and modeling can also be a fertile approach for formalizing the arguments and negotiations when adopting a fourth generation evaluation approach. Fourth generation evaluation lends itself as a privileged approach for the emancipation of diverging ideas, concerns, issues, and claims that the various actors within the project may have, which may allow the emergence of the controversies. Systemic modeling can become a form of representation of these and may allow a comprehension of the interrelationships of these. In addition, the disconnected nature of the understanding by each of the stakeholder groups can be improved through the modeling of the various perspectives and result in a more integrated vision of the claims, issues and concerns.

So, in trying to understand the issues related to sustainable design, the interests of the client and all its stakeholders must be comprehended. But who are these stakeholders? Who are the decision makers? What issues and claims are included in the problem definition? These questions represent critical boundary judgments (Midgley, 1997), and are based on critical systems heuristics. An important first element of any planning project is the definition of the boundaries (who and what is included/excluded and why) (Midgley, 1997) and are equally important considerations in fourth generation evaluation.

There are several other principles that must be seriously considered when establishing and assessing sustainable solutions within a global and systemic vision: the principle of incommensurability (of values and goals); the principle of non-reversibility (of effects); the principle of non-predictability; and the principle of non-substitutability (of natural or social resources) (Young & Tilley, 2006; Dyllick & Hockerts, 2002). These principles cannot be adequately dealt with using traditional evaluation approaches alone. So, complementing a traditional approach with a global and systemic vision may encourage a richer reflection than that of statistical predictability alone. So in essence, the specialist knowledge from each of the stakeholders can be contextualized within the broader knowledge of the product system.

Finally, in a systemic modelling process as described by Le Moigne, the criterions of inseparability and irreversibility are important to consider (Le Moigne, 2000). Inseparability allows us to consider the recursive relationships of the systems and within the system. Irreversibility will allow to consider the teleological behaviour of the complex and evolving system (Le Moigne, 2000). Here there is an attempt to intelligently elaborate and re-elaborate the system's projects and ends. Modelling presents itself as the most appropriate tool for studying the complex behaviour of the evolution of design projects (Morin, 2005; Le Moigne, 1999a; Morin, 1986). One of the reasons is because every modeling exercise is guided by a goal (Le Moigne, 2000), and this goal may evolve with every new understanding of the design problem.

To illustrate the significance of the use of systemic modeling for design, the example of system level innovation, where the artefact to design is just one element of a larger set of changes necessary so that the system can operate or function is useful. In this type of approach to design, not only material transformations must take place, but also social, organization, cultural and even political. These types of modifications are of a fundamental nature, where the repercussions are not easily understood and where a system level approach may help comprehend the wider scope of the changes necessary.

In summary, a global and systemic modelling approach is beneficial to comprehend and construct the design problem by adopting a complex worldview. Since design is an activity that is based on the ideas of 'what is', 'what should be' and 'what can be' (Bjorn *et al.*, 2005; Boutinet, 2005; Nelson & Stolterman, 2003; Simon, 1996b), designers and decision makers in a context of sustainability must consider (1) the multiple objectives and criteria; (2) the multiple users and user preferences; (3) the multiple concerns, issues, and claims; (4) the multiple design alternatives; (5) the complex changing perspective of the problem; (6) the complex changing global situation; and (7) the various disciplines embedded in a design problem. In this perspective, it cannot be based solely on functionality, material or form, but more fundamentally on a global and systemic vision that includes the cultural, social, environmental and economic issues and their interrelationships (Cucuzzella & De Coninck, 2008).

Systemic Modeling for Comprehending Complex Phenomena

Systemic modeling is based on the general theory of systems. The general theory of systems began to emerge slowly in the USA around the 50's. This initial systems theory was concerned with structural concepts, information, regulation, and totality – this was first generation systems thinking (Morin, 2005; Le Moigne, 1999a; Durand, 1996). A second generation systems thinking – referred to as systemic thinking – emerged during the 70's and 80's. This thinking integrated two other concepts, that of communication and autonomy, and that of auto-eco-re-organization (Morin, 2005; Le Moigne, 1999a), therefore including social and human sciences. At the basis of autonomy is the idea of open-systems by von Bertanlanffy (Morin, 2005; Durand, 1996).

There are various definitions of systems. Von Bertalanffy defines a system as a set of elements in mutual *interaction* (Durand, 1996). De Rosnay defines a system as a set of elements in *dynamic interaction*, organized in *function of a goal* (Durand, 1996). Edgar Morin defines a system as a *global unit* organized by the interactions among *elements*, *actions*, or *individuals* (Morin, 2005; Durand, 1996; Morin, 1986). They are all concerned with the elements within a set, the relationship among these elements and the dynamism of the system[68], but De Rosnay emphasises the notion of a goal.

Systems modeling can be used as the underlying conception tool for a systems design approach as proposed by Nelson and Stolterman (2003). In other words, in order to be able to fill up the systems grids to understand the interrelationships between the elements in a system, it may be helpful to sketch out the system using systems modeling techniques as described in the next few paragraphs.

There are four fundamental concepts related to systems. They are (1) interaction; (2) global thinking (or whole system thinking); (3) organization (structural and functional); and (4) complexity (Pirotton, 2005; Le Moigne, 1999a; Durand, 1996). A system can be described based on its structure, in which case it is defined by its: boundary, elements, network of relationships, and storage areas (for memory) (Pirotton, 2005; Durand, 1996). A system can also be described by its functional aspects. In this case the system is comprised of: the flow, the decision center, the feedback loops, and delays (Pirotton, 2005; Le Moigne, 1999a; Durand, 1996).

In addition, the idea of input and output materializes the relationship between the system and its environment. These relationships (to the system's exterior environment) can be numerous, in which case the system is considered open to its environment (Pirotton, 2005; Le Moigne, 1999a; Durand, 1996). When there are very few links to the outside environment, then the system is considered closed within itself (Pirotton, 2005; Durand, 1996). Consequently, a system is considered closed when it is isolated from its environment (Pirotton, 2005). In this case, the system reaches 'real' equilibrium (Pirotton, 2005). In the case of an open system, the system maintains a permanent exchange with its environment or other systems; it has a tendency towards a 'stable' equilibrium[69] (Pirotton, 2005). In this case, the system and its environment are mutually influenced (Pirotton, 2005). In fact, a system can be, at once, closed and open (Le Moigne, 1999a).

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68 This refers to the fact that the structure and their interrelationships may evolve, which is the qualifying difference between a systemic and a mechanist approach.

69 It is important to highlight that if the system remains closed for too long, it dies, representing the principle of entropy.

An open system permits the system to auto-produce (it transforms itself by assimilating the components of its environment), to have auto-references (to affirm its identity), to experience autonomy (by adapting to constantly changing conditions in its environment), and to have the power to auto-eco-re-organize (to evolve its internal constitution and its behaviour) (Morin, 2005; Le Moigne, 1999a; Durand, 1996). A systemic vision refers to a vision where knowledge is constructed through the action of systemic modeling – the modelling helps to understand the organization of the elements of the system, as well as the organization itself (the structure) (Le Moigne, 1999a).

Complex phenomena can then be comprehended through systemic and projective modeling (Le Moigne, 1999a). The exercise of systemic modeling can be thought of as "*at the same time, action of modeling and modeling of actions"* (Le Moigne, 1993, p.10). So it implies a theory of modeling, and not a theory of models (Le Moigne, 1993). Le Moigne suggests that systemic modeling does not claim to solve, but to help understand (1993). This is important for sustainable design, since systemic modeling can be used as a tool to comprehend the complexities of the design problems.

THE PRECAUTIONARY PRINCIPLE AS THE BASIS OF A THEORETICAL MODEL FOR DESIGN FOR SUSTAINABILITY

This research began with an interest to introduce the precautionary principle for design thinking for projects that have a focus on sustainability. Current preventive forms of design for sustainability although useful, are limiting, since they may constrain design thinking and inhibit innovation on a more global scale. This is the main reason why the precautionary principle was explored.

An elaboration of the theory underlying the precautionary principle allowed for a comprehension of its pertinence for design thinking. The ideas presented in this chapter provide both, the underlying theory of this principle as well as a basic toolkit for a precautionary approach for design for sustainability. Both these are included in the theoretical model founded on this principle. Consequently, as a result of the many comparisons and analysis of preventive and precautionary approaches for design inquiry, the existence of an epistemological barrier was revealed.

This chapter therefore concludes only a preliminary theoretical model of the precautionary principle for design. This model will be further developed in the next chapters. The way in which the theoretical model will be further developed is through the characterization of the epistemological barrier that exists between prevention and precaution for design thinking. In order to characterize this barrier, the gap between these two approaches must to be better understood for design thinking. This will be done by locating it within design thinking as defined by Schön (1983).

In addition, in order to further enrich this model, it will be studied through a concrete empirical situation. The next chapter will present this empirical situation. Specifically, the architectural competition will represent the participatory design situation and the environmental rating system LEED will represent the preventive tool adopted for sustainability. These will all be described in the next chapter.

CHAPTER THREE: PRUDENCE AND THE CHALLENGES OF JUDGING ARCHITECTURAL PROJECTS WHEN ADOPTING LEED FOR SUSTAINABILITY IN A CONTEXT OF COMPETITIONS

In the preceding chapters, design for sustainability was discussed. The concept of prudence and its relationship to current assessment and judgment approaches for design for sustainability was elaborated. The precautionary principle was the main focus, and was shown that its conceptual basis can be used as a theoretical model to address the gap between the Cartesian based evaluation methods used for assessing the environmental or social sustainability of design projects, and the creative space necessary for the process of design and its inherent uncertainty. In the preceding chapter, both the theoretical basis that comprises a precautionary approach to sustainable design and a basic toolkit of approaches in which such an approach may be manifest were explored. These were explored with the intent of complementing preventive approaches for design for sustainability. This exploration was a demonstration that current Cartesian based tools for assessing sustainability have limitations and that there is still much potential regarding the way in which tools can be integrated into design thinking so that they can encourage innovation in a transformative way, rather than inhibit innovation through a one-dimensional approach to innovation which is incremental, based on efficiency gains.

This chapter will begin with a presentation of architectural design in a context of sustainability. This cannot escape a reflection of prudence, particularly given the historical importance of prudence for architectural design. Then LEED will be presented as the modern standard for rating environmental sustainability for architecture. This will be followed by a description of architectural competitions and the difficulties encountered in the judgment process. This chapter will conclude with a presentation of the architectural competition as the privileged space for studying a precautionary approach for design thinking. The design thinking process will be deconstructed in order that the epistemological barrier may be located.

ARCHITECTURAL DESIGN IN A CONTEXT OF SUSTAINABILITY

Architects, as purveyors of change can play a major role in the pursuit towards a society that is more responsible towards their environment for both current and future generations. However, the paradox is that while architects have historically been concerned with the environment, society, culture and the economics regarding the impacts of their projects within a integrated project perspective, a plethora of quantitative methods have recently emerged (and still in their infancy) that address many of these concerns in a disjointed manner, but hold considerable weight regarding the judgment of projects. As pertinent as these standardized, quantifiable evaluation methods may be to help quantify the impacts of architectural projects, on their own, they represent fragmented realities and do not address the inter-related issues of sustainable architectural projects. It is not surprising that such methods have surfaced as increasingly significant yet controversial regarding the judgment of architectural projects, particularly in architectural competitions.

A CRITICAL APPROACH TO ARCHITECTURAL DESIGN FOR SUSTAINABILITY

A reflection on architectural design that is interesting for the context of the crisis of sustainability is that by Kenneth Frampton on critical regionalism (Frampton, 1985). In his article entitled Towards a Critical Regionalism: Six Points for an Architecture of Resistance, he claims that,

> *"Ever since the beginning of the Enlightenment, civilization has been primarily concerned with instrumental reason, while culture has addressed itself to the specifics of expression - to the realization of the being and the evolution of its collective psycho-social reality. Today civilization tends to be increasingly embroiled in a never-ending chain of 'means and ends' " (Frampton's emphasis, Frampton, 1985, p.17)*

Frampton borrows the idea of a 'never-ending' chain of means and ends from Hannah Arendt, from her book *The Human Condition, first published in 1958* (Arendt, 1998). According to Hannah, the means to arrive at some intended end will always remain means, however, ends, once they become ends, can no longer remain ends, but become part of a set of things that can be used as means to pursue some end. This is what she refers to as the never ending chain of means and ends. The only way to stop the chain is to say that something is 'an end in itself'. Consequently, ends also remain living entities which in themselves, as they are reused as means for some other end, may produce unintended consequences; the act of changing the world is put out there with the burden of irreversibility and unpredictability. This is what is referred to as the ecology of action.

It is in this perspective, that architecture can be seen to be the intent of a designer, and in its realization, remains a living entity, where its repercussions are irreversible and unpredictable. This is why the 'good' architect must act with prudence, just as Philibert de l'Orme had established as early as the sixteenth century (Chupin, 1990).

Frampton proposes the idea of arrière-garde as a way to address the problems that have faced architects since after the Enlightenment. He asserts that,

> *"Architecture can only be sustained today as a critical practice if it assumes an arrière-garde position, that is to say, one which distances itself equally from the Enlightenment myth of progress and from a reactionary, unrealistic impulse to return to the architectonic forms of the preindustrial past. A critical arrière-garde has to remove itself from both the optimization of advanced technology and the ever-present tendency to regress into nostalgic historicism or the glibly decorative. It is my contention that only an arrière-garde has the capacity to cultivate resistant, identity-giving culture while at the same time having discreet recourse to universal technique." (Frampton, 1985, p.20)*

Here we can see that the idea of arrière-garde is very much related to the idea of retrospectivity as elaborated by Chupin in his article entitled *Proactive, rétrospective, rétroactive (De l'anticipation critique en architecture)* (2009). He defines retrospectivity as a critical anticipative approach in architecture that is founded on a dialogue with memory[70]. In the arrière-garde approach that Frampton proposes, a dialogue with memory can be seen to exist in the way that the architect seeks to respect the social and cultural heritage of a site as well as the environmental specificities of the site and is why it

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70 The notion of retrospective as defined by jean-Pierre Chupin (2009), is contrasted to two other approaches in this article: proactive and retroactive. He defines proactive as an approach founded on invention and retroactive as an approach founded on a concrete utopia. These two (proactive and retroactive) do not represent what Frampton is seeking in his critical regionalism.

is considered as a retrospective mode of anticipation. Frampton concludes the article by stating that,

> *"Until recently, the received precepts of modern curatorial practice favored the exclusive use of artificial light in all galleries. It has perhaps been insufficiently recognized how this encapsulation tends to reduce the artwork to a commodity, since such an environment must conspire to render the work placeless." (Frampton, 1985, p.27)*

So the idea of placeless, or universality of a building is the antithesis of his approach. However, context specificity is one of many concerns for architecture built for sustainability. In fact, over and above the widespread concern of energy efficiency (as in the current preventive approaches to architecture), and site specificity (as in a critical regional approach to architecture), the link between ethic (the imperative to provide a better place to live for society) and poetics (the architect's desire for an eloquent place to live) is what true architecture is according to Pérez-Gómez (2006).

In fact, this tension that Pérez-Gómez (2006) alludes to is analogical to the tension that this research is addressing – the tension between design and evaluation tools represents in many ways the tension between poetics and ethics, where precaution is a dimension of a modern notion of prudence.

The exploration of the idea of modern notion of prudence has brought to light some of the tensions between creativity and normative evaluation approaches. Figure 12 on page 97 can be seen as a conceptual model for design approaches necessary in a context of sustainability where a set of possible tools in each dimension of prudence can be used to help reveal repercussions of design projects. Specifically, in the precautionary axe, the focus is on approaches that help reveal uncertainties and ambiguities (knowing that there are unknowns) of design projects. In its most basic form, a precautionary approach to design is represented by an anticipatory exploratory alternative scenario generation and judgment process that may include as one dimension of this process, a deductive risk analysis process based on statistically identified risks. The architectural competition process is a concrete example of such a participatory alternative assessment process. It represents a space for the deliberation of potential project proposals and is anticipatory in its approach to design.

The intent for the following section is to show that prudence has historically been a part of the architectural design process. The advent of Cartesian reasoning and its valorization in modern society has caused an imbalance in the way in which architects address design situations. The question that arises is: what are the impacts on design projects when architects adopt a heavy emphasis on universally accepted environmental evaluation tools and instrumental knowledge for conceptualization? How is creativity affected? How are social and cultural repercussions or concerns, which are difficult to quantify with any respectable level of certainty, addressed?

A Historical Perspective of Prudence in Architectural Design

As far back as Vitruvius in 20-30 B.C., treatises or sets of recommendations have sought to define the responsibilities of a good architect and the characteristics of good architecture. These criteria and recommendations were intended to help architects avoid pitfalls.

The idea of prudence, where the architect must tread with care in his work is not an idea that emerged in the 20th with the advent of the sustainability crisis, but instead has long been embedded in the architect's responsibilities (de l'Orme, 1567).

Vitruvius defined the architect as a person of many talents and a broad knowledge (Rowland & Howe, 1999). This is where he claimed that all architecture must be built with, utility, aesthetic, and structure[71]. Vitruvius's succinct classification of basic architectural values characterizes the essence of good architecture (Spector, 2001; Rowland & Howe, 1999).

Moving forward many centuries, during the renaissance, Leon Battista Alberti had a more philosophical approach with regards to these irreducible criteria for good architecture, compared to Vitruvius. He claimed that,

[71] This is one translation of Vitruvius's three irreducible criteria for architecture - firmitas, utilitas and venustas. There have been a variety of other translations of Vitruvius's terms. Wotton (1924) translates these terms as firmness, commodity and delight. Rowland and Howe (1999) use the terms soundness, utility and attractiveness in their 1999 publication. In 1914, Morgan translated these as durability, convenience and beauty (Vitruvius).

> *"For to build is a matter of necessity; to build conveniently is the product of necessity and utility; but to build something praised by the magnificent, yet not rejected by the frugal, is the province only of an artist of experience, wisdom, and thorough deliberation" (Alberti, 1988, p.315)*[72]

For Alberti, beauty was in part, an outcome of the careful and prudent consideration of use and structure. He claimed that the prudent architect would act in a way such that,

> *" (…) he would be forewarned and cautious in approaching the matter; he would study the strength and nature of the ground on which he was to build the house; he would learn from ancient buildings, as well as from indigenous practice and customs, what the climate is, and what materials – stone, sand, lime and timber, local or imported – would be capable of resisting the weather. (…) Although the prime concern of such precautions seems to be structure and use, they are almost all such that if ignored they will lead to considerable deformities" (Alberti, 1988, p.313)*

In fact, a little after Alberti, de l'Orme wrote a treatise for architects and builders that essentially represented an ethical foundation of architecture (Chupin, 1990). The idea of the prudent architect as elaborated by de l'Orme's *Premier Tome* (Chupin, 1996) is revelatory of concerns regarding the architect's virtuosity and ability of mature reflection and to reach sound judgment. According to Chupin (1996), de l'Orme's intention was to teach active prudence rather than to refrain action. In this Premier Tome, de l'Orme refers to architecture as the prudent gathering and beautiful assemblage of heavy stones (de l'Orme, 1567) – a balance between ethic (prudent gathering), technique (assemblage of heavy stones), and aesthetic (beautiful assemblage). For de l'Orme, the materiality and its spirituality were inseparable. This has changed since the end of the Middle Ages and after the Enlightenment.

It was during the Industrial Age that the emerging division of scientific fields brought on a separation of the architect and the engineer, particularly with the advent of new materials, technologies and inventions. The cultural and social aspects were the concern of the architect, whereas the technical aspects of the building were the concern of the engineer. Could the tensions between the technical and the aesthetic have originated at this time?

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72 The original title of Alberti's treatise is "De re aedificatoria", which he wrote in the middle of the fifteenth century.

At the beginning of the 20th century, modernism's precept was "form follows function"[73]. Here, buildings would be stripped of their tradition since their forms were purely a function of their utility. So the moral fabric of modernism was utilitarianism, since the design decisions were made rationally, where art and utility were intertwined. In fact, in his article entitled, "Modernity – An Incomplete Project", Habermas (1985) claims that there are three main elements to modern culture, the cognitive-instrumental, the moral-practical, and the aesthetic-expressive, which are increasingly separated from each other in modern culture. According to Habermas (1985), it seems that the more these are rationalized and separated from each other for the sake of clarity and instrumentalization, the more difficult it becomes to address these as an integrated system of values for design. How are Habermas's three main elements of culture (cognitive-instrumental, moral-practical, and aesthetic-expressive) related to Vitruvius' three irreducible values (structure, utility and structure) for architects? In fact, these two sets can be considered analogous (Figure 16).

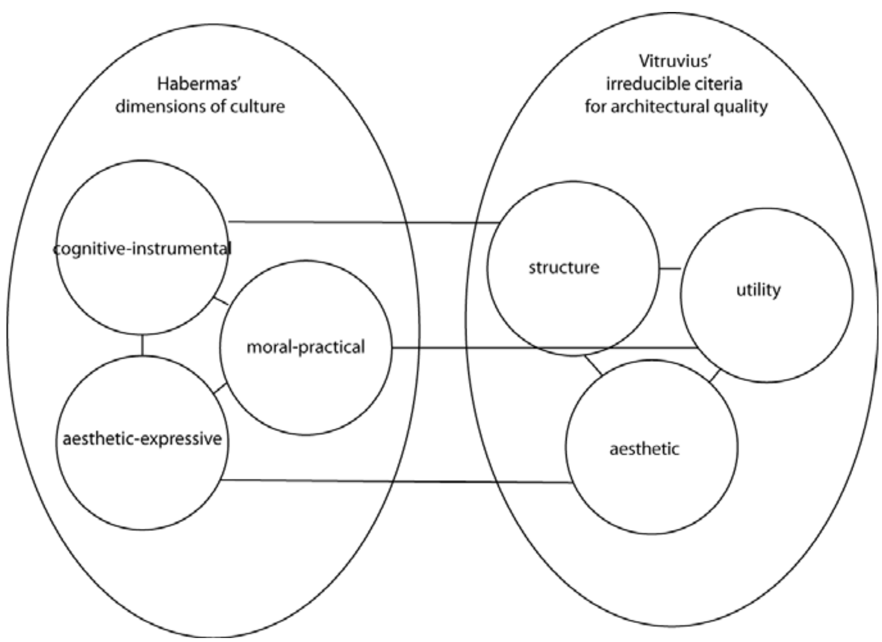

FIGURE 16; RELATIONSHIP BETWEEN VITRUVIUS' IRREDUCIBLE BASIC CRITERIA FOR ARCHITECTURE (STRUCTURE, AESTHETIC AND UTILITY) AND HABERMAS' DIMENSIONS OF CULTURE (COGNITIVE-INSTRUMENTAL, MORAL-PRACTICAL, AND AESTHETIC-EXPRESSIVE)

73 Louis Sullivan first stated "form ever follows function" in his article entitled, "The Tall Office Building Artistically Considered", (1896).

The way in which these are analogous is that the structure of an architectural project requires on the most part, cognitive-instrumental rationality; utility requires moral-practical rationality; and aesthetic requires an aesthetic-expressive form of thinking.

However, each of the cultural dimensions defined by Habermas, just as each of the irreducible criteria defined by Vitruvius have come under the control of specialists since modernism, and as a result, there is not only an ever increasing distance between these dimensions, but also between the experts and non-experts of culture.

The postmodernists later claimed that these three values of utility, structure and aesthetic were independent (Venturi, 1966). So these three irreducible criteria were no longer intertwined like Vitruvius suggested, but freed from each other. In fact, for the postmodernists, the aesthetic was completely separated from function and utility and therefore the way aesthetic was handled became increasingly problematic during this time, as the idea of complexity and contradiction resulted in juxtapositions of styles, so elements no longer fit the harmony of the entire project.

Today there is an even greater divide in architectural practice, as design is often separated from the project management, opening up to a further set on conflicts of values. Consequently, with the energy crisis of the 1970's and the sustainable development crisis in the 1980's taking hold, the doctrine of efficiency seems to have encompassed all other concerns, to the detriment of the irreducible architectural values as defined by Vitruvius.

CONTEMPORARY ISSUES, ETHICS AND THE ARCHITECT

It is therefore not evident how these irreducible criteria can be resolved in architectural projects, especially in a contemporary context of sustainability. This is because many concerns related to the contemporary context of sustainability require the use of new indicators that must be integrated into the design process and therefore must be reconciled with all the other considerations in the architectural project. It is important to emphasise that sustainability concerns – meaning the consideration of the social, cultural economic and environmental of the architectural project – have been concerns for architects for a long time. However, today, these concerns have been intrumentalized on the most part, changing the way in which architects and decision makers address these concerns within the architectural project.

How do architects make judgments? How can they prioritize, unify or ignore such value systems in order that the result is good architecture? One answer is through one's ethic. Yet, which system of ethics would be most appropriate to help the architect come to a sound judgment when resolving such a multitude of criteria?

First, as the problem of weighting various criteria is problematic, so the weighting of these three characteristics (based on a Vitruviun categorization) is not as simple as it may appear since these may represent contradictory intents (Spector, 2001). Second, the weighting is based on value systems; therefore a sense of ethics is introduced in the reflective thinking of an architect. A balance between design and ethics is now unavoidable, particularly since the interrelationship between the irreducible criteria of utility, structure and aesthetic has become increasingly disjointed. The Vitruvian definition of architectural values have stood the test of time (Spector, 2001), and even if the emerging sustainability crisis has shifted the focus to one of energy efficiency, this criteria cannot be the defining criteria of good architecture in the 21st century to the detriment of the aesthetic experience of a building, the usability of the building, the strength of the building nor the significance of urban form.

According to Spector (2001), good architecture cannot be defined as a function of an architect's preparation and moral fiber, but on the results of a building designed. It is important to note that there are three main approaches to addressing the conflict of values (Spector, 2001). First, the architects can decide to prioritize one of the values over the others, but this would lead to value pluralism, since not everyone would agree on the prioritization. A second approach would be the unity of values, much like Alberti (1988) has defined[74]. In fact for some scholars, beauty is the evidence of the good, while for others it represents the two sides of the same coin. A third approach would be the total

74 "Beauty is the reasoned harmony of all the parts within a body, so that nothing may be added, taken away, or altered, but for the worse. It is a great and holy matter; all our resources of skill and ingenuity will be taxed in achieving it; and rarely it is granted, even to Nature herself, to produce anything that is entirely complete and perfect in every respect" (Alberti, 1988, p.156).

withdrawal of any value conflict, as here the argument is that either of the other two approaches are engaged in a constant game of compromise. This is directly in contradiction to a humanist approach to architecture, where the effects of architecture on humankind are not considered; the focus instead is on creating the object itself (Spector, 2001). Here however, it seems then that the architect has reverted back to some kind of humanism since the creation of an object for the sake of creativity is in and of itself, a cultural good.

Spector (2001) has therefore suggested that moral philosophies or ethical approaches (Table 3 on page 91), can help provide a better understanding of how these tensions can be dealt with. A utilitarian ethics seeks to maximize the greatest good for the greatest number. However, this may present difficulties since there are situations where the architect must decide whether to choose a small benefit for the greatest number or a large benefit for the smallest number. Although this approach is suitable for transparency and rationalization of choices, it may force architects to give certain judgments an importance that would otherwise not be given. So, this approach has its difficulties. A deontological ethic (or one based on the Kantian imperatives) valorizes normative thinking, which may inhibit creativity and encourage the status quo. In addition it is important to consider the architect's intentions and motivations to help resolve value conflicts arising in design. For Spector, (2001) the way to resolve value conflicts in architectural design is a combination where (1) values are considered plural; (2) subjectivity based on one's opinion is important; and (3) intentions and motivations are important.

Comparing Spector's (2001) suggestion of adopting moral philosophies for addressing value conflict, with the notion of modern prudence as defined by Ewald (1996), it is interesting that a precautionary approach, also valorizes plurality, intentions, anticipative action and deliberation of opinion. The main difference is that the modern notion of prudence delves deeper in the need to bridge the gap between rigor and relevance, between validity and meaningfulness, between instrumentality and intuitiveness. In summary, the notion of prudence is already embedded in the architectural project.

The Architectural Project, Precaution and the Varying Modes of Anticipation

Conditions of anticipation represent the basis of architectural projects as the stakes are long-term and in many cases far-reaching. However, anticipation comes in many forms as Boutinet has emphasised in his book *Anthropologie du projet*, first published in 1990 (Boutinet, 2005). In fact, Ewald (1996) also makes a distinction among various modes of anticipative action, as the previous chapter highlighted. Table 6 categorizes the modes of anticipation based on Boutinet (2005).

TABLE 6: THE CHARACTERISTIC MODES OF ANTICIPATION (BASED ON: BOUTINET, 2005, P.59)

MODES OF ANTICIPATION		**FORMS OF ANTICIPATION**	**CONCEPTIONS LINKED TO ANTICIPATION**
ADAPTIVE	empirical	Foresight prevention	conjecture prediction
	scientific	forecast (or prevision)	conjecture/prediction
COGNITIVE	hidden	divination	prediction / destiny
	religious	prophetic	prediction / destined
	scientific or philosophical	prospective / futurology	conjecture
IMAGINARY	rational imaginary	utopia	in the future
	dreamlike imaginary	science-fiction	in the future
OPERATIONAL	rational	goal / objective / plan	to become
	deliberate intent	wish / promise	mixed
	fuzzy	project	to become

Anticipation or anticipative action is characterized by the fact that one must decide which course of action to take when faced with decisions or dilemmas in a situation. The possible courses of action are represented by an infinite set of potential options. This implicitly implies freedom of choice yet at the same time, responsibility of choice – both of which are important for architects and the projects they engage. As anticipation represents a decision to take now that will have future impacts, it is projective (Boutinet, 2005).

According to Boutinet (2005), the adaptive mode is characterized by the ability to identify probable consequences based on adjustment to current behaviour. The cognitive mode is characterized by a preoccupation to pierce the mystery of the future by conjuring all that the future can bring. The imaginary mode is characterized by taking the opposite of what currently exists and elaborating on what does not exist, but could exist in some distant future. And the operational mode is characterized by some personal future that the author of the anticipation seeks to bring about.

In addition, the foresight and forecasting forms both seek to anticipate the most probable future states of affairs, but where the horizon for forecasting is typically much longer. Both are meant to readjust current means in order to accommodate the possible future states. Preventive presents the ability to predict. Both prevention and foresight are similarly defined by Ewald (Ewald, Gollier & Sadeleer, 2001). However, Boutinet has not identified precaution as a mode of anticipation. Where can the precautionary form of anticipation fall within this categorization (Table 6)?

As was elaborated in the previous chapter, according to Ewald, precaution differs from prevention and foresight in that it is characterized by a very long-term vision and where the future consequences of adaptations (or actions) taken now are not known since the uncertainty is of an indeterminate nature. However, the future can be invented. Forecast, as defined by Boutinet, may correspond to precaution since there is no attempt to predict and where conjecture drives the anticipation. And in addition, forecast's time scale is much larger than foresight. So it represents a suitable model for a precautionary form of anticipation.

However, a precautionary approach may also correspond to Boutinet's definition of a cognitive (scientific or philosophical) mode of anticipation. In a cognitive mode, prospectivity and futurology are the main forms of anticipation. Many authors have claimed that prospectivity is a viable approach for conceptualizing the future within a precautionary approach (Gonod, 2009; Neuilly, 2008; Gonod, 2002; Stirling, 1999; Gonod, 1997). Therefore, in trying to situate precaution within Boutinet's table, both adaptive (forecast) and cognitive (scientific or philosophical) modes are compatible. So the project perspective as defined by Boutinet therefore represents a fitting epistemological framework for introducing the precautionary principle in the architectural design project in a context of sustainability, where its anticipatory form is somewhere between adaptive and cognitive.

Consequently, Chupin (2009), has also characterized anticipative variations, however, he has done this specifically for a critical approach to architectural projects – whereas Boutinet (2005) has proposed a characterization of anticipation based on the generic notion of the project. In Chupin's article entitled *Proactive, retrospective, retroactive (De l'anticipation critique en architecture)* (2009), he defines three types of anticipative forms – proactive, retrospective and retroactive. According to this author, proactive represents a crisis of innovation and invention. Retrospective represents a crisis of memory, so there is a dialogue with the memory of space. Retroactive represents a crisis of utopia. In trying to map these definitions to those of Boutinet (2005), proactive could correspond to an adaptive empirical form of anticipation (specifically prevention), retrospective does not clearly correspond to any of the categories by Boutinet (2005), since retrospective represents contemplation with the past, and retroactive can represent an imaginary rational form of anticipation. Reactivity, a mode of anticipation based on instinct or cause and effect, not mentioned by any of these authors (Boutinet, Chupin or Ewald), is not considered here, probably because the temporal horizon is much too short to be considered anticipative.

In an architectural design project, then anticipative modes represent a critical approach to the project, but where the project will ultimately differ depending on the mode of anticipation adopted. Specifically for an architectural project that is concerned with sustainability, then the modes of anticipation will directly affect the types of solutions proposed. Prudence, as defined by Ewald (1996) is therefore a relevant philosophical basis for the architectural project in the context of the current crisis of sustainability.

The North American norm for addressing sustainability (LEED) is the focus of this following subsection.

LEED: A MODERN NORM FOR RATING ENVIRONMENTAL SUSTAINABILITY FOR ARCHITECTURE

According to the Canada Green Building Council (CaGBC)[75],

> *"The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ encourages and accelerates global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria."*

The CaGBC advocates LEED as the way towards the global adoption of sustainable green buildings (Boecker *et al.*, 2009; Kilbert, 2008). LEED certification is intended to move towards the goal of achieving and demonstrating sustainability and is a North American standard for certifying green buildings.

The development of LEED began in the 1990's in the USA, where the pilot project of LEED version 1 was released in 1998. It is a North American norm adapted for Canada, the United States, Mexico, and parts of South America (specifically Brazil). The norms are developed for the context of each country, as the priorities for each varies. In 2004, Canada released LEED-NC[76] version 1.

LEED is a checklist of prescriptive indicators geared towards performance optimization, specifically in terms of energy technologies. There are 6 different types of LEED applications, each with a different focus (either commercial, residential, or neighbourhood) and therefore a different set of performance criteria and tools. For example, LEED-NC version 1 has 5 main areas of concern, with one area dedicated to innovation and design process. These 5 areas are: (1) sustainable site development, (2) water efficiency, (3) energy efficiency and atmosphere, (4) materials selection, and (5) indoor environmental quality – all are essentially performance criteria. For example, there are 17 credits dedicated to the Energy and Atmosphere category, with criteria such as:

75 More information can be found at URL= http://www.cagbc.org/leed/la_certification_leed/index.php

76 There are six categories of LEED norms: (1) LEED-NC for new construction; (2) LEED-EB for existing buildings; (3) LEED-CI for commercial interiors; (4) LEED-CS for core and shell; (5) LEED for HOMES; (6) LEED-ND for neighborhood development. More information regarding this norm can be found at http://www.cagbc.org/leed/what/index.php

optimization of energy performance, percentage of renewable energy used, CFC reduction, ozone protection, etc. There are 5 credits dedicated to the sphere concerned with innovation and design process and may be used for a variety of issues such as acoustic, education of occupants, etc. The new LEED-NC released in 2009 has added a category called "regional priority" to address some of the main concerns plaguing LEED, which are those related to site specificity.

In LEED Canada NC 1.0, the LEED category and version currently used for new public buildings, LEED is obtained with a minimum of 26-32 credits, LEED-silver with 33-38 credits, LEED Gold with 39-51 credits, and LEED Platinum with 52-70 credits. LEED Canada NC 2009 was just released in 2010, with a total of 110 credits and where LEED Gold requires a minimum of 60 credits. Although LEED Canada NC 2009 has just been released, LEED Canada NC 1.0 still remains the version most adopted for architectural competitions for now.

Many considerations fundamental to sustainable architectural projects cannot be considered when using LEED, such as many site specific concerns (even if the latest version of LEED-NC has started this reflection), community revitalization as a result of the new architecture project, social acceptability of alternatives proposed, concerns or issues of the various stakeholders of the project, aesthetic elements that may benefit the community's identity and the resulting landscape, etc. since, as mentioned, the focus is on energy efficiency, land disturbance, water efficiency, materials efficiency and indoor quality. This is why an extra category of Regional Priority was added to address some of the limits regarding site specificity from the older version.

A General Critique of LEED for Assessing Sustainability

One of the main concerns with LEED is that it is often used as the privileged tool to address the sustainability criteria of architectural projects. Most architects and decision makers are well aware of some of its main fall-backs, but continue to use this tool as it provides a perception of transparency in the decision process. One of the main problems with using LEED to address the sustainability criteria of projects is that it only focuses on environmental risks. However, sustainability is also concerned with social, cultural, and economic issues. How are these then considered in the architectural project? There are no current tools as prescriptive and systematic as LEED that may be used to assess the social and cultural issues of the project. How then are the various concerns, which are inherently integrated yet conceptually very different, addressed in the architectural project?

LEED is an example of a traditional approach for risk analysis – it allows the identification of a risk (through the prescriptive indicator) and the corresponding optimization to reduce risk occurrence. It is not a diagnostic tool, but a rating tool, where users collect points to reach a certain level of certification. Each of the indicators in the LEED rating system represents one point, which means that the weighting system is implicit. Each indicator is equal to all other indicators. This in itself is disconcerting since for all situations, for all regions, for all projects, all these indicators have equal importance, which seems unlikely since each situation is geographically and symbolically different. In addition, as the system is a binary rating system, it is ambiguous by definition, since there is no nuance regarding the level of attainment of an indicator. The indicator is either obtained or it is not. Given the effort and expense incurred to obtain any one of the indictors, it seems that a more graduated rating system would benefit the clarity of the results.

Uncertainties are dealt with statistically which is considered an advantage as it seeks to remain objective, even when uncertainties are very high. Yet results are often seen as the truth, where instead, the results of such an evaluation have to be considered in their true complexity – where the risks identified are potential risks and the level of uncertainty in the risk assessment may be high – which is often the case since this rating system lacks a great deal of nuance. In fact LEED may be considered as a “general” analysis.

However, LEED can help simplify a project into a simplified problem in order that a technical solution can be found, albeit, it may no longer address the original project, but a simplification of the original design situation.

An Epistemological Critique of LEED

Several authors argue that a reflective distance from deterministic-based evaluation methods is necessary (Harper & Stein, 1992; Jonas, 1985) to prevent tools like LEED from becoming the driving force of our future due to their authoritative presence in all aspects of decision-making (Ellul, 1987; Heidegger, 1977; Ellul, 1964). What tools like LEED provide is a means to democratize risks, in the sense that universal systems of indicators have been developed by national or international stakeholders with an interest in environmental building design. The problem with such democratized indicators is that they can become very abstract and sometimes far removed from the context in which they are to be applied (Guy & Moore, 2005a). These universal codes represent the values of their creators (on the most part an international set of stakeholders) and not the balanced value systems of a society within which they are adopted (Guy & Moore, 2005b). Such methods are simply an aggregated sum of a fragmented set of indicators, far from a representation of the complexity of the real world. Thus, attempts to conceptualize and judge an architectural project that seeks sustainability through a set of standard environmental indicators may have the effect that the complex reality of a design situation becomes fragmented. This could shift the focus of the qualitative dimensions of an architectural project to a set of quantitative indicators, possibly leading to a loss of coherence of the project.

So, the assessment of sustainable architecture based on LEED recommendations is limiting primarily because of the predominant utilitarian, technocratic approach to evaluation, which relies on a single predictable truth. This rigorous assessment approach imposed on the design process of architectural projects that require LEED certification may have an impact on the design process. For example, designers may get caught up in an optimization mode where the scope of the problem is then reduced to the set of universal context independent indicators far removed from the design situation at hand.

Although LEED helps evaluate the environmental sustainability of an architectural project at some level, using the set of indicators provided, an architectural project is not only a building seeking optimal performance, but also one that has existential significance (Fisher, 2008; Fox, 2000a; Harries, 1997). When judging an architectural project, then how can a designer or decision maker (i.e. a juror in an architectural competition) ensure that such a tool is given its fair weighting and does not overwhelm the design? In fact, according to Alberto Pérez-Gómez, in his book entitled, *Architecture and the Crisis of Modern Science*, he claims that,

> *'Although Cartesian dualism is no longer a viable philosophical model, faith in mathematics and logic as the only legitimate way of thinking is still commonplace. Decisions concerning planning or the establishment of new towns, for example, continue to be made on the basis of statistics. The immediate perception of the reality of quality of place is disregarded as a subjective interpretation of traditional urbanism.' (1983, pp.6-7)*

And so, the technical approach to design has had an effect on the way many decisions have been made, including that of architects. LEED represents another example of this statistical approach to decision making for design. It is not the LEED tool in itself that it the subject of this critique, but the way it is adopted in design projects and the relationship users have to its results. The implication of a predominant technological perspective of the architectural project is the cause for concern. Today many concerns regarding architectural projects are related to environmental sustainability, often reduced to technological innovations. The dominance of technology on the architectural project, has, as far back as 1954, been a concern for Jacques Ellul (1964). Regarding the technological society, this author has stated that,

> *"A house must be conceived less for the comfort of its occupants than for the accommodation of the numerous mechanical gadgets to be installed in it" (1964, p.327, published originally in French in 1954)*

So the tension between creativity and technique is not new. The implications of the technological society on architectural design have had far more reaching consequences. The problematic is that it is not only the technical gadgets that must be accommodated for in architectural projects, but on a more global perspective, it is the reliance that society has on technological gadgets, as well as the belief that technology can solve all problems, including that of the current crisis of sustainability. And on this point, Ellul claims that

> *"Technique, in the form of psychotechnique, aspires to take over the individual, that is, to transform the qualitative into the quantitative. It knows only two possible solutions: the transformation or annihilation of the qualitative" (Ellul, 1964, pp.286-287)*

And this can be attested to by the authoritative presence and strict reliance that society has on predictive tools (Dewey, 1930) – tools such as LCA or LEED. A quote from Hannah Arendt from the prologue of her book *The Human Condition*, confirms some of the problems that a strict adherence to a tool like LEED for sustainability may engender,

> *"If it should turn out to be true that knowledge (in the modern sense of know-how) and thought have parted company for good, then we would indeed become helpless slaves, not so much of our machines as of our know-how, thoughtless creatures at the mercy of every gadget which is technically possible, no matter how murderous it is." (Arendt, 1958, p.3)*

In fact, in this same book, in the chapter called *The Viva Activa and the Modern Age*, referring to Cartesian reasoning and society's diminishing capacity to reflect on the tyranny of mathematical knowledge, dominating even over the capacity of common-sense and intuition, she states that,

> *"Its highest ideal must therefore be mathematical knowledge as the modern age understands it, that is, not the knowledge of ideal forms given outside the mind but of forms produced by the mind which in this particular instance does not even need the simulation – or, rather, the irritation – of the senses by the objects other than itself." (Arendt, 1998, p.283)*

So common-sense, once the one from which all other senses were fitted into the common world, has retreated as an inner faculty without any world relationship (Arendt, 1998). Cartesian reason reigns to the detriment of common-sense reasoning – instead of a self-evident harmony, it is the proven result of some mathematical equation that is valorized above all.

Moving beyond LEED and the Need for the Precautionary Principle

Given the state of society's dependence on such instrumental tools, the tension that exists between the duty of environmental sustainability in the context of a world in crisis, and the duty of sustaining a diverse and stimulating cultural and social life must be reconciled.

What then can guide a design team or a judgment process to ensure that the sustainable intent is not funneled through technical solutions alone? How can the importance of the cultural and social dimensions of architectural design projects be upheld? The preventive approach to assessing the risks regarding the sustainability of a design project is reduced to one where there is an attempt to transform all qualitative into quantitative, so the projects are commensurable and may render comparability as efficient as possible. This aggravates the dilemma of the tyranny of quantification and reductionism. John Dewey in his book entitled *The Quest for Certainty, a Study of the Relation of Knowledge and Action*, first published in 1930, stated that,

> *"Men readily persuade themselves that they are devoted to intellectual certainty for its own sake. Actually they want it because of its bearing on safeguarding what they desire and esteem. The need for protection and prosperity in action created the need for warranting the validity of intellectual beliefs." (Dewey, 1930, pp.40-41)*

Dewey suggests that the certainty in which humans have attributed to quantified results is a way for them to be able to justify their own desires. Therefore, these quantified results then actually represent value systems and therefore are not as objective as they want to appear to be. Consequently, the certainties they attribute are only perceived certainties.

The question of values systems inherent in the activity of developing criteria/objectives for a design project, or in evaluating and judging design projects is an important consideration for design. It may help reveal assumptions and hypotheses hidden under cloaks of perceived objectivity.

There have been a few approaches for addressing these varying values systems for addressing the concerns of sustainability in architecture. For example, Guy and Farmer (2000) have elaborated six different green logics, each based on a different value system – an interesting deconstruction that may help to understand the different ways of thinking about the same issue. What is interesting about this approach is that they explicitly identify six different worldviews, and based on these, there are six different sets of criteria or objectives. These six different worldviews are: ecological, smart, aesthetic, symbolic, comfort, and community. Each of these six different logics is characterized by: ecological concerns, risk, design strategy, scale, space, mobility, evaluation, etc. In other words, each of the different logics has a different approach to addressing each of these issues. For example, in a symbolic perspective, the element that is at risk is the individual, the design strategy is contextual, the ethical concerns are identity, the sought mobility is pedestrian, etc. Here we can see that the logic of symbolism is rich in concerns regarding sustainability, of which tools like LEED cannot address.

The six competing logics identified by Guy and Farmer (2000) are a very different approach than Fisher (2008) who in his book entitled *"Architectural Design and Ethics*" he proposes a set of 14 design principles that may help the design community address the issues related to sustainable development. These 14 principles are intended to move away from the 'efficiency' mindset but without being prescriptive. So this book explores the idea of value systems from the basis of each of these principles. This set of 14 principles by Fisher (2008) are in some ways similar to the 10 principles identified by One Planet Living[77], which range from preventive based sustainability principles (i.e. making a building more energy efficient by striving for zero carbon) to more precautionary based sustainability principles (i.e. encouraging active, sociable and meaningful lives). Each of the 10 principles by One Planet Living is therefore based on different worldviews and therefore value systems. Another example of principles, the Hannover Principles as defined by William McDonough Architects are based on the idea that humans and nature must coexist (William McDonough Architects, 1992). Although these principles seek to emphasise the interrelationship between humans and nature, they fail to consider cultural issues related to the sustainability of the built environment. In addition, they do not suggest how these interrelationships may be understood. Van Der Ryn and Cowan's (2007) five principles of ecological design focus on the environmental pillar, however adopting a vision of contextual, passive, integrated design that has didactic elements for learning. Their approach however overlooks social, economic and cultural concerns. These are just a few examples of frameworks or tools used in a context of sustainable development each one adopting a varying set of value systems. LEED has its own value system based on performance optimization.

The precautionary principle is suggested as a response to the failures of the technical approach to risk assessment and design, particularly for sustainability. The main

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77 The set of these principles are defined on URL=http://www.oneplanetliving.org

characteristics of a precautionary approach to design[78] for sustainability are: a collaborative design environment; transparency in decision making; awareness that the ideas of others can greatly nourish one's own ideas; that cross-fertilization of ideas is fundamental; requires both reflective and reflexive thinking; rejecting a blind adherence to technique alone for addressing sustainability; awareness that the cultural element of design in a context of sustainability is often ignored and therefore this is a diminishing capital in our societies; awareness that universal strategies are not appropriate to all situations; awareness that we must move beyond measurement alone for the sustainable assessment of architectural projects; embracing a more intuitive thinking where uncertainty is valorized and not ignored; where context is of utmost importance; and where a global an systemic approach can help construct an understanding of the complex interrelationships of a design project.

In addition, in a context of sustainability, designers and decision makers consider (1) the multiple objectives, criteria and users; (2) the multiple concerns, issues and claims; (3) the multiple design alternatives; (4) the complex changing perspective of the problem; (5) the complex changing global situation; and (6) the various disciplines embedded in a design problem - and not only a score resulting from a universally accepted environmental evaluation tool (Cucuzzella, 2009b).

So the *relevance* of a project proposal is as important (or more) than its *performance*. It is important to emphasize here that although this may seem as a basic element for good architectural design, it may be overlooked because of a focus on LEED. A precautionary approach to design is in many ways a call for a return to the historical framework of prudence that has been the basis of an architect's responsibilities for many centuries.

In this sense, the architectural competition process is a pertinent concrete situation for the exploration of multiplicity and complexity, through the potential of the many projects proposed. From a methodological point of view, the competition process presents itself as a fertile field for observation and experimentation that is conducive to the comparison

78 A precautionary approach to design is a term developed in this thesis that signifies an approach to design in a context of sustainability based on the model and format elaborated and developed in the first chapter. It is founded on the philosophical basis of the precautionary principle as a way to address the failures of the Cartesian based approaches to addressing sustainability in design.

of the representations and their interpretations by the jury and therefore represents the concrete situation with which these tensions may be observed. In the next section, the architectural competition process will therefore be introduced.

The Architectural Competition and the Judgment Process

As far back as 1418, when Filippo Brunelleschi won the competition for the main Dome of the Santa Maria del Fiore Cathedral in Florence, architectural competitions were used as a way to select the best project and/or the best designer (King, 2000; Lipstadt, 1989). Brunelleschi's solution was brilliant, and remains a solution which does not cease to awe today. Since then, architectural competitions have continued to be used as a method to seek out the best designs.

The architectural competition has existed since antiquity, however, the development of competitions as a specific practice for the attribution of a master work for public or private projects as it is recognized today, can be situated at the beginning of the Italian Renaissance (Adamczyk, 2004; Lipstadt, 1989). The architectural competition is not the only form of architectural commissions - a variety of other formats exist for assigning architectural contracts. There can be a call for tender (public or private), a public private partnership arrangement, a private commission, a specific invitation for proposals, among others (Adamczyk, 2004; Strong, 1996).

According to Adamczyk (2004) the architectural competition, in its globality, represents a mode of action that is necessary for the renewal of architecture as a main constituent of culture. Consequently, its participatory nature allows the confrontation of ideas, of technical choices, of aesthetic tendencies, where it encourages the innovation of processes, products or uses (Adamczyk, 2004).

The Architectural Competition in Canada

The Royal Architectural Institute of Canada, established in 1907, defines an architectural competition as a method of, *"obtaining a design solution to a sponsor's requirements that relies on a process which is fair and equitable to all stakeholders"* (RAIC, 2007). The main purpose continues to be the selection of the best design and/or designer, where the award is either the production of the winning project or an award of recognition.

The competition can be manifest in a variety of formats: open, limited or invited. Any of these competition formats can have one or two phase selection process. An open competition is open to anyone, a limited competition restricts the competitors based on some criteria, and an invited competition is invitation only (the sponsor selects the competitors). The RAIC also defines endorsed and non-endorsed competitions, where endorsed implies that the competition is endorsed by the respective territorial association of architects. All RAIC endorsed competitions must have a professional advisor and a jury. The endorsement criterion is meant to promote fairness in the competition process. Invitation-only competitions are not endorsed by the RAIC.

The stakeholders in a competition process refer to the sponsor, the professional advisor, the jury, the technical committee, competitors, and the public. In a competition process, people from various disciplines and professions are brought together to first initiate the call, then to generate alternatives (public offering), then evaluate and render judgment on a series of architectural projects submitted by various competitors and finally to evaluate the judgment made (Adamczyk, 2004; Chupin *et al.*, 2004).

The construction of a design brief, containing the set of rules and regulations, as well as the sponsor's criteria and requirements is provided at the launch of a competition. This is the common document that all competitors work from to conceptualize their proposals and from which the jury elaborates the set of judgment criteria to help them select the winning project. The jury is a selected group that is defined at the time of the launch of the competition – in an effort to adhere to the transparency and fairness of this process. It is often made up of a group of architects and individuals from a variety of disciplines or professions.

THE CHALLENGES OF JUDGING ARCHITECTURAL PROJECTS

In an architectural competition, the challenges are numerous. Some related to the judgment process will be enumerated. A first challenge is the need to comprehend the complex nature of the many design projects, the elements that comprise each project, their inter-relationships, the possible implications of each of these based on their interdependencies – in essence the interpretation of the competitor proposals.

A second challenge is the knowledge that is constructed from the jury deliberation – the multiple interpretations of each project; the plural views and the validity of these views for each of the actors of the design competition, the value systems of each, who has the power to decide, how decisions are made, and why some issues and claims are ignored. Here, the challenge then is to understand the multiple interpretations among the jury members.

A third challenge is the need to manage or address the plural views of all the actors of the design project; what methods to use to comprehend these multiple views, what approaches are used to address the conflicts of interpretations, which arguments are retained, why are these considered the strongest arguments, what are the rhetorical elements of the strongest perceived arguments. So here, the challenge is to identify the tensions and conflicts of the multiple interpretations of each of the proposals.

Finally, the challenge to form a consensus that is based on a collective understanding, so that the winning project becomes a construction by the jury members and not a project selected by a vote or worst, a divided vote. So here, the challenge is to bridge the gap between the multiple interpretations, if possible, in order to reach a consensus for the winning project, as much as possible.

If the varied backgrounds of the jury members are meant to enrich the jury deliberation process, their lack of common worldviews may at times render the deliberation process coercive or unbalanced. What social, creative, argumentative or cognitive processes do the jury members adopt so that the process can remain transparent, fair and constructive? One of the difficulties in judging competitions resides in the language and worldview gaps that exist among the various stakeholders involved in competitions, and in particular between jury members and expert evaluators. These challenges are, on the most part, inter-dependant.

CONFLICTS BETWEEN ETIC AND EMIC CONSTRUCTIONS IN THE JURY DELIBERATION PROCESS

The jurors in a competition process are confronted with a variety of data and proposals, must address these with their own knowledge and experience in order to reach a synthetic judgment. This task is different to that which is conducted by the technical evaluators during the judgment process of an architectural competition. Expert evaluators are external to the jury process, but provide quantified information to the jury regarding a series of technical (structural, financial, environmental, etc.) evaluations.

The jury in an architectural competition must select a winning project among the competing projects by not only considering the various expert studies (evaluations), but also by integrating these with their own assessment of the projects and their own knowledge (rendering a judgment).

One of the difficulties may be that the recommendations by expert evaluators are highly valorized because they provide a sense of security in their quantified results (van der Sluijs, 2007; Dupuy & Grinbaum, 2005; Haag & Kaupenjohann, 2001; Dewey, 1930). Such quantified results can provide the cognitive certainty that the public can relate to, even if this only reflects a perceived sense of certainty (Dewey, 1930). Such quantified results may be adequate for arriving at a judgment when the focus of inquiry is relatively technical or utilitarian (Dewey, 1930), but when the focus of inquiry is a complex architectural project consisting of cultural, social, aesthetic, technical, environmental, and economic considerations, against a political backdrop, then technical considerations and therefore their evaluations are but one element of a larger set of elements to consider. Expert evaluators seem to provide the "warranty" of the best project through the validity of their measurable data – this represents an objective perspective of the project. John Dewey, states that,

> *"(…) no amount of pains and care in action can ensure complete certainty, certainty in knowledge was worshipped as a substitute. In minor matters, those that are relatively technical, professional, 'utilitarian', men continued to resort to improving their methods of operation in order to be surer of results. But in affairs of momentous value the requisite knowledge is hard to come by and the bettering of methods is a slow process to be realized only by co-operative endeavor of many persons." (Dewey, 1930, p.41)*

According to Habermas (1975), arguments based solely on objective perspectives satisfy only one of three criteria needed for a strong argument in an ideal speech situation; the other two being subjective and normative.

It is important to emphasize that emic (insider) constructions and tacit knowledge are important in the judgment process for architectural competitions. Tacit knowledge represents all that is known minus all that can be articulated (Guba & Lincoln, 1989). Positivists deem this type of knowledge as irrelevant because of its subjectivist nature and prefer to rely on etic (outsider) views only (Guba & Lincoln, 1989). Yet, architects depend on and acquire tacit knowledge through their daily work (Schön, 1983). The use of tacit knowledge is necessary if the possibility of reaching a more systemic and collective assessment of the projects is desired, without which such a judgment process would be constrained and would remain within a positivist approach (Guba & Lincoln, 1989). On the other hand, such tacit knowledge is considered as opaque data for evaluators using a positivist worldview (CETal, 2009; Trochim, 2006; Rowe & Frewer, 2000; Guba & Lincoln, 1989). The dichotomy between these two worldviews often presents tension in the jury process since jury members may be advocates of diverging schools of thought.

Expert evaluations are embedded in the search for certainty (essentially a perceived certainty), and cannot often deal with the discourse regarding architectural critique. This opens the question, should expert evaluators be allowed to be members of a jury? Would a LEED jury member place unwarranted bias on their own expert results (which are external to the jury deliberation) when constructing the judgment? And as the definition of sustainability is ambiguous, could it be that jury members also tend to overstate the guidelines provided by experts, since these seem to provide the desired certainty especially when there is so much ambiguity regarding the definition of sustainability or quality of architectural projects? In addition, evaluation criteria regarding sustainable aspects, specified in the competition program, may signify different things to different members of the evaluation committee or the jury. How is this handled in the jury deliberation process?

In summary, the technical experts perform evaluations of the various competing projects, whereas the jury members seek a judgment for selecting a winning project based on the a priori results of the various expert studies and their own background and knowledge. Although it may sound fairly straightforward, this process is quite complex because of the hidden assumptions in the planning, design and judgment phases of the competition process. This is why the results of competitions are occasionally called into question, more specifically, because: (1) the difficulty in setting the weighting of various expert evaluations within the greater context of the judgment process, (2) the difficulty in resolving the fact-value dichotomy, specifically when integrating the results of the expert evaluations (facts) into the final judgment (values); and (3) in forming a collective synthesis and understanding of the intended project. The tensions between the competing worldviews during the judgment process then represent important elements for a better understanding of the judgment process.

LEED for Addressing Environmental Sustainability in Architectural Competitions

In North America, the LEED standard has become the norm from which to judge green building design. However, LEED is often used in competitions as the privileged tool from which to assess sustainability in general, as in many competition brief, the criteria of sustainability is described completely in terms of LEED categories and indicators (for example, as defined in Saint-Laurent, 2009a; Ville de Québec, 2009b; Ville de Montréal, 2008a). At times, this may contribute to decisions where important criteria may be compromised because such heavy weighting is given to results of LEED evaluations.

Having said that, it is important to understand why LEED has become such a prevalent tool for architectural competitions seeking sustainability. One of the perceived strengths of the LEED rating system is that it is conducive to comparison and is one of the main reasons why it seems so easily adapted to the architectural competition process - since the basis of the competition is comparison.

However, it is not always so straightforward when it comes to comparing the projects because the strategies adopted by the various projects for obtaining the credits are often so different resulting in incomparable scenarios. So as much as LEED tries to be an ideal tool for comparing, difficulty arises even in its seemingly strongest point. In addition, imagine when these results must be used against the more qualitative based criteria of architectural aesthetic and the functionality of the project.

The Architectural Competition as a Privileged Space for a Precautionary Approach to Design for Sustainability

The theoretical framework underlying the precautionary principle was introduced in this research as the basis for addressing the gap (or more specifically, the tensions) between the instrumental and deterministic nature of universally accepted environmental evaluation tools and design thinking. The concern was that such tools may impeach the space for design exploration by forcing a narrow view of the design situation.

When an architectural competition adopts such an environmental evaluation tool to address the sustainability criteria, where the competitor proposals must attain a certain level of certification, and where the jury must evaluate these proposals in order to make some judgment, what can ensure that the judgment process remains open and exploratory so that the standardized quantitative nature of the environmental evaluation method does not burden the deliberation unfairly?

Summary of a Preventive and Precautionary Approach to Design Inquiry

The precautionary principle helps address the gap between scientific uncertainty and the need for action in policy making through public deliberation of such controversial scientific findings. When seeking to adopt the theoretical underpinnings of this principle for design thinking, how can it help bridge the gap between the use of quantitative environmental tools and design? Quantitative, universally accepted environmental and social assessment tools may provide a level of information to help decision making, but provide results with varying levels of uncertainty, provide a fragmentary picture of the problem, and may be too rigid in their recommendations to leave any exploratory space, and therefore in a context of design, a reflective distance of the results presented is recommended. In addition, the results provided are but a small picture of what the design situation entails and comprises.

Design thinking represents a much wider area of exploration (when compared to the recommendations provided by such environmental evaluation tools) with an imperative for action regarding a specific design situation. The precautionary principle, as one of the domains of prudence, can help open up the exploration when a limited preventive perspective is imposed on design thinking. One of the main purposes of this principle is to challenge the status quo. It represents a call for action when deterministic methods of evaluation on their own fail since they cannot provide a long-term perspective. The precautionary principle allows this to be exposed by and therefore opens a space for alternative assessment through participatory deliberation. In this sense, it fits directly in a mode of design thinking that is in search of conceptual leaps for moving forward in the search for alternatives to a given design situation. The architectural competition then becomes a privileged space for such public exploration and deliberation of issues, since the competition process is in itself an open participatory public space for deliberation of possibly conflicting potential solutions.

As a summary, the following are the main elements of this exploration. A precautionary approach to design thinking in a context of sustainability would ideally entail the following:

1. Addressing epistemological uncertainty in design projects since statistical methods of addressing uncertainties (methodological uncertainty) are inadequate for the type of projection and anticipative decision making necessary in design projects
2. Rests on the notion that alternative exploration and assessment are unavoidable for sustainability, in a sense where risk analysis is not reduced to the comparison of indicators, but to the comparison of intents

3. Adopting an approach to risk assessment and conception that is at once prospective and projective, where potential long-term alternatives are sought (integrated systemic solutions) instead of short term fixes (incremental technical optimizations) for addressing risks related to sustainability

4. Focuses on the contextual elements and relevance of a situation, and therefore questions the unchallenged adoption of universal norms and solutions

5. As the precautionary principle addresses those uncertainties that instrumental knowledge cannot deal with, it therefore cannot limit itself to the valorization of deterministic logic alone, but is also open to more analogical forms of thinking in order to explore alternatives

6. Encourages innovation through the cross fertilization of ideas and ways of thinking by adopting a collective exploration and deliberation approach for addressing public concerns and issues

7. Issues of project cut across various domains and require a consideration of technical, aesthetic and ethical foundations in an integrated manner - ensures that the social and cultural domains have not been ignored in the process

8. Open and transparent process of deliberative collective decision making

9. Burden of proof is shifted from client to decision makers

This research will address all but the last point from this list. By studying the judgment process in architectural competitions through a precautionary approach, some of the tensions that exist between design thinking and the adoption of such quantitative environmental evaluation tools may be revealed.

In Table 7, some examples of concerns for each of the pillars of sustainable development from either a preventive or precautionary perspective of design inquiry were presented. These examples are based on a four pillar definition of sustainable development, where the cultural pillar is equally important to all others. This fourth pillar is especially important in a context of public architectural projects that are intended to bring the community together, such as museums, libraries, train stations, cultural centers, etc. Table 7 is an illustrative list to show that concerns regarding sustainability cannot be easily enumerated and are in fact infinite. Sustainable strategies adopted by any design project are contextual and project specific, and therefore just like any other architectural criteria.

TABLE 7: EXAMPLES OF CONCERNS (OR QUESTIONS) WITHIN A PREVENTIVE AND PRECAUTIONARY PERSPECTIVE FOR ARCHITECTURAL DESIGN INQUIRY IN A CONTEXT OF SUSTAINABILITY

Spheres of Concerns → **Sustainable Inquiry Principles ↓**	**Economic** (addressing individual and organizational economic development)	**Environmental** (addressing resource depletion, environmental damages and environmental regeneration)	**Social** (addressing social coherence, participatory opportunities, community life and individual comfort)	**Cultural** (addressing symbolism and contextual significance and cultural diversity and cultural heritage)
Prevention (short to medium term optimization objectives)	**The green building as a form of organizational growth.** How can we make a profit with the building by making it efficient?	**The green building as a way to optimize performance while reducing impacts. *** How can we reduce the negative environmental impacts of the artifact?	**The green building as a way to increase local business opportunity (socio-economic).** How can we reduce the negative social repercussions for producing artifact?	**The green building seen as a way to increase local tourism (cultural-economic).** How can we increase the number of people visiting the building?
Precaution (medium to long-term urban renewal objectives)	**The architectural project as a form of organizational and community development.** How can our ecological strategy be economically fecund? Does the technology or product contribute to the economic development of the community or society and not only to the profit of the promoter?	**The architectural project as means for environmental regeneration.** How can we offset the negative environmental effects of the artifact? Are we sustaining not only our species but all species? How has the concern of biodiversity been addressed? Have passive or contextual solutions been used to address the environmental concerns?	**The architectural project as a means of social cohesion and equity, enhancing community life.** How can we ensure that the social and cultural repercussions for producing the artifact are equitable? Does it push personal limits beyond that which is acceptable? Does it contribute to the social regeneration of the community? Is the functional dimension flexible enough to ensure its longevity?	**The architectural project as a means for cultural impetus.** How can we ensure that the cultural diversity and the contextual significance of place are enriched? Does this artifact provide a cultural impetus for the community? Has the symbolic dimension been explored? How can we ensure a cultural longevity?

*LEED falls into this category, but does not cover the entire category.

It can be seen that such sustainability concerns for design inquiry can be infinite. Consequently, this list helps clarify the difference between preventive and precautionary concerns. It could be seen that their respective levels of engagement differ greatly. It is important to highlight that LEED indicators fall into the square that intersects prevention and environment, and therefore at best represent one eighth of the concerns of an architectural project in a context of sustainable development based on this perspective.

In this sense, a deeper concern for design when adopting standard environmental evaluation methods may be represented by the tensions between these two ways of thinking (preventive and precautionary). In essence, the precautionary principle for design helps challenge the strict use of universally accepted quantitative environmental evaluation tools such as LEED or LCA, allowing for a broader perspective of the design situation in a context of sustainability. So instead of the technical concerns alone driving the project, it is the architectural concerns that are put back into the driver's seat of the project. And in addition, the instrumental approach for designing or judging an architectural project is circumvented for a more collective participatory design or judgment process that is not only based on the instrumental, but also on intuition and reflection.

LEED, although limiting in a perspective of sustainable development on the whole, may help in the assessment of environmental performance of an architectural project. However, the earlier that LEED credits are calculated, the less certain the estimate is. So for a competition process, LEED credits are calculated, on the most part, right after the system-level design is complete Figure 17.

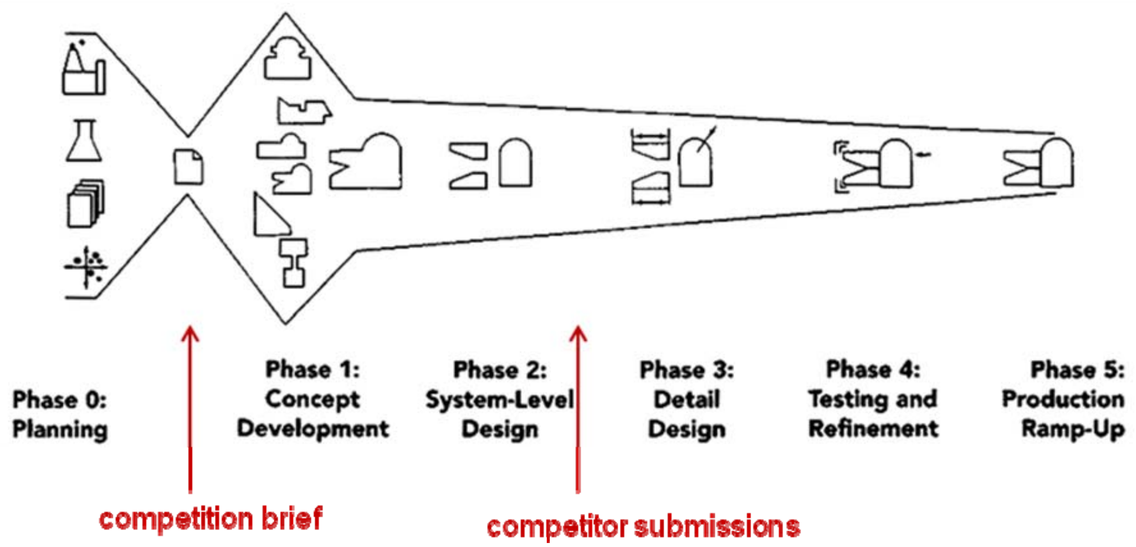

FIGURE 17: TRADITIONAL DESIGN PROCESS AND THE VARIOUS COMPETITION MILESTONES

Therefore, as LEED strategy development and evaluations for a competition are done fairly early, as shown in Figure 17, it is therefore likely that unforeseen problems may arise regarding the implementation of their proposals. This is why LEED evaluations are considered to be imprecise (or rough estimates) at this phase in the design project, and must be considered by the jury with a critical perspective. It can then be stated that the judgment process may be compromised if the jurors rely too heavily on the number of LEED credits to rate the sustainability of an architectural project in the context of a competition.

THE ARCHITECTURAL COMPETITION AS A COLLECTIVE ALTERNATIVE EXPLORATION AND ASSESSMENT PROCESS

As two of the most important elements for a precautionary approach to design are alternative exploration of potential solutions and their assessment within a collective deliberative environment, then the architectural competition presents itself as an ideal methodological environment for this approach.

The competition process is an ideal space for presenting a series of alternatives (which may address conflicting values) for a specific design situation. The call for proposals encourages the public to participate in the planning of public space by soliciting ideas from the public domain. It allows the exploration of various alternatives for their possibilities and potentialities through the jury deliberation process. The cross-fertilization of the multiple visions and worldviews, both from the competitor proposals and from the jury deliberation, is important for arriving at conceptual leaps. It is an open and transparent process where the deliberation of the alternatives proposed results in a collective, participatory approach for planning public space.

In fact, variations on the traditional competition format can encourage a wider space for deliberation of issues regarding the planning of public space. For example, a competition format with public input for the brief or a public process for the presentation of the finalist proposals constitutes an ideal format for a precautionary approach for the planning of public projects, since over and above the basic competition format, the views of the wider general public may also be considered.

However, in Canada, there are only a few examples of competitions where the public has been involved in either phase, as a research in the Canadian Competitions catalogue (ccc.umontreal.ca) indicates. For example, the competition for the NDG Cultural Center of 2010 had a public presentation of the finalist proposals the day before the 'closed door' jury process. Although the public's involvement was only silent observation, the diffusion of these projects, resulted in the dissemination of knowledge and a sensitization of the issues and concerns that each project entailed.

THE TENSIONS BETWEEN REFLECTION-IN-ACTION AND TECHNICAL RATIONALITY IN DESIGN THINKING AND THE ARCHITECTURAL COMPETITION

Bachelard in his 1934 book entitled *"Le Nouvel Esprit Scientifique"* recognized that the question of completeness is unavoidable when organizing our systems of thoughts. In fact, for this author, assessing whether or not a system is complete, can be done in a variety of ways, but has nothing to do with the simple enumeration of possibilities, since contemporary science does not enumerate, but theorizes (Bachelard, 1934). He suggests that in order to find opportunities to extend knowledge, that we should follow one or another avenue of dialectical development.

Consequently, according to Diani (1988) *"if the sciences of the artificial are opposed to the natural sciences, design is the scientific method to interpret and solve problems related to the architecture of complexity"* (p.7). In this sense, design can be thought of as a method that enables the comprehension and ultimately encourages the search for solutions to complex real world problems. The complexity of such problems has introduced the *"simultaneous presence of opposed, contradictory phenomena"* (Diani, 1988, p.6).

Both Bachelard (1934) and Diani (1988) identify the significance of either exploring dialectical avenues in order to arrive at a more comprehensive system of knowledge or in recognizing the presence of 'opposed contradictory phenomena' for addressing the complexity of real world problems. Although these ideas are not the same, they both indicate the existence of tensions through either dialectical thinking or through contradictory phenomena for arriving at an improved comprehension of systems of thought.

How does this relate to sustainable development and more specifically, design for sustainable development? In a context of sustainability, designers are often at the mercy of instrumental, quantitative tools that help identify problem areas, and where this information can help designers optimize their projects (a process based on the natural sciences). These tools are within a preventive risk assessment worldview. Consequently, these tools cannot help designers with concerns regarding the long term concerns, which however can be addressed by adopting the questioning based on the precautionary principle (for example the questions presented in Table 7). We can say that the questioning founded on the precautionary principle can help the designer reflect on the problem-setting (what Schön refers to as reflection-in-action), whereas the quantitative tools that a designer uses to help solve specific problems is based on Schön's technical rationality.

When tools like LEED, which are problem-solving tools, are imposed on the design process and given a level of importance such that the attainment of a certification level is a defining objective for project, then such tools may impeach the exploration during the design process by narrowing the problem to a set of fragmented indicators. This is where tensions begin to emerge between the problem-solving activities and the problem-setting activities.

According to Schön (1983), the problem-solving activity typically associated with a technical rationality is only a part of the larger activity of reflection-in-action which comprises problem-setting. However, when tools like LEED are given such prominence in architectural design competitions, then the relationship between problem-setting and problem-solving is no longer as that defined by Schön (1983). The question is: what is the relationship between problem-solving and problem-setting in such cases, and why does it become problematic?

Figure 18 presents a model where problem-solving and problem-setting are disconnected from one another, and where they each seek equal footing in design thinking. According to Schön, a reflective distance is necessary from technical rationality especially when the end or goal is not fixed. This is what reflection-in-action allows the designer to achieve – it allows the designer to construct the ends while considering varying means.

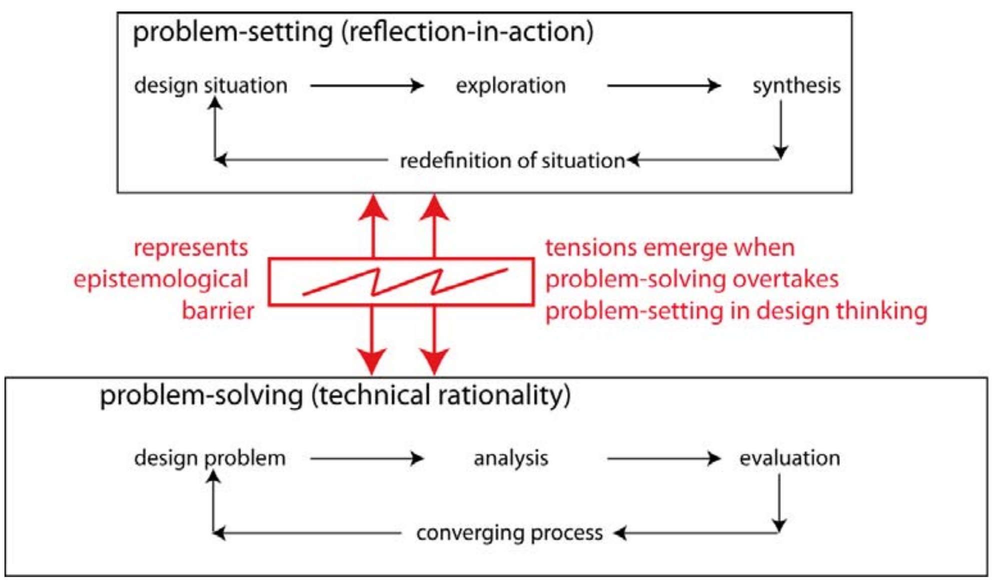

FIGURE 18: EMERGING TENSIONS BETWEEN CURRENT ENVIRONMENTAL EVALUATION METHODS ADOPTED FOR DESIGN (BASED IN PROBLEM-SOLVING) FOR SUSTAINABILITY AND THE EXPLORATORY SPACE DURING DESIGN THINKING (BASED IN PROBLEM-SETTING).

Figure 18 shows that the surfacing of tensions between the activities of problem-setting and problem-solving may occur when problem-solving becomes disjointed from the problem-setting-process activity of design thinking. The reason why tensions may appear in this case is because the problem-setting phase then struggles to maintain its dominant reflective position in design thinking and instead relinquishes its reflective space to the problem-solving space of the technical problems.

And therefore from an epistemological sense, problem-solving can be mapped onto a preventive form of design inquiry for a context of sustainability and problem-setting can be mapped onto a precautionary form of inquiry. In this case, Figure 18 can therefore also help understand the tensions between a preventive and a precautionary approach to architectural design and judgment for projects that adopt an objective of sustainability. These tensions therefore represent an epistemological barrier in design thinking, tensions that may be revealed when the use of standard tools like LEED are given an overwhelming weight in the design project.

The precautionary principle represents a way to critique the rational project of prevention for design for sustainability. Figure 19 presents an interpretation of the relationship between problem-solving and problem-setting as defined by Schön (1983).

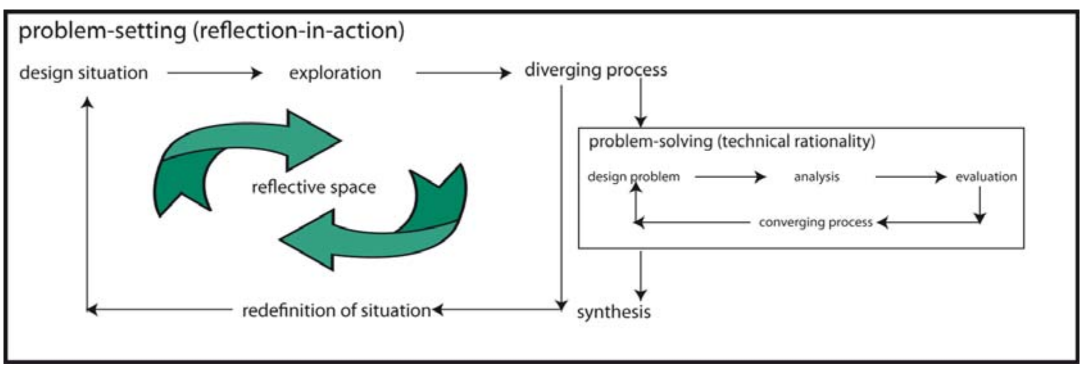

FIGURE 19: THE RELATIONSHIP BETWEEN REFLECTION-INACTION AND TECHNICAL RATIONALITY AS DEFINED BY SCHÖN (1983).

In an ideal jury deliberation, the jury seeks to construct a collective understanding of the winning project through a reflection of each of the qualities of each finalist project. This reflection may at times be nourished by information that is quantitative in nature, information collected by the expert committee, separate from the jury. The jurors take this quantitative information into their own understanding and consider if it may contribute to their final decision. This is similar to the process of reflection-in-action as defined by Schön. In this sense, we can say that a jury deliberation process can be modelled by reflection-in-action. If on the other hand, a LEED expert that may be on the jury tries replace the reflection-in-action activity by one that is dominated by a technical rationality, then tensions may arise. This is the focus of this research.

The model represented in Figure 18 is a starting point for a precautionary approach to evaluation and judgment of design projects in a context of sustainability. The next step is to understand and characterize these tensions that constitute the gap between problem-setting and problem-solving.

CHAPTER FOUR: OBSERVATIONS OF TENSIONS IN THE DESIGN AND JUDGMENT PROCESS OF ARCHITECTURAL COMPETITIONS ADOPTING LEED

The main objective of this research is to understand the gaps between standard environmental evaluation or rating tools (i.e. LEED) and design thinking through a reflection of the theoretical basis of the precautionary principle. In essence, it is seeking to understand the gap between preventive approaches to design and the more exploratory precautionary approaches, both within a context of sustainability.

The architectural competition serves as an empirical situation offering a basis for comparisons. Contrary to calls for public tender or public-private partnerships, the competition distinguishes itself through the competing proposals formulated in the form of a "project". Besides the technical, quantitative or budgetary data, these projects are judged on the basis of their intrinsic qualities, i.e. aesthetic, utility, structure[79]. This procedure is complex and is therefore not exempt from its problems, in particular in what concerns the judgment criteria and the qualitative evaluation of the projects.

The treatment of these cases contributes to the construction of a basic theoretical model that helps identify and categorize the gaps or even contradictions arising from the adoption of such quantitative tools in design practice thereby contributing to the knowledge of evaluation and judgment processes for design thinking in a context of sustainability.

79 The importance of these criteria for the architectural project was presented earlier in this chapter.

Framework for Observation and Analysis of Empirical Data

Let us return to the initial motivation of this thesis. The concern was that the increasing use of quantitative environmental evaluation tools for addressing the concerns related to sustainability has had many repercussions. One of which is that such tools are focused predominantly on the value of efficiency, and therefore for the most part, sustainable solutions are based on technological means. The concern is not only the tools themselves, which are a question for debate on their own, but the impacts that they have, in general on humanity, but more specifically, on design and its outcomes. This is where the focus of this research emerged. The philosophy of technology has been widely written by many authors[80], an important lens which will be used by this research seeks as a way to understand how such evaluation tools have impacted the design process, and more specifically, the judgment process in the context of architectural competitions.

This research is therefore not seeking to critique environmental sustainability evaluation tools such as LEED[81], even if such methods have intrinsic limits regarding their results and the sustainability impacts they can assess, as was mentioned previously. Such methods represent the fragmented abstractions of their creators, far removed from the complex concrete buildings that are eventually realized. Consequently, these essentially quantitative environmental evaluation tools, even if they may appear to be objective, are as value driven as any other more qualitative elements of sustainable evaluation (cultural concerns, social benefits, etc) since any vision of a sustainable building is a social construct (Guy & Moore, 2005a).

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80 As early as 1938, Bachelard (La formation de l'esprit scientifique) questioned the blind adherence to science. Since then, many other authors have reflected on the question of technology and humanity. Ellul in 1964 (The Technological Society) suggested the omnipresence of technology in the everyday, and humanity's incapacity to free itself from the technological world. In 1977, Heidegger (The Question Concerning Technology) did not seek to demonize technology, but instead to reveal its danger to humanity since, according to him, technology has the capacity to hinder human self-development, since purely technological ways of thinking may exclude activities of creation or interpretation of works of art. In 1985, Jonas (The Imperative of Responsibility: In Search of an Ethics for the Technological Age) stated that the heuristic of fear can help humanity escape the dangers that technology has brought with it. His predominantly utilitarian approach to addressing his nihilistic perspective of technology in contemporary society has allowed the precautionary principle to emerge as a promising approach to address the dangers that the predominance of technology has brought with it. These authors, among others, have sought to reflect on the philosophy of technology in contemporary society.

81 LEED (Leadership in Energy and Environmental Design) was described in Chapter 3 of this thesis, and a critique of LEED for assessing sustainability for architectural projects was presented in the sub-section entitled "LEED: a Modern Norm for Rating Environmental Sustainability" on page 141 of this thesis.

Why are universally accepted evaluation tools (i.e. LEED) considered to be socially constructed? The international stakeholders that build such tools form a community who collectively construct a vision of sustainability based on their proposed evaluation tool or method. Consequently, not only are such quantitative environmental evaluation tools social constructs, but they represent a fragmented reality of the real-world situation. Therefore, adding more indicators cannot help synthesise a real-worldview of the problem, since the results of a set of indicators represent an aggregated sum of a fragmented and disjointed set of indicators – which is not representative of the complexity in the real world, where issues and concerns are not in the form of a checklist (as LEED), but are interrelated and interdependent. This is the reason why the problematic of judgment introduced in this research for the context of sustainability, will not be addressed through an exploration of additional indicators or through the fine tuning of the evaluation procedure.

An understanding of the underlying values systems of the varying approaches for designing for sustainability and the ethical models they abide by represents another field of study important for design since this may contribute to a comprehension of how designers and decision makers prioritize or unify such value systems in a context of sustainable development. Some of this work has been already been undertaken by several authors (Fisher, 2008; Ekvall, Tillman & Molander, 2005; Harremoës, 2003; Spector, 2001; Pultar, 2000) in the field of design, and although there is still much work in this area, this will not be the focus of this research.

Instead the focus will be on the way in which such tools are used in design thinking. More specifically, the relationship that users have to such quantitative environmental evaluation tools, particularly competitors in a competition process and decision makers in a competition jury process. A reflection of the precautionary principle for assessing risk in contemporary design practice has led to the realization that there is a difficulty in moving beyond results of such quantitative methods in a context of sustainable development. Although the societal adherence to certainty and quantitative results has been theorized, this research will study the architectural judgment process within the competition process and seek to identify and categorize the tensions that exist between the adoption of quantitative environmental evaluation tools and design thinking - a process that is inherently exploratory, projective and concrete.

The main hypothesis is that *a precautionary approach to design inquiry in a context of sustainability may help bridge the gap between the exploratory, reflective nature of design thinking and the use of quantitative environmental evaluation tools increasingly imposed on the architectural competitions - an important concern as these tools have had an increased importance at the international level.*

As we have mentioned in the section entitled *"An Epistemological Critique of LEED*" of this thesis, the use of LEED for rating the environmental sustainability of architecture projects provide decision makers and designers a sense of security founded on the perceived certainty of data. If the results of such quantitative tools are given more weighting than other more traditional qualitative architectural criteria and modes of judgment, then contention may arise in the jury deliberation since the traditional reflective modes of judgment for architectural projects may be seen as too opaque.

In addition, designers often perceive the introduction of such quantitative environmental evaluation frameworks as an additional constraint to this creative space necessary for conceptualization (Ots, 2010; Pallasmaa, 1996), and therefore this research is seeking to model the tensions through a reflection of the theoretical basis of the precautionary principle. In the next section a description and justification of the research corpus and the sampling strategy is presented. It will be followed by the analysis model and finally the presentation of the collected data and a preliminary analysis of this data.

Research Corpus and Sampling Strategy

Architectural competitions provide empirical situations with a propensity for comparative studies (Chupin, 2004). They also provide excellent examples of projects that are at the crossroad between the architectural discipline and professional practice (Chupin, Bilodeau & Adamczyk, 2002). The main source for the corpus of this research will be the

Canadian Competitions Catalogue (CCC)[82]. This is a database of Canadian competitions and is available to the public through the internet. It is the most comprehensive database of Canadian Competitions in Canada in the world. It is used for both academic research and professional practice. To date, this database has documented 78 competitions, comprising over 2000 projects, with almost 10,000 publically accessible documents. The database has identified 197 competitions in Canada since 1946, but lack of available data from the organizers of the competitions limits their documentation. From these 197 competitions, 105 are from the province of Quebec, and from these, 46 are from Montreal. Therefore the province of Quebec represents an important geographical area for the study of competitions in Canada, and the CCC represents an important methodological resource for this thesis. The competitions will be selected from the geographical region of Quebec, where the type of project for the competitions selected will have both, a social and cultural significance for their communities, i.e. libraries, museums, cultural centers, planetariums, etc.

This research is seeking to study tensions between quantitative methods of evaluation for environmental sustainability and design thinking. The environmental system selected as the focus of this research is LEED, the North American standard for the certification of green buildings. LEED has become increasingly important in architectural competitions as a way to address the sustainability objective, even if it only addresses the environmental sustainability axe[83]. There are many reasons for this, one of which is that LEED seemingly eases the comparability of the competitor projects. It has become problematic not only for its limited benefit for addressing the sustainability of architectural projects, but also for its impact on the design process, and more specifically on the outcomes of architectural competitions.

The empirical field work will be based on a series of Canadian competitions for public buildings with strong cultural and social goals (such as museums, train stations, public

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82 The Canadian Competitions Catalogue (www.ccc.umontreal.ca) is the result of the archival and research work conducted by the Laboratoire d'étude de l'architecture potentielle (L.E.A.P). It is a database of competitions across Canada, dating back as far as 1946.

83 A review of competitions in the CCC (www.ccc.umontreal.ca), confirms that competitions of municipal projects launched in the province of Quebec after 2009 have a LEED requirement.

libraries, sports centers, cultural centers, etc.), specifically, competitions where LEED is defined as a main criterion for addressing the sustainability objective. As there are four LEED certifications (LEED Basic, LEED Silver, LEED Gold, and LEED Platinum), the intent is to select four competitions each requiring a different level of LEED. The hypothesis is that the level of certification may have implications on the way the results of the LEED evaluations are used by jury members in rendering a final judgment. It is important to emphasize that the use of LEED in competitions has been on the rise, but has only started to appear since 2008. Therefore the competitions that have adopted LEED are not many. There is no competition where LEED Silver was a requirement and for which the documents were available in this database of competitions (CCC). For this reason, only three competitions will be analyzed, each having a different level of LEED requirement – LEED Basic, LEED Gold, and LEED Platinum. The competitions that were selected for observation are identified in Table 8.

TABLE 8: LIST OF COMPETITIONS THAT WILL BE ANALYSED IN THIS RESEARCH

Name of Competition	Launch Date	Launched by City	LEED Certification Level
Montreal Planetarium	October 2008	City of Montreal	LEED Platinum
Musée national des beaux-arts du Québec	June 2009	Quebec City	LEED Basic
Saint-Laurent Library	September 2009	City of Montreal for the borough of Saint-Laurent	LEED Gold

All three projects are projects with an emphasis on community enhancement, both socially and culturally. In each case the LEED-NC version 1 was adopted. When the Planetarium competition was launched in 2008, the City of Montreal did not have a LEED policy. It was not until 2009, that a LEED policy for all Montreal municipal buildings took effect. So for the Saint-Laurent Library competition, this policy was in effect. Quebec City has had a policy since 2009 where all public buildings with a budget exceeding 2.5 million must be LEED certified.

EMPIRICAL DATA FOR ANALYSIS FROM CORPUS OF ARCHITECTURAL COMPETITIONS

In order to model these tensions for the competition process, a series of competition documents (which includes the visual and textual elements) will be analyzed. There are four main types of data in a competition process:

(1) promotional documentation and documentation provided to the competitors;

(2) the competitor projects (visual and textual presentations);

(3) documents related to evaluation; and

(4) media coverage and public reception of the competition.

These four categories are intimately related and are all necessary for understanding the interpretations of the projects as support to “design thinking” (Rowe, 1987). The first two inform the jury process, the third represents the results from the jury process, and the last one evaluates the jury process.

In this research, for each competition, all four types of documents will be analysed. However, the document related to media coverage and public reception will only be referred to, and not analysed in their entirety. The media coverage documents will be used to support arguments presented.

Qualitative techniques and methods will be adopted for the analysis, where the promotional documentation, the documentation provided to competitors, the documents related to evaluation, and the media coverage will entail a text analysis, and the design discourses of the competitor projects will entail a discourse analysis (hermeneutic). The analysis of the architectural projects include the texts, drawings and maquettes (De Biasi, 2000; 1990), where the image and the text constitute a pair that cannot be separated (Boudon, 2008; Chupin, 1998). Observations in jury deliberations, although a fundamental source of information for competitions as this may help in reconstituting the historical events of the competition process, will not be conducted in this study, as permission was either not granted (MNBAQ and Saint-Laurent Library) or the jury deliberation had already passed by the time the data collection process started (Montreal Planetarium)

Therefore, this research will focus on the argumentative logic constituting the justifying text and discourses of each of the actors (competitors and jurors predominantly). The set of these will be submitted to a comparative analysis.

RESEARCH PROTOCOL

In this section, the specifications of the particular tensions for design thinking and judgment will be presented. These tensions will be the main focus of both the empirical study and for the further development of the theoretical model of design thinking and judgment.

CONTEXT OF RESEARCH

Design represents an activity of intention for change, where reflective creativity must comprise a technical rationality so that considerations of production, norms, rules, budget, etc. are taken into account within the larger vision of the project (Boutinet, 2005; Schön, 1983). Among considerations that lie within technical rationality, the ongoing requirement for sustainability nowadays has major impacts on traditional design practices. Tools like LEED (formatted as checklists) may force designers to focus on the items within the checklist, thereby compromising their efforts and vision on the entire architectural project. Others feel that such methods provide a clear framework that is affordable and easily accessible[84].

Consequently, the use of quantitative environmental evaluation tools (i.e. LEED) has become increasingly prevalent in the architectural competition. Most new architectural competitions for municipal buildings launched in Quebec have a LEED component (a research in the www.ccc.umontreal.ca indicated this).

84 This is one of the benefits identified on the Canada Green Building Council web site - www.cagbc.org.

Confronting Quantitative Environmental Evaluation and Architectural Design

Quantitative methods for assessing environmental and social impacts of sustainable design projects may drown out the richness embedded in design problems by seeking to disjoint the varying forms of knowledge in an architectural judgment process. This is because the fragmented quantified indicators may result in a loss of perspective of the whole architectural project. In other words, the global view of the design problem may be compromised when adopting only traditional quantitative modes of evaluation for sustainability for architectural projects (Fisher, 2008; Guy & Moore, 2005c; Cole & Lorch, 2003; Fox, 2000a; Cole, 1998; Pallasmaa, 1996).

A study of the tensions between the instrumental approaches for addressing sustainability (i.e. LEED) and the exploratory space for fostering innovation within design thinking (i.e. the impact on the designers' work or on the jurors' process of deliberation) is the main objective of this research. The precautionary principle is adopted as a theoretical model and is the basis the epistemological framework regarding these tensions in a design project scenario[85], thereby contributing to the knowledge of evaluation and judgment processes for design thinking in a context of sustainability.

In Chapter 3, the questions in Table 7 on page 161 demonstrate the limits of LEED in evaluating the sustainability of a project. In this table, it was shown that LEED's extent of design inquiry for sustainability is limited to the preventive/environmental partition of Table 7. This table also illustrates that a more global perspective of the design situation in a context of sustainability is available through a precautionary approach to design inquiry.

Based on this demonstration, the general theoretical research question is*:* ***How can the theories underlying the precautionary principle facilitate a more global and integrated perspective and enhance the richness in the deliberation regarding the judgment of design projects in a context of sustainable design?***

85 This was discussed in Chapter 2.

IMPLICATIONS ON THE JUDGMENT PROCESS OF ARCHITECTURAL COMPETITIONS WHEN ADOPTING LEED

The main concern in this research is that in a context of architectural competitions, there may be an ever increasing conflict of worldviews in the judgment process when sustainability is introduced as an objective, because of the increasing significance given to quantitative environmental evaluations, such as LEED. The concern is that such standard rating tools may present increasing difficulties between exploration/innovation and evaluation/judgment[86]. This is a postulate constructed from a comparison of Schön's concepts of reflection-in-action and technical rationality, and the implication on design thinking when technical rationality is disjointed from the activity of reflection-in-action, as the figures in Chapter 3, Figure 18 and Figure 19 show.

In addition, as the LEED rating of competitor proposals in a competition context may not be as reliable as if the LEED rating was estimated at the end of the detailed design phase, as ideas are still in a conceptual phase in competitor proposals, uncertainty of the rating provided may be high. In this sense then, relying heavily on such estimates may be problematic. So a reflective distance may become necessary; otherwise society may fall into a mode where the authoritative presence and strict reliance on predictive tools (as LEED) will be the driving force of humanity's future instead of designers' intentions.

Therefore the general empirical research question is: ***Which basic qualitative architectural design criteria used by the jury to select the winning architectural project are overlooked when LEED is adopted as the main criterion for its sustainability dimension?*** The basic qualitative architectural design criteria will be categorized according the three irreducible qualities of aesthetic, utility and structure, as many architectural competition briefs adopt a general descriptive breakdown founded on these three basic concepts (www.ccc.umontreaal.ca).

In this research, sustainable architectural design is then studied from a critical perspective, where there is a constant awareness that the use of quantitative

86 (Dewey, 1980) states that criticism is judgment. He claims that an understanding of the judgment process is the first condition for theory about the nature of criticism.

environmental evaluation methods do not necessarily result in a more sustainable project – especially from the perspective where sustainability regards the four spheres of concerns of economical, environmental, social and cultural, from both a preventive and precautionary perspective (refer to Table 7 for an example of design questions using the four pillars of sustainable development from both a preventive and a precautionary form of inquiry).

So in the final interpretation of the judgment process, it would be interesting to understand the nature and level of difficulties in the judgment process based on a few concerns: the richness of deliberation; the globality of the analysis; the facilitation of comparability; and the contextual relevance of the proposals. This empirical question is intended to help understand and model the tensions resulting from the use of quantitative environmental evaluation methods in the context of architectural competitions.

Categories of Tensions based on the Theory of the Precautionary Principle

The theory underlying the preventive and precautionary principles already imbues a series of tensions, as was presented in Table 5, where the distinctions between prevention and precaution were identified. In fact, Salomon (1999) has stated that precaution allows the recognition of the limits of intelligence when predisposed to systematic and deterministic approaches of knowledge construction alone. The notion of tensions when pressed against the conceptual and methodological limitations of deterministic approaches is therefore an interesting space of observation. The objective is to categorize these tensions so that the impact of quantitative environmental evaluation tools on design thinking can be modelled.

In order to begin a categorization of tensions based on the theory underlying the precautionary principle, it is important to clarify what is meant by the word *tension*. In this thesis, tension refers to the dialectical relationship between two elements, which is representative of the coexistence of conflicting elements[87]. In other words, the need of the coexistence of two poles such that a recursive relationship between them may help either to arrive at a resolution or open up more questions.

Based on the theory underlying the precautionary principle - a principle that enables an awareness of the limitations of deterministic rational methods (as was described in the previous chapters) – we have identified a series of both theoretical and practical tensions. Theoretical tensions cannot easily be observed in the competition, but may be inferred through an observation of the practical tensions. This is why two general categories of tensions will be defined: theoretical and practical. Practical tensions can be observed through the architectural competition documents. Theoretical tensions will be inferred from the observed practical tensions. These two categories of tensions will be more fully described in the following sections. They are introduced here as two lists in order to provide a general view of the type of tensions that may be considered in this study. These lists are not exhaustive but are instead focused on the theoretical framework that underlies the precautionary principle and its importance to design.

Some basic elements of design thinking were used to identify the theoretical tensions – conceptualization, comparability, uncertainty and contextual relevance of proposals. As mentioned, this list is not meant to be exhaustive. The following is the list of the theoretical tensions important for this study:

1. between analogical/logical conceptualization
2. between epistemological/methodological uncertainty
3. between interpretive/analytic comparability
4. between universality/contextual relevance of proposal

In addition to these theoretical tensions, a series of practical tensions have also been identified. The categorizations of the practical tensions are based on three main ideas: (1) that LEED may be in conflict with the more traditional criteria of quality for architectural projects, i.e. aesthetic, utility and structure; (2) that the political climate or political

87 Morin (2005; 1986) has identified a logic in which he refers to as dialogic, where the relationship between elements is founded on antagonism, complementarity and competition, and is in many ways similar to the tensions that will be observed in this research.

pressure regarding certain requirements may present tensions that have an impact on the outcome of the competition; and (3) that there may be a general diverging assessment of specific dimensions of the project among actors related to sustainability. This list is also not meant to be exhaustive, but demonstrative for the purposes of this research. For this study the following practical tensions will be the focus:

1. Between political objectives/cultural repercussions
2. Between requirements in brief / context of site
3. Between environmental performance/quality of space
4. Between environmental performance/constructive choices
5. Between environmental performance / aesthetic quality
6. Diverging views: between jurors or between jurors and finalist proposals

The theoretical and practical tensions are closely interrelated (refer to Table 9 for a summary). For example, environmental performance of a project is assessed using quantitative methods, where the conceptualization will more than likely be an exercise of logics, rationally comparing various technologies in order to arrive at a solution perceived as most efficient. This is in tension with the inherent qualitative aspect of the space, and therefore in this example: the tension *environmental performance/quality of space* is interrelated to both the tensions of *interpretive/rational comparability* and *analogical/logical conceptualization*.

TABLE 9: SUMMARY OF TENSIONS BETWEEN QUANTITATIVE ENVIRONEMTAL EVALUATION TOOLS AND DESIGN THINKING

Practical → Tensions **Theoretical ↓ Tensions**	political objectives/ cultural repercussions	requirements in brief / context of site	environ performance/ quality of space	environ performance/ constructive choices	environ performance / aesthetic quality	Diverging views
analogical/logical conceptualization						
epistemological/ methodological uncertainty						
interpretive/ analytic comparability						
universality/ contextual relevance of proposal						

Table 9 will be used to identify the interrelationships between the theoretical and practical tensions after the analysis is complete. This categorization of tensions will be the basis of the empirical observations in the competitions. The empirical study may help to enrich the comprehension of the practical tensions by seeking to understand their theoretical basis by seeking to find their interrelationships. These two main categories of tensions represent some of the core concerns from a precautionary perspective of sustainability, both for policy making and design thinking.

TENSIONS FOUNDED ON A PRECAUTIONARY REFLECTION OF DESIGN FOR SUSTAINABILITY: A THEORETICAL PERSPECTIVE

The four theoretical tensions described in the next sections are based on a reflection of the precautionary principle for design thinking. These four tensions comprise a system as they are concerned with: conceptualization, comparability, uncertainty and contextual relevance. In other words, they are concerned with the integration of the processes of creation, evaluation/ judgment, projection/anticipation and relevance of proposals. Each of these has opposing and complementary poles that are important for design thinking in a context of sustainability.

TENSION BETWEEN ANALOGICAL / LOGICAL CONCEPTUALIZATION

The tension between analogical and logical conceptualization is based on three main books. First, the book by Edgar Morin (1986), entitled, *La méthode 3: la connaissance de la connaissance*, where he elaborates on the double play of knowledge as fundamental since it identifies the dialectical relationship (tension) between analogical and logical thinking for the construction of knowledge. The second book that nourished the identification of this tension is the book by Jean-Pierre Chupin (2010), entitled *Analogie et théorie en architecture, de la vie, de la ville et de la conception, même*, where in the third chapter he claims that analogy has not only had a heuristic function in the process of design research, but that it has also been used as a technique for creativity.

Finally, the book by Dewey (1933), *How We Think*, is important for understanding how the process of actual thinking[88] differs from strictly formal logic, a pragmatic perspective of knowledge construction that is fundamental for a precautionary approach to conceptualization.

This tension is characterized by, on the one end, the need to remain excessively logical, and on the other, the need to remain completely analogical. If arguments in design discourse remain strictly logical, important criteria may be overlooked because logical thinking engenders exploratory blinders by sterilizing the design or judgment process (Morin, 1986). However, if there is only analogical thinking in the arguments presented, without a logical understanding regarding their implications in the real (regarding scale, feasibility, etc), then the exploration will likely lead nowhere (Chupin, 2010; Morin, 1986). In this sense, each of these forms of argumentation and discourse can nourish each other, and this is one of the tensions of interest. Some of the dialectical elements that may be identified in the arguments or design discourse are: imagination versus verification; mythological (symbolic) versus empirical; thick versus thin concepts; macro-micro thinking versus linear; and exploration versus proof. These can all comprise elements in a tension that seek to resolve the logical with the analogical.

Tension between Epistemological / Methodological Uncertainty

According to Bindé (2000, p.54), in the absence of knowledge, it is power that determines duty, in other words, power over the power we currently exhibit over nature. Hans Jonas (1985) claimed that this power to act goes beyond the categorical Kantian imperative, and is born out of contemporary risk and uncertainty resulting from technological progress. In this perspective, the extension of power is therefore the extension of ethical responsibility (Bindé, 2000). What is necessary, according to this author, is that a cognitive shift occurs in the way we relate to the absence of knowledge.

88 Actual here does not refer to the idea of current but to the real act of thinking and not the notion of formal logic.

On this point, the tension between epistemological and methodological uncertainty, is founded on the idea that design, even if not in a context of sustainability, is projective, as it seeks to build a set of intentions through a process of reflectivity and intervention with the design situation (Boutinet, 2005) – and not just the design of an artefact[89]. The notion of project as defined by Boutinet (2005) has made this distinction, and with it, he has identified various forms of anticipative thinking, where the management or awareness of uncertainty is a main concern. In fact, both Arendt (1998) and Morin (2005) reflect on the idea that all action escapes original intentions, since once an action is put out in the world, there is no way that its repercussions can be controlled, and therefore uncertainty is at the basis of all action. This is what is referred to as the ecology of action, leading to a type of uncertainty that is indeterminate (also referred to as epistemological).

Methodological uncertainty, unlike indeterminate uncertainty (or epistemological uncertainty), refers to the inadequacy of tools or methods adopted, leading to data unavailability, and therefore a type of uncertainty that can be resolved with the fine tuning of methods. Such distinctions of uncertainty have been thoroughly elaborated in the literature related to the precautionary principle for policy making (Mayumi & Giampietro, 2006; Stirling, 2006; Whiteside, 2006; Harremoës, 2003; Haag & Kaupenjohann, 2001; Ewald, 1996; Funtowicz & Ravetz, 1994). These distinctions and definitions of uncertainty have been appropriated to enrich the understanding of this tension for design thinking.

This tension focuses on the uncertainty related to data or method deficiencies and the uncertainty related to anticipative projective thinking of the project. The discursive elements that will be identified here are related to arguments based on the certainty of the data, and how this may or may not push aside the more projective long-term arguments regarding the project. The tension between arguments based on the qualitative evaluation results and the exploration of the potential each of the projects - between the need to be pragmatic in the short-term and the need to project a vision into the future.

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89 The idea that design is projective was elaborated in Chapter 1.

Tension between Interpretive / Analytic Comparability

The tension identified between interpretive and analytic comparability is directly related to the difference between a preventive and a precautionary approach to risk assessment[90]. One of the purposes of traditional risk assessment is decision support, and may be made through either individual assessment or through comparison (Proske, 2008; Whiteside, 2006; Hofstetter *et al.*, 2002; Tukker, 2002; Stirling, 1999). The traditional preventive approaches to risk assessment are founded on the idea that in order to compare two different situations they must similar on some level in a measurable way, such that the analysis can be conducted fairly (Hofstetter *et al.*, 2002; Matthews, Lave & MacLean, 2002; Tukker, 2002). For example, in LCA, a comparison of environmental risks is based on the idea that the two product systems in the comparison have the identical 'functional unit'[91]. In fact, in many comparative LCAs, the social benefits related to the function of a product are often included in this quantified functional unit (Grießhammer *et al.*, 2006; Jolliet, Crettaz & Saadé, 2004). One can already imagine the difficulties in defining the quantified social benefits of such a functional unit, as it is the basis of comparison. How can the results of such a comparison be deemed reliable, when the very basis of the comparison is at times, questionable? For LEED, the list of indicators serve as a basis for direct comparison of solutions adopted. Here again, there is an inherent difficulty since the solutions adopted for each of the indicators may not be directly comparable. When comparing architectural projects, the idea of comparability is hardly ever separated into a set of clear and fragmented indicators as is done when using a tool such as LEED, which is based on an analytical form of comparison. Although a set of criteria may be used to form the basis of an architectural comparison, the idea of formal measurement and quantification is not often used for judging the architectural projects. Comparing the inherent qualitative elements of an architectural project often moves outside measurable comparability, into a mode of interpretation, far removed from quantification (for example, Fisher, 2008; Guy & Moore, 2005c; Spector, 2001; Fox, 2000a; Pérez-Gómez, 1983). This is the tension that is referred to in this category – the

90 The comparison between prevention and precaution was elaborated in Chapter 2.

91 A functional unit is a measurable (and therefore quantifiable) unit of function of a product. It is the "quantified performance of a product system for use as a reference unit" (ISO, 2006, p.4)

tension between the need to quantify as much as possible in order to seek as 'accurate' a comparative basis as possible, with the ability to understand the project's intents and compare them at an interpretive level.

The main concern in this tension is the difficulty that jurors may experience when trying to judge an architectural project when they are faced with a set of fragmented indicators which are becoming increasingly important within the political context. Therefore the concern is that the globality of the interpretation of the project[92] may be at peril. If the instrumental, quantitative approach to comparing the competing projects outweighs the intuitive, more qualitative arguments regarding the projects, the comparison and final judgment may essentially be made through an aggregated sum of indicators, a set of indicators that cannot be said to provide the entire picture of the project. The difficulty here is that LEED is the tool used to compare the sustainability objective of projects, where LEED indicators are often disjointed from the rest of the project criteria, not only in the proposal, but at times also in the judgment process, pushing the competitor or juror to an ever increasing disjointed perspective of the project, if a strict adherence to the LEED results is maintained.

Tension between Universal / Contextual Relevance of Proposal

Finally, the tension between universality (based on site independent solutions) and the contextual relevance of a proposal represents the last of these tensions. In a precautionary approach to risk assessment, such universal type solutions or risk assessments are often questioned for their pertinence within a specific local context (Petrini, 2007; Stirling, 2007a; van der Sluijs, 2007; Whiteside, 2006; Tukker, 2002). There are many authors that have addressed the difficulty of assessing architectural solutions in a context of sustainability, especially within a context of increasing universalization of norms (Guy & Moore, 2005c; McMinn & Polo, 2005; Cole & Lorch, 2003; Gibson-Graham, 2003; Kohler, 2003; Frampton, 1985). In fact, there is a growing concern among these

92 This refers to the systemic interpretation of the project which is in direct contrast to an assessment of the amalgamation of the individual fragmented list of criteria.

authors that this path of sustainable architectural design is pulling architects away from the fundamental questions of architectural form and the cultural projects that they may represent.

Often, when quantitative environmental approaches are adopted for addressing sustainability, it is difficult to steer away from universal arguments and solutions, as these have been adopted in many other contexts and situations. There is relative comfort in 'tried and tested' solutions – they are trusted since they have been used in other situations, and perhaps, many times. So the idea of repeatability and predictability of the feasibility of the universal solutions is the basis of this tension. It is much more time consuming and perceived as riskier when trying to find culturally or contextually adapted solutions, as these have not been 'tried and tested'. The opposition between doctrines of universality versus the relevance of local community concerns, local skills, passive technologies (working with local climate and landscape) are the main concerns in this category of tension.

Consequently, this tension directly addresses the 2030 Challenge of reaching carbon neutrality by year 2030. The RAIC states that:

> *"Architects can design buildings to operate with far less energy than the typical Canadian building at little or no additional costs. This can be accomplished through proper siting, building form, glass properties and locations, material selection and incorporating natural daylighting, heating, cooling and ventilation." (RAIC, 2010)*

Here the contextual singularities of the site must be thoroughly addressed in order that architects can exploit as much free passive energy[93] as is available on the site. It is easier to adopt universal technical solutions than to understand and work with the site, even if the universal technical solutions may be more costly in terms of budget (Cole & Lorch, 2003). By taking advantage of the free passive energy available through the site, transformational improvements regarding energy reduction is possible for the long-term and at low costs.

93 Passive energy refers to capturing energy that is free directly from the site, implying that building location, position, form, envelope choices etc. all have an impact on how much free energy can be captured (Cole & Lorch, 2003).

In fact, the exploitation of passive energy is not considered by LEED since LEED requires clean energy sources and reduction of energy consumption, in the LEED category of energy efficiency. This is why a building can be certified LEED Platinum yet ignores the free passive energy. In such situations, costs are therefore invested in technology instead of other architectural elements or on social or cultural aspects related to the project. It can be seen from this argument that LEED is a tool that seeks incremental improvements through technology and cannot guide architects in addressing the 2030 Challenge, since transformational improvements are difficult.

This theoretical tension is also directly related to Ehrlich's I=PAT formula (Ehrlich & Holdren, 1971; Ehrlich, 1968), where 'I' represents impact, 'P' represents population, 'A' represents affluence (or consumption habits) of a population, and 'T' represents technology. If only technology is addressed in the design, then the improvements can just be incremental, since both population and affluence are on the rise. Relating this to architectural projects, then architects must not only focus on the technology of the building in order to render it more energy efficient, since this is not sufficient. This is one reason why adopting a critical perspective with regards to tools like LEED have become increasingly important.

Summary of Theoretical Tensions

These four theoretical tensions are directly drawn from the theory underlying the precautionary principle. However, these tensions would be difficult to observe in field. In architectural competitions, the types of tensions that may be observed are more likely related to the practice of design, for example, the tensions observed between the adoption of a solution or strategy for achieving some level of environmental performance on the one hand and the functionality of the project on the other hand. These are the types of tensions that will be observed in each of the competitions. The next section will describe those that will become the focus of this study.

TENSIONS FOUNDED ON POTENTIAL DIVERGING OR CONTRADICTORY ARCHITECTURAL OBJECTIVES: A PRACTICAL PERSPECTIVE

The identification of the set of practical tensions is based on the premise that when the focus is on primarily one dimension (such as environmental) for solving a problem, then there is likely a shift of impacts from this dimension (or domain) to others (such as constructive quality). The coupling of some of the dimensions or concerns typically involved in the architectural design of public spaces will represent the set of practical tensions. This practical perspective of the tensions involved in adopting quantitative environmental evaluation methods is directly motivated by a complex view[94] of the problem, where a global view of the problem is necessary to avoid the shifting of impacts from one domain (concern or dimension) to the next - a basis of a precautionary approach for design.

It is important to emphasise that the five tensions described below are intended to corroborate the theoretical tensions, and are in no way exhaustive. In other words, the identification of these practical tensions in the empirical study will be used to build the interrelationships between them and the theoretical tensions identified above, helping to enrich the model regarding the impact of the use of quantitative environmental evaluation methods in the architectural competition judgment process.

TENSION BETWEEN POLITICAL OBJECTIVES/ CULTURAL REPERCUSSIONS

The political climate of the municipality where the competition takes place may have an impact on the environmental views of some of the members of the jury. This is because the client, and therefore the municipal representatives, will be part of the competition jury and may impact the way in which the environmental sustainability dimension of projects is assessed within the whole project. In this perspective, this will likely have a repercussion on the way in which LEED is adopted in the judgment process. The specific empirical questions here are:

94 The concept of a complex view is elaborated in Chapter 2.

- What is the political position regarding environmental policies for the municipality of the competition project site?
- How are these policies translated in the competitions brief?
- How has the jury dealt with the imperatives from the municipality regarding their environmental policy?

These three questions may help identify the importance of the LEED component for the municipality and not only for the competition. In fact, if the LEED component is an overwhelming requirement for the municipality, then this may indicate why so much emphasis is given to either the LEED credits or to the characteristics of the projects that may easily communicated to the general public (i.e. green roofs, solar panels, insulated envelopes, organic building forms, etc.) the idea of environmental sustainability. These elements that are easily communicated to the public are a result of what David Orr, in his book entitled "*The Nature of Design: Ecology, Culture and Human Intention*", refers to as fast knowledge, knowledge of elements that is based on quick, solutions that may undermine long-term sustainability (Orr, 2002).

Tension between Requirements in Brief / Context of Site

At times, the requirements in the brief may be challenged by either the competitors or the jury. This presents an important debate as to whether the requirements in the competition brief may be challenged by the jury in selecting the winning project. There may be situations where the context of the architectural project site was not thoroughly thought through during the construction of the brief which in turn, may present itself as conflicts during jury deliberation. In a situation where requirements in the brief are contradictory, it may not be clear to the members of the jury how this should or could be handled. In the end, it is often the requirements in the brief that dictate the decision (Strong, 1996). Is this always the best course of action? The specific empirical questions here are:

- What important urban form or architectural concerns have been overlooked in the brief that would challenge the contextual relevance of the project?
- What arguments were used to defy the brief and did the jury consider them as valid and acceptable?

These two questions are meant to understand how the jury or competitors addressed any gap in the brief, particularly, one that may have overlooked important contextual site elements. The first question addresses any possible gap in the brief, the second question addresses the way in which this gap was dealt with.

Tension between Environmental Performance / Quality of Space

The concern in this tension is that often when environmental performance criteria is given a high weighting, then the projects may have a tendency to push aside other important qualitative architectural characteristics (Farmer & Guy, 2005; Cole, 1998). The quality of the space, the ease of use, the adaptability for future changing needs, accessibility of place, may be compromised. So, by focusing heavily on initial or immediate environmental performance, the result may be a building that although may be environmentally efficient using the most advanced technological choices, it may also be non-usable and confusing for users. This is not what is sought for in public buildings that have strong cultural and social goals (such as museums, train stations, public libraries, sports centers, cultural centers, etc.), where the space must be easy to understand and delightful. Some specific empirical questions are:

- Have the adopted environmental strategies resulted in a compromised flow of space through the building (e.g. a strategy of compactness may result in a non-intuitive space flow)?
- Have the adopted environmental strategies resulted in a compromised access for some people or users?
- Have some of the environmental strategies resulted in a rigid design that is inflexible to future changing needs?

These three questions are meant to cover the main concerns regarding the quality of space – rigidness and inflexibility of space, inaccessibility to some users, and non-functionality of basic requirements of building. The answers to these questions will be based on the comments of the jury as they represent the experts in which to judge the quality of space. So for each competitor proposal, the jury comments regarding the quality of space will be analysed to understand whether the lack of quality of space was a result of some strategy adopted for environmental performance.

Tension between Environmental Performance / Constructive Choices

The concern here is that constructive choices are made entirely based on environmental efficiency considerations. This may have implications on various constructive elements, such as, of the envelope of the building, strength of materials selected, strength of building structure, all dimensions that provide the physical durability of the project, where its compromise may have repercussions in terms of its life span. Some specific empirical questions are:

- Why have constructive choices been made (is the decision based solely on its environmental potential)?
- Is the choice of envelope appropriate for the project? Is the decision of the envelope based entirely on performance efficiency?
- Have the long-term repercussions of the constructive choices been considered for other domains (social – local skill and materials, cultural – symbolic pertinence, etc.)?

This set of questions is meant to understand if the choice of materials and structure were a result of only environmental performance considerations. They seek to cover three considerations of structural quality, envelope and significance of the materials selected. These three questions are meant to highlight those important aspects regarding the materiality of the project and their relationship to the LEED strategies adopted.

Tension between Environmental Performance / Aesthetic Quality

The concern here is that environmental performance is given priority to the criterion of aesthetic quality. This is why this tension will be observed in the context of architectural competitions. The general aesthetic quality of the project has to be seriously considered in a project where the social and cultural implications are important for the long-term perspective and usefulness of the project. This may have implications on various elements, such as, language of form, perceptive experiential quality, urban renewal capacity, contextual relation to site, didactic experience exhibited - all dimensions that provide a strong symbolic character of a building, where its compromise may have future cultural repercussions. Some specific empirical questions are:

- How have the environmental performance efficiency measures been addressed with relation to the form and symbolism of the project?
- Have the environmental strategies resulted in a building that is characterless, yet efficient (i.e. does the building have any redeeming innovative qualities that would provide a social and cultural impetus)?

These questions are meant to relate the strategies adopted for performance efficiency measures needed for LEED and the symbolism or innovative aesthetic quality of the project. This will be studied based on the comments in the jury report for each finalist project. This implies that the judgment (or assessment) of the project's aesthetic will be taken from the jury report, but the interrelated nature between the aesthetic and the discourse related to acquiring LEED credits will be assessed based on the discourse of the finalist proposal. These two questions are meant to highlight that important qualitative social and cultural concerns may be omitted from considerations of sustainability.

Tension of Diverging Views: between Juror's or Between Jurors and Finalist Proposals

In this final practical tension, it will also be important to identify the diverging views regarding the assessment and judgment of the projects. An analysis of these diverging views may help to better understand the value systems inherent in the divergences. The diverging views that will be analyzed are those related to solutions related to sustainability. The question here is:

- What are the diverging views regarding the assessment of the sustainable dimension of this project?

So if the competitor proposed a particular solution regarding the sustainability dimension in which the jury did not agree, this will be highlighted as a tension of this category.

Summary of Empirical Questions to Help Identify the Practical Tensions

The three tensions regarding the context of site, quality of space and constructive choices (refer to Table 10) are meant to understand if a systemic approach to the LEED strategies was adopted. The focus here is to understand if the strategies adopted for LEED accreditation, a requirement for each of the competitions in this study, have been interrelated and considered in light of other important architectural qualities. In other words, have the LEED strategies been added onto the project as a kind of afterthought, or have they been considered as having an integral impact on the other important qualities of the project. A summary of the practical tensions and the questions used to help identify them in the empirical study are presented in Table 10.

TABLE 10: SUMMARY OF QUESTIONS FOR IDENTIFYING PRACTICAL TENSIONS

Practical Tensions	Questions to Help Identify Practical Tensions
Political Objectives/ Cultural Repercussions	What is the political position regarding environmental policies for the municipality of the competition project site? How are these policies translated in the competitions brief? How has the jury dealt with the imperatives from the municipality regarding their environmental policy?
Requirements In Brief/ Context Of Site	What important urban form or architectural concerns have been overlooked in the brief that would challenge the contextual relevance of the project? What arguments were used to defy the brief and did the jury consider them as valid and acceptable?
Environmental Performance/ Quality of Space	Have the adopted environmental strategies resulted in a compromised flow of space through the building (e.g. a strategy of compactness may result in a non-intuitive space flow)? Have the adopted environmental strategies resulted in a compromised access for some people or users? Have some of the environmental strategies resulted in a rigid design that is inflexible to future changing needs?
Environmental Performance/ Constructive Choices	Why have constructive choices been made (is the decision based solely on its environmental potential)? Is the choice of envelope appropriate for the project? Is the decision of the envelope based entirely on performance efficiency? Have the long-term repercussions of the constructive choices been considered for other domains (social – local skill and materials, cultural – symbolic pertinence, etc.)?
Environmental Performance/ Aesthetic Quality	How have the environmental performance efficiency measures been addressed with relation to the form and symbolism of the project? Have the environmental strategies resulted in a building that is characterless, yet efficient (i.e. does the building have any redeeming innovative qualities that would provide a social and cultural impetus)?
Diverging views (either among jurors or between the juror and the finalist proposal)	What are the diverging views regarding the assessment of some sustainable dimension of this project?

In addition to these tensions, contextual information regarding each of the competitors and the competitions will also be collected. The following sections describe the type of data that will be collected regarding the context related information.

General Data to Collect for each Finalist Within each Competition

In order to better understand the competitor proposals, some general information regarding each finalist team including some information regarding each of their strategies for sustainability will be described. This data may help in the identification of the practical tensions, but more importantly this data may help understand the general approach to sustainable development adopted by each finalist. There are two main sections in this table; the first section is general data regarding their discourse, while the second section is an interpretation of their sustainable development discourse from the perspective of precautionary/preventive design inquiry. Table 11 presents a template of this table.

TABLE 11: GENERAL DATA TO COLLECT FOR EACH FINALIST PROPOSAL OF EACH COMPETITION

General Descriptive Data for each Finalist	**Data**
City and country of team	
Number of LEED points sought and distribution	Total: Ecological site: Water efficiency: Energy and atmosphere: Materials and resources: Quality of interior environment: Innovation and design process:
Did they consider the 4 pillars of sustainability in their sustainability strategy?	
What were the main sustainable strategies adopted?	
Did they adopt sustainable strategies outside LEED credit requirements?	
Identify elements that would communicate 'green' to the general public – green roofs, windmills, solar panels, organic shapes, etc.	
Interpretation of Approach to SD Inquiry	
General worldview of the team regarding sustainability - preventive (juxtaposed LEED credits) or precautionary (integrated systemic solution)	

General Data to Collect for each Competition

In order that the context within which the competition has taken place is better understood, some basic contextual information will be collected. This data will help in the identification of the practical tensions. Table 12 specifies the questions for collecting this contextual information for each competition.

TABLE 12: GENERAL DATA TO COLLECT FOR EACH COMPETITION

General Descriptive Data	**Data**
Name of competition	
Location and date of launch of the competition	
Competition type (one phase, two phase, etc.)	
Number of entries for each phase	
Number of jury members, number of architects, number of city representatives, etc.	
Position or background of president of the jury	
Number of LEED experts on the jury and what level of recognition (regional, national, international)	
LEED certification level required for the competition	
Criteria defined for sustainable development	
Is LEED a sustainable development policy for the municipality in which the competition project will be built	
Type of building (cultural center, library, museum, etc)	

SUMMARY OF EMPIRICAL RESEARCH

Throughout this thesis, a set of theoretical concepts related to the precautionary principle for design have been presented with the intent to study and model the set of tensions that may exists between the use of quantitative environmental evaluation methods and design thinking necessary for the judgment process of architectural competitions for selecting the winning project. These have led to one hypothesis[95], one general theoretical research question[96], one general empirical research question[97], and a series of specific

95 The main hypothesis for this research was identified in this chapter, in the section entitled, “Framework for Observation and Analysis of Empirical Data”.

96 The general theoretical research question was identified in this chapter, in the section entitled, “Confronting Quantitative Environmental Evaluation and Architectural Design ”.

empirical questions which will be used to study these tensions. The analysis process consists of the following main phases:

1. Understand the main context related information for each competition (political context, basic background information of jury members, level of LEED certification required, etc.) and for each competitor (country origin of finalists, number of LEED credits sought, main strategies adopted, etc). This may help draw out some conclusions based on the set of tensions identified.

2. For each competition, answer the general empirical question: Which basic qualitative architectural design criteria used by the jury to select the winning architectural project are overlooked when LEED is imposed as the tool for sustainability? This will be done through the identification of the practical tensions in each competition. To achieve this, the list of questions identified in Table 10 will be used. This may help enrich the understanding of how LEED was used. This evidence may support or refute the set of these tensions, which in either case, will help enrich this part of the model.

3. For each of the practical tensions identified within each of the competitions, find the interrelationships[98] with the theoretical set of tensions. This may help better understand the difficulty of adopting quantitative environmental evaluation approaches in the competition process for addressing the sustainability criteria, specifically for the jury process. This may support or refute these tensions, which in either case will help enrich this part of the model.

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97 The general empirical research question was identified in this chapter, in the section entitled, "Implications on the Judgment Process of Architectural Competitions when Adopting LEED ".

98 An example of these interrelationships was described in the section of this chapter entitled, "Categories of Tensions based on the Theory of the Precautionary Principle".

ANALYSIS OF THREE QUEBEC COMPETITIONS WITH A FOCUS ON LEED

In seeking to build the knowledge related to the judgment process of competitions, three competitions will be analyzed[99]. For each of the competitions, the following will be the focus. Is it the richness of the deliberation or the more logical arguments based on quantitative proof that helps in the judgment process? Is it the ability to address long-term uncertainty through projection that helps construct a vision of the winning project, or is it the more methodological approach to assessing risk based on statistics that helps the judgment process? Is it the ease of comparison that renders the jury process the most successful – in other words, the analytic-empirical discourse afforded by tools such as LEED, for assessing if the criteria have been met by each project? And finally, does an understanding of the contextual considerations help the judgment process, instead of focusing on the universality of the technical solutions? These four questions represent the theoretical tensions described previously in this chapter. The analysis of each of the projects for each of the three competition based on the above questions may help to enrich an understanding of these tensions.

The documents used for analysis will be the brief, the jury report and the descriptive text of each finalist proposal. There will be no interviews conducted with the professional advisor of the competition, since the professional advisor (who is the same person for all three competitions) did not want to provide any additional information than that already provided in the jury report.

The three competitions will be presented in chronological order according to the date of the competition launch: (1) Montreal Planetarium; (2) Musée National des beaux-arts du Québec; and (3) Saint-Laurent Library.

A few points should be highlighted before starting the competition analysis.

First, the LEED expert evaluations were not available for analysis for the three competitions. The LEED details available for analysis are the presentation panels provided by each design team in their finalist proposals as well as the descriptive text describing

99 The justification for selecting three competitions was provided at the beginning of this chapter.

their sustainable strategy. As the design projects submitted to the competitions are not yet in their final detailed design phase, the LEED estimates provided by the design teams are estimates, as would be the understanding of these proposals by the expert evaluators. So the LEED proposals present results with some level of uncertainty as the stage of solutions provided is still preliminary and where much could happen in the project to affect these estimates.

Second, the role of the professional advisor of a competition is an important position as the professional advisor is the main organizer of the competition and ensures that all phases of the competition process are conducted according to the rules provided by the RAIC. The professional advisor for the three competitions is an architect. This may have some implications in the way the competitions were conducted as each competition was also a learning ground for the competitions that followed. However, it is not only the professional advisor that has a pivotal role in the competition process; the president of the jury usually has a pivotal role in the way the jury deliberation takes place.

Third, the president of the jury also has a pivotal role for two reasons. First he has an extra vote that he/she may use at his/her disposal. Second, the president of the jury is the jury member that runs (or directs) the deliberation process, and therefore has a direct impact on the way in which the selection of the winning project is made. For each of the three competitions, the president of the jury was different person, so there was no learning process or relation among the three competitions.

And finally, the city in which the competition takes place is also a defining element in terms of how the competition is communicated to the public and the information in the press releases broadcasting the winners of the various stages of the competition. Both the Saint-Laurent Library and the Montreal Planetarium were launched by the City of Montreal. The Musée national des beaux-arts du Québec (MNBAQ) competition was organized by the City of Quebec. The differences between the policies regarding sustainable development in general and LEED more specifically are different for the two cities. In 2008, when the Montreal Planetarium was launched, Montreal did not yet have a LEED policy. However, for the other two competitions, a LEED policy was in effect for both the City of Montreal and the City of Quebec.

The next sections present the analysis of the three competitions. As mentioned, the order of analysis will be: (1) Montreal Planetarium, (2) MNBAQ and the (3) Saint-Laurent Library.

MONTREAL PLANETARIUM COMPETITION

The Montreal Planetarium competition was launched on October 22, 2008 in Montreal (Ville de Montréal, 2008b). The level of certification of LEED for this competition was LEED Platinum (52-70 credits), the highest LEED certification possible. Even if LEED Platinum requires a minimum of 52 credits, there was a strong recommendation in the competition brief to seek a minimum of 58 credits in order that a buffer of credits can be used to compensate for uncertainty.

There were 9 members in the jury, ranging from the architects, architects with expertise in the sustainable built environment, architects representing academia, artists, and client representatives. All jury members but two are from Canada. Of these two, one is an architect from New York, and the other is an architect and a consultant from the *International Initiative for Sustainable Built Environment* (iiSBE), an organization that strongly advocates LEED, and is also a leading LEED expert with international recognition. In addition, there were only 4 architects in the jury, of which one was also a LEED expert. Table 13 lists the jury members and their background.

TABLE 13: LIST OF JURORS FOR THE MONTREAL PLANETARIUM COMPETITION

Jurors	Description
A	Representative of the city, Director of the Nature Museums of Montreal, president of jury
B	Representative of the city, Director of Planetarium
C	Set designer for Cirque du Soleil
D	Full Professor with the Faculty of Environmental Design at the Université de Montréal
E	Chair of the Board of Directors of the Olympic Installations Board
F	Architect with Asymptote, a New York firm
G	Architect with Stoa architecture, Montreal
H	Architect and Director of iiSBE (International Initiative for Sustainable Built Environment)
I	Architect and Associate Professor at the University of Calgary

It was a two-phase competition process, where the first phase invited architectural teams from around the world to submit anonymous architectural ideas. The ideas proposed by the 62 teams, came mostly from Quebec (48), while the rest came from Italy, Germany, France, the United States and China. The teams had to meet the requirements of the *Ordre des architectes du Québec*. After the first phase, the jury selected 5 finalists (Ville de Montréal, 2009c). The five finalists were:

- Atelier Big City & L'Oeuf, Montreal, Quebec
- Chevalier Morales Architectes/Les Architectes Fabg/Bouthilette Parizeau /Nicolet Chartrand Knoll /Williams Asselin Ackaoui / Gsm Prjct, Montreal, Quebec
- Saucier + Perrotte Architectes
- Croft Pelletier/Jodoin Lamarre Pratte / Architectes En Consortium/Dessau/Sdk, Montreal, Quebec
- Winning Project: Cardin+Ramirez /Aedifica/Snc Lavalin/Dupras-Ledoux/Fauteux Et Associés, Montreal, Quebec

All finalists are design teams based in Quebec, so there is no international representation among the finalist projects. Consequently, some quotes from the various press releases will help understand the context of this competition. The press release announcing the launch of this competition, (Ville de Montréal, 2008b, p.1), Montreal Mayor Mr. Gerald Tremblay states in the second paragraph that,

> *"(…) The new Planetarium will be built in line with our family policy and our commitment to make all our public buildings universally accessible, while meeting our sustainable development objectives by incorporating LEED standards."*

In fact, in the second paragraph of the press release announcing the winning project, the requirement for LEED Platinum certification was also highlighted. For Montréal Mayor Gérald Tremblay,

> *"This project is in line with Montreal's characteristic daring and creativity. It will enhance the city's reputation around the world, and confirm its commitment to culture, knowledge, sustainable development and biodiversity."*

The city's reputation is a major concern for the mayor, where sustainable development and biodiversity are put on equal footing with culture and knowledge, as this quote shows. As the purpose of the project is educational and cultural, then it became clear that the winning project had to have visible evidence of its sustainable development qualities and that biodiversity had to be addressed.

Consequently, a quick search on the internet shows that the majority of press releases related to this competition stated the requirement of LEED Platinum as significant for this project. So for this competition, the sustainable development criteria which focused on the LEED Platinum objective were heavily weighted. Table 14 presents a summary of the main information regarding this competition.

TABLE 14: GENERAL COMPETITION INFORMATION FOR THE MONTREAL PLANETARIUM

General Descriptive Data	Data
Name of competition	Montreal Planetarium competition
Location and date of launch of the competition	Montreal, October 2008
Competition type (one phase, two phase, etc.)	Two-phase, first phase anonymous
Number of entries for each phase	62 first phase, 5 second phase
Number of jury members, number of architects, number of city representatives, etc.	10 jury members comprising of: 5 architects, 2 designers, 3 representatives of the city
Position or background of the president of the jury	Representative of the city, Director of the Nature Museums of Montreal
Number of LEED experts on the jury and what level of recognition (regional, national, international)	1 internationally renowned LEED expert (from outside Quebec)
LEED certification level required for the competition	LEED Platinum
Criteria defined for sustainable development	LEED category definitions
Is LEED a sustainable development policy for the municipality in which the competition project will be built	Not in 2008 for Montreal
Type of building (cultural center, library, museum, etc)	Science center

MAIN OBJECTIVES FOR THE MONTREAL PLANETARIUM COMPETITION

The main objectives for the new planetarium as defined in the competition brief are: (1) socio-cultural (synergy with existing institutions and facilities of the complex); (2) urban (recreational, dialog with existing buildings, added value; etc.); (3) functional (improve the facilities for planetarium); (4) architectural (immersive, stimulating experience, compatible with existing buildings, sustainable, unforgettable and unique experience); (5) museological (objective to become a museum similar to the other Nature museums of Montreal); and (6) environmental objectives (LEED) (Ville de Montréal, 2009a).

The main issues and challenges as defined in the brief are: (1) urban (revitalization of the Olympic site); (2) environmental (LEED Platinum – a budget and architectural challenge); and (3) budget and functional constraints (Ville de Montréal, 2009a).

The main design criteria as defined in the brief are: (1) architectural (municipal rules, peripheral spaces, spatial organization, interior space conducive to experimental immersion, an architecture that opens up to the environment, an entrance that is symbiotic with the Biodome); (2) structure (existing buildings underneath site, nature of the floor, quick execution of project, maintenance costs, LEED criteria); (3) mechanical (mostly LEED adherence); (4) sustainable development (LEED Platinum accreditation); and (5) budget (a vital decisional criteria) (Ville de Montréal, 2009a).

Finally, as identified in the phase 2 jury report, the winning project was selected based on 6 elements. These had been decided during the phase 1 jury deliberation (Ville de Montréal, 2009b):

- the innovative environmental approach and the quality of the integration of the chosen LEED credits (20%);
- the originality of the museum concept in keeping with the architectural ensemble (15%);
- the quality of the experience of the indoor spaces in keeping with the functional and technical program requirements (20%);
- the fit between the solution and the program requirements (15%);
- compliance with the budget (15%); and
- the quality of the team (15%).

The most weighting was given to LEED among the six criteria. In fact, the technical elements of the project (structural and mechanical) were also driven by the use of LEED. It is evident that LEED will be the most heavily weighted criterion among the other more qualitative criteria. There is already evidence in the brief that the environmental performance of the building will be in tension with the aesthetic, utility and structure criteria. Also, even if Montreal did not yet have a LEED policy for public buildings in 2008, the excerpts of quotes from the Montreal mayor indicate the presence of political pressure.

It is important to highlight that in the first paragraph of the first page of the competition brief the mission of the planetarium is stated as:

> *"Le Planétarium de Montréal a pour mission de faire connaître et apprécier à la population les sciences de la nature et la nature elle-même et d'en enrichir les connaissances, plus particulièrement dans le domaine de l'astronomie. Le Planétarium contribue ainsi à une plus grande conscientisation, à la conservation du patrimoine naturel et à la relation entre l'humain et l'environnement" (Ville de Montréal, 2009a, p.1)*

So a didactic environmental element had to be visible in the winning project to contribute to such a consciousness.

FINALISTS FOR THE MONTREAL PLANETARIUM COMPETITION

ATELIER BIG CITY & L'OEUF

The jury judged this project as one of the bottom two projects out of the four finalists left. This team sought the most LEED credits (total of 62). The strong point for this project was that they had the best LEED expertise; their weak point was that the architecture itself did not delight the jurors. According to this design team, regarding the geometry of the building, they stated that:

> *« La géométrie du construit témoigne de négociations entre une enveloppe développée à partir d'une transposition d'un déploiement de la voûte céleste (une sorte de baldaquin étoilé), le construit existant et les intentions programmatiques et écologiques annoncées. » (Atelier Big City & L'Oeuf, 2009)*

However, the jury felt that the celestial map imagery was overcome by the immensity of the volume of the building and that the green roof did not correspond to this image of monumentality. So there was a contradiction between the immense volume of the building and need to design an efficiently performing building. The contradiction rested on the symbolism of the massive structure when designing for sustainability (see Figure 20).

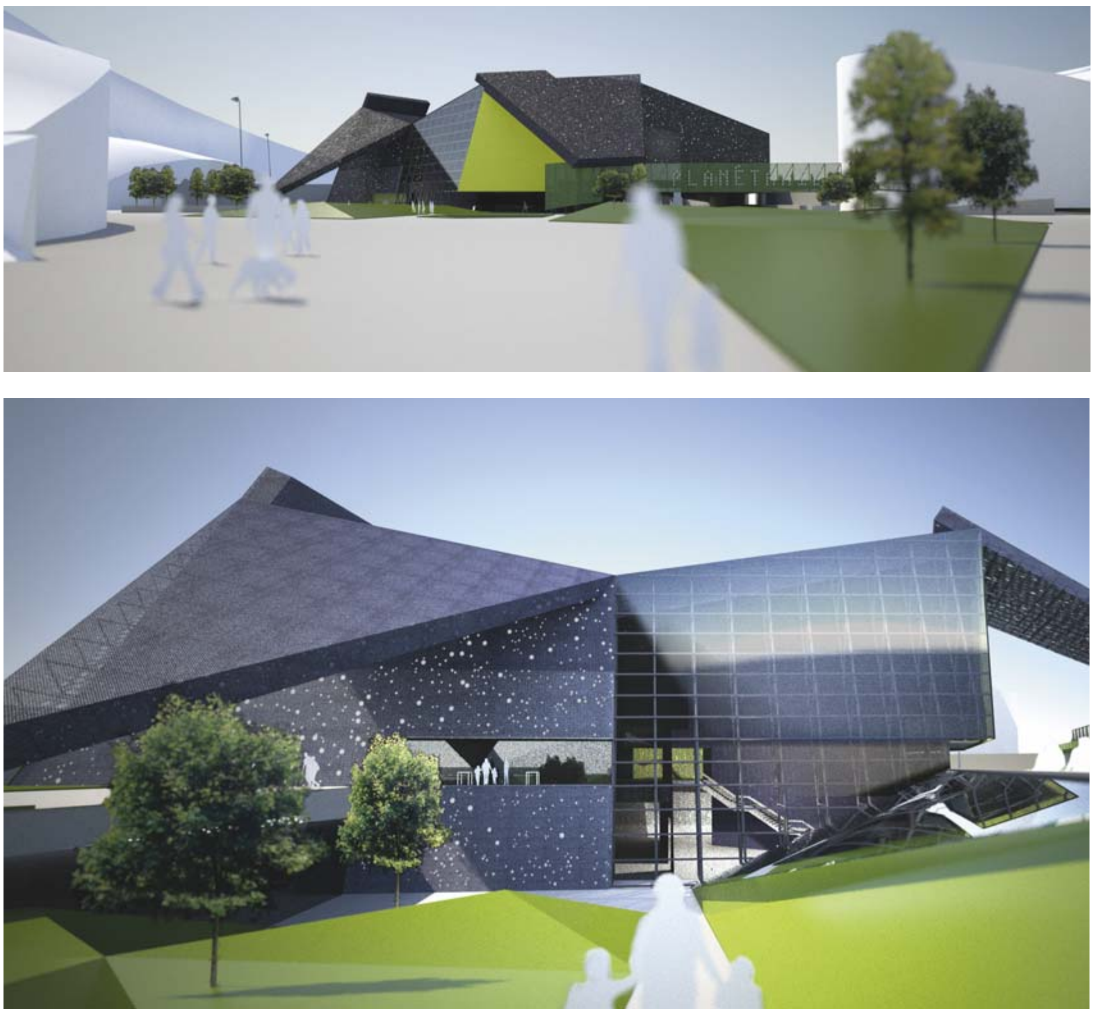

FIGURE 20: FINALIST PROPOSAL BY ATELIER BIG CITY & L'OEUF FOR THE MONTREAL PLANETARIUM COMPETITION (TOP, MAIN FRONT VIEW; BOTTOM, THE SOLAR WALL SHOWING THE ACTIVITY INSIDE)

Consequently, there are much evidence in their design discourse indicating that the relationships between the aesthetic, structural, functional and LEED solutions was addressed. For example,

> *« Des vues sur le stade olympique sont soigneusement dévoilées à travers le mur solaire qui contrôle la lumière et absorbe l'énergie. (…) De l'intérieur, comme de l'extérieur, le bâtiment est un fragment étoilé de la voûte céleste. » (Atelier Big City & L'Oeuf, 2009)*

In this quote, there is an attempt to inter-relate the technical (solar wall), the experiential (view of the stadium) and the symbolic (the building is a fragment of the starry sky). In fact, there are many examples where this team tried to identify the links between the various environmental strategies (with respect to the water or energy consumption, or air quality) and the project's experiential quality, for example:

> *« Dans le projet, plusieurs stratégies sont combinées qui impliquent la collecte et le recyclage des eaux, la collecte de l'énergie solaire, la géothermie et l'éclairage naturel. Le projet du planétarium favorise la double voire la triple fonction de différents éléments: par exemple, le jardin en coupant dans le sol permet d'exploiter la géothermie et l'éclairage naturel et d'augmenter les dimensions du mur solaire. La cour et le mur solaire jouent également un rôle important dans la scénographie globale du bâtiment. Ils en présentent le caractère durable, l'un renforce la dimension écologique végétale des Muséums nature de Montréal, alors que l'autre contribue à la lecture du ciel » (Atelier Big City & L'Oeuf, 2009).*

Also, the design of their green roof was inspired by the Tarantula Nebula and was intended to provide a particular experiential quality as described in the following quote:

> *« De la rue Sherbrooke, mais aussi de l'ascenseur qui mène au sommet de la tour olympique, le Planétarium présente une autre de ses faces écologiques et donne en spectacle son toit végétalisé dont le dessin est inspiré par une image pixellisée de la Nébuleuse de la Tarentule » (Atelier Big City & L'Oeuf, 2009, p.2)*

Here again, there was an attempt to integrate the solution for attaining LEED credits with other important architectural qualities.

However, at times, the micro focus on technical details by this team may have resulted in the compromise to some other architectural qualities. An example of this was this team's focus on minute details: the imagery on the wall and ceiling, plant species details, specific technical details relating to the acquisition of LEED credits, other technical details relating to the bioclimatic details of the building, etc. Although some of the details were appreciated by the jury, there was such a heavy focus on such details that the project description sounded more like an engineering specification and far less like an architectural design project. Here the global view of the cultural and symbolic significance for the city was lost. In fact according to the jury report:

> *«(…) L'imagerie de la carte céleste est brisée par la lourdeur du volume; le toit vert ne correspond pas à celte image. (…) La volumétrie extérieure n'est pas à la hauteur de la qualité des plans; l'architecture n'émerveille pas de l'extérieur. (…) La complexité de la forme de ce pavillon est en rupture avec le site. » (Ville de Montréal, 2009b, p.5)*

Consequently, this focus on environmental and interior details may to some extent explain why the aesthetic of the building reveals a heavy and massive structure that may not have fully considered its insertion into the site. In trying to include as much environmental features as possible (both passive and active), had they have forgotten to consider the integration of the building into the site? In addition, had they considered the incoherence of the green roof with the symbolism that this project presented? Table 15 summarizes some elements for this finalist. Table 16 summarizes the practical tensions identified for this design team.

TABLE 15: GENERAL DATA FOR ATELIER BIG CITY & L'OEUF OF THE MONTREAL PLANETARIUM COMPETITION

General Descriptive Data for each Finalist	**Data**
City and country of team	Montreal, Canada
Number of LEED points sought and distribution	Total: 62 Ecological site: 14 Water efficiency: 5 Energy and atmosphere: 17 Materials and resources: 14 Quality of interior environment: 15 Innovation and design process: 5
Did they consider the 4 pillars of sustainability in their sustainability strategy?	yes
What were the main sustainable strategies adopted?	Mostly passive strategies
Did they adopt sustainable strategies outside LEED credit requirements?	yes
Identify elements that would communicate 'green' to the general public – green roofs, windmills, solar panels, organic shapes, etc	Solar panels, green roof
Interpretation of Approach to SD Inquiry	
General worldview of the team regarding sustainability - preventive (juxtaposed LEED credits) or precautionary (integrated systemic solution)	Precautionary (integrated systemic solution)

TABLE 16: PRACTICAL TENSIONS IDENTIFIED FOR ATELIER BIG CITY & L'OEUF OF THE MONTREAL PLANETARIUM COMPETITION

Categories of Practical Tensions	**Identified Practical Tensions**
Political Objectives/ Cultural Repercussions	None evident in this project.
Requirements In Brief/ Context Of Site	None were challenged by this team.
Environmental Performance/ Quality of Space	None, the functional requirements were well met according to the jury report.
Environmental Performance/ Constructive Choices	The massiveness of the volume did not marvel the jury (the exterior solar panels contributed to this massive effect).
Environmental Performance/ Aesthetic Quality	According to the jury, the green roof was incoherent with the symbolism they proposed.
Diverging views (either among jurors or between the juror and the finalist proposal)	The celestial imagery selected by the team and the green roof do not correspond; the jury felt that the general aesthetic was too heavy.

Chevalier Morales Architectes / Les architectes FABG / Bouthilette Parizeau / Nicolet Chartrand Knoll / Williams Asselin Ackaoui / GSM prjct

This team proposed 57 LEED credits (second least among the five finalists). They were the first team to be disqualified, where the main critique by the jury the incoherence of the team and the ambiguity of the project. This project was unanimously disqualified at the beginning of the phase 2 jury deliberation. According to the jury report,

> *"La non cohérence de l'équipe, l'ambiguité du projet et le manque de conviction de la présentation ont soutenu cette décision" (Ville de Montréal, 2009b, p.3).*

The jury also felt that their choice of envelope was inappropriate because it may interfere with the animation and the museological experience. However, this team specifically designed this project with a perforated envelope. They described this as,

> *« au lieu d'être opaque et mat comme le béton qui forme le stade et l'ancien vélodrome, le planétarium est, par contraste, légèrement translucide et laiteux. Il laisse la couleur l'envahir et le teinter de l'intérieur. Il multiplie les surfaces polies et réfléchissantes, comme le verre opalescent, l'acier inoxydable, l'aluminium blanc lustré, le panneau d'aluminium perforé blanc et le verre céramifié. Ce dernier réduit également la surchauffe intérieure en agissant comme de multiples micros pare-soleil. » (Chevalier Morales Architectes et al., 2009b).*

Here we can see that this team sought to relate the symbolic, the aesthetic elements of the envelope (poetic) to the environmental dimension of the project (technical). So the team did show that they did not use the LEED checklist only as a way to accumulate the points, but as a way to integrate the solutions with other architectural elements. So there was a contradiction between the designer's intent and the jury's interpretation of this dimension (see Figure 21).

FIGURE 21: FINALIST PROPOSAL BY CHEVALIER MORALES/FABG FOR THE MONTREAL PLANETARIUM COMPETITION (TOP, VIEW FROM THE STREET PIERRE-DE-COUBERTIN; BOTTOM, MAIN ENTRANCE)

On the one hand, the team suggested that the envelope was appropriate to address aesthetic and environmental concerns, yet, ironically the jury decided that it was not appropriate because of the extra solar heat that it would introduce into the building. The intent here is not to judge who is objectively correct in their argument (the design team or the jury) as the tools necessary for this assessment are beyond the scope of this study, but to show that the choices regarding environmental performance in this project are in tensions with the three basic architectural criteria (utility, structure, aesthetic). Table 17 presents the summary of the general data regarding this project. Table 18 presents the summary of the practical tensions exhibited by this project.

TABLE 17: GENERAL DATA FOR CHEVALIER MORALES /FABG OF THE MONTREAL PLANETARIUM COMPETITION

General Descriptive Data for each Finalist	**Data**
City and country of team	Montreal, Canada
Number of LEED points sought and distribution	Total: 57 Ecological site: 14 Water efficiency: 5 Energy and atmosphere: 17 Materials and resources: 14 Quality of interior environment: 15 Innovation and design process: 5
Did they consider the 4 pillars of sustainability in their sustainability strategy?	Only environmental
What were the main sustainable strategies adopted?	Orientation of building to take advantage of natural light, wind, and sun exposure
Did they adopt sustainable strategies outside LEED credit requirements?	no
Identify elements that would communicate 'green' to the general public – green roofs, windmills, solar panels, organic shapes, etc	none
Interpretation of Approach to SD Inquiry	
General worldview of the team regarding sustainability - preventive (juxtaposed LEED credits) or precautionary (integrated systemic solution)	Preventive (juxtaposed LEED credits) mostly. One example of a systemic vision (envelope).

TABLE 18: PRACTICAL TENSIONS IDENTIFIED FOR CHEVALIER MORALES /FABG OF THE MONTREAL PLANETARIUM COMPETITION

Categories of Practical Tensions	**Identified Practical Tensions**
Political Objectives/ Cultural Repercussions	The jury disqualified this team immediately because of its incoherence – no indication in jury report of political bias here.
Requirements In Brief/ Context Of Site	none
Environmental Performance/ Quality of Space	According to the jury, the orientation of the building would introduce solar gains that would affect the functionality of the planetarium. This was their main strategy for sustainability.
Environmental Performance/ Constructive Choices	The envelope selected by the team to reduce solar overheating was problematic for the jury because of risk of overheating.
Environmental Performance/ Aesthetic Quality	The envelope was selected for its symbolic (aesthetic) quality but was also used to protect from solar rays (according to the design team's discourse), yet the jury felt this same envelope would result in solar overheating rendering the planetarium non-functional.
Diverging views (either among jurors or between the juror and the finalist proposal)	Choice of envelope and the choice of form were for the jury contradictory.

SAUCIER + PERROTTE ARCHITECTES

This project was ranked as one of the bottom two projects. They proposed 60 LEED credits. So the two bottom ranked projects (this and Big City / l'OEUF) had the top two highest LEED scores according to the estimates provided by each team. As mentioned previously, whether these credits can actually be realized cannot be assessed as the solutions are still too preliminary. In addition, the assessment by the LEED expert evaluators for this competition is not publicly available. However, as the jury report did not mention any discrepancy of LEED estimates for any of the teams in this competition, the LEED estimates provided by each team will not be challenged for this research.

The jury claimed the LEED strategies adopted were superimposed on the project without integration to the architectural concepts. In fact, in contrast to the Big City/l'OEUF team, the LEED strategies were described in complete disconnect from the experiential dimension of the project. They presented almost an entire page of LEED strategies adopted, and in no instance were any of these strategies linked to any experiential, social or cultural benefits provided. The following quote illustrates this sense of disconnect between the LEED strategies and other architectural elements (i.e. integration to site, resulting spatial or more generally aesthetic quality, etc.):

> « *L'objectif est d'intégrer les exigences du développement durable à la conception des systèmes de bâtiment, ce qui se traduit par de nombreux avantages, dont :*
> - *l'obtention d'espaces sains et agréables offrant entre autres une qualité d'air intérieur supérieure et une plus grande quantité de lumière naturelle à travers l'utilisation de fenestration ample et de puits de lumière stratégiquement placés;*
> - *la réduction de la consommation d'énergie;*
> - *la réduction de la consommation d'eau;*
> - *la réduction de la consommation des ressources non renouvelables;*
> - *la réduction des rejets dans l'atmosphère et aux égouts;*
> - *la réduction de l'espace nécessaire aux équipements mécaniques;*
> - *l'augmentation de la flexibilité des installations;*
> - *la réduction du coût et de la fréquence des activités d'entretien;*
> - *la réduction des coûts d'exploitation;*
> - *la réduction du coût des réaménagements futurs;*
> - *l'intégration de pratiques environnementales dans l'utilisation des installations telles que l'entretien écologique intérieur et extérieur.* »
>
> (Saucier + Perrotte architectes, 2009, p.3)

Consequently, they also stated that

> *« Toutes ces options ont été étudiées au cours du concours et seront validées lors de l'étape des études conceptuelles. Elles ont été évaluées en fonction notamment de leur faisabilité et de leur coût, en tenant compte de leur impact sur la durée de vie des installations » (Saucier + Perrotte architectes, 2009, p.3)*

So their concerns regarding sustainability were isolated in the functional, cost-benefit and the impacts along the life span of the installations – a technical perspective ignoring associated architectural dimensions. In this team's descriptive text, there was no attempt to interrelate the solutions adopted to acquire LEED credits to any of the other architectural qualities or dimensions, such as the functionality, aesthetic or structural dimensions of the project. In fact, there was no attempt to interrelate the LEED solutions with other sustainable development pillars, such as the social, economic or cultural either. So the LEED solutions seemed added on and not integrated with the project. This presents an excellent example of the limitations presented when a design team juxtaposes the solutions related to LEED credits instead of integrating them into the project by exploring the interrelationships with other architectural elements. According to the jury, the solutions to obtain LEED credits seemed superimposed to the project. This is what they claimed:

> *« Les stratégies LEED semblent superposées au projet, sans intégration au concept architectural. « (Ville de Montréal, 2009b, p.5)*

As an example, the green roof proposed by this team does not easily communicate with the site (see Figure 22). The sole argument this team presented to relate the green roof to an aesthetic element was the following:

> *« (…) la gestion des eaux pluviales au travers l'aménagement de toits verts, de bassins de rétention et de bassins filtrants qui auront une valeur esthétique et fonctionnelle » (Saucier + Perrotte architectes, 2009, p.5)*

There is no additional discourse in their descriptive text related to how the green roof would provide an added aesthetic or functional value. This is one example of many. All their discourse related to sustainability was similar - they did not interrelate any of the LEED elements to any experiential, spatial or structural architectural quality, which is directly in contrast to how the team Big City/l'Oeuf addressed some of the LEED elements.

FIGURE 22: FINALIST PROPOSAL BY SAUCIER+PERROTTE FOR THE MONTREAL PLANETARIUM COMPETITION (TOP, GREEN ROOF; BOTTOM, MAIN ENTRANCE)

The jury report also stated that the presentation and quality of team members was convincing and positive for this group. This is how the jury referred to the constitution of this team:

> *Le jury fait mention de la qualité très convaincante de la présentation et de l'équipe. (Saucier + Perrotte architectes, 2009, p.5)*

Yet in the final analysis the jury stated that this team did not succeed in pushing the project forward based on the jury's phase 1 comments. This is how the jury perceived their advancement in the development of their project:

> *« L'évolution du concept en étape 2 n'a pas intégré les commentaires du jury de l'étape 1, (…) La symbolique générée par la volumétrie est peu développée et semble figée au premier degré. » (Saucier + Perrotte architectes, 2009, p.5)*

This team had an in depth discourse of their museum experience, an in depth discourse on the LEED credits and a fairly detailed description of the functional dimension, but they did not attempt to describe how one affects the other and how they all affect the project as a whole. There was a weakness with regards to an integrated design of sustainable elements. Table 19 presents the general data for this project. Table 20 presents the practical tensions for this project.

TABLE 19: GENERAL DATA FOR SAUCIER + PERROTTE OF THE MONTREAL PLANETARIUM COMPETITION

General Descriptive Data for each Finalist	**Data**
City and country of team	Montreal, Canada
Number of LEED points sought and distribution	Total: 60 Ecological site: 12 Water efficiency: 5 Energy and atmosphere: 16 Materials and resources: 10 Quality of interior environment: 12 Innovation and design process: 5
Did they consider the 4 pillars of sustainability in their sustainability strategy?	Only environmental
What were the main sustainable strategies adopted?	Compactness – for LEED categories predominantly
Did they adopt sustainable strategies outside LEED credit requirements?	no
Identify elements that would communicate 'green' to the general public – green roofs, windmills, solar panels, organic shapes, etc	Green roof, solar panels
Interpretation of Approach to SD Inquiry	
General worldview of the team regarding sustainability - preventive (juxtaposed LEED credits) or precautionary (integrated systemic solution)	Preventive (juxtaposed LEED credits)

TABLE 20: PRACTICAL TENSIONS IDENTIFIED FOR SAUCIER + PERROTTE OF THE MONTREAL PLANETARIUM COMPETITION

Categories of Practical Tensions	Identified Practical Tensions
Political Objectives/ Cultural Repercussions	The way in which the LEED solutions were proposed appeared to be more of a political statement (agreeing to comply) than an approach that convinced the jury of their commitment towards sustainable solutions. Yet they proposed the second most LEED points.
Requirements In Brief/ Context Of Site	None were defied
Environmental Performance/ Quality of Space	Because the building itself was very compact, according to the jury report, the interior space offered very little varied experiences, therefore compromising the usability of the space.
Environmental Performance/ Constructive Choices	None were evident.
Environmental Performance/ Aesthetic Quality	The green roof necessary for LEED credits did not integrate well with the building itself nor the site.
Diverging views (either among jurors or between the juror and the finalist proposal)	None

CROFT PELLETIER / JODOIN LAMARRE PRATTE / ARCHITECTES EN CONSORTIUM / DESSAU / SDK[100]

This project was ranked one of the top two projects among the four finalists for this competition. The proposed a solution that would attempt to obtain 59 LEED credits. Their proposal regarding the sustainability criteria for this project included an idea called the "Living Machine". This is how they describe their concept of the "Living Machine":

> *« Une partie des eaux noires contenant des matières organiques sera envoyée dans des bassins d'aquaculture (LIVING MACHINE ™) pour recevoir un traitement. L'eau filtrée et purifiée naturellement à l'aide de plantes et d'organismes vivants sera une vitrine sur des processus de purification biologique. En plus le biogaz produit par la décomposition des déchets transformés en énergie servira à alimenter l'éclairage du hall niveau 100. » (Croft Pelletier et al., 2009, p.3).*

100 The proposal text and images were obtained from www.ccc.umontreal.ca

There was no other description regarding this concept of the “Living Machine”, so it is not clear to the jury what this team was referring to, other than that they will create an organic cycle within the building by using the black water coming from the building. There was not enough information in their descriptive text to fully understand how this idea would operate. The jury did not find this idea convincing (Ville de Montréal, 2009b) and therefore felt that many of the strategies in this concept were debatable. This is what the jury stated regarding this idea:

> *« Au plan du développement durable, plusieurs stratégies sélectionnées sont discutables dont le «Living Machine» en raison de la présence de services municipaux, de même que les points d'innovation.» (Ville de Montréal, 2009b, p.6)*

By municipal services, the jury implied that the intervention this team proposed for their “Living Machine” may interfere with existing municipal services and therefore may not be a realistic strategy for sustainable development. By points of innovation, the jury was referring directly to the LEED credits in the category of “Innovation and Design”, since this “Living Machine” was not a promising idea for the jury. Yet, this team claimed that,

> *« La synergie entre les systèmes est la stratégie visée pour l’atteinte des objectifs de la certification LEED niveau platine. Ce, même si aucun point d’énergie renouvelable n’est atteint à cause des contraintes économiques. Des solutions innovantes ont été choisies pour maximiser l’optimisation de la performance du bâtiment au lieu d’infrastructures couteuses, pour qu’il y ait un équilibre entre résultat écologique et les dépenses encourues. Dès lors, le projet se développe en étroite relation avec la nature où tout est inter relié » (Croft Pelletier et al., 2009, p.3)*

So they sought to obtain LEED credits by ensuring that the budget was still maintained, without resorting to expensive technical solutions. Because of the lack of information regarding their strategy of “Living Machine”, it was difficult to assess if it could be realistic. However, their strategy of compactness is an example of an inexpensive approach to address the questions of performance optimisations. Even if this was not mentioned in their discourse, compactness was a driving force in their sustainable strategy as their structure was not as spread out on the site as the other finalists.

This is an example of a contradiction between the intent of the design team and the interpretation by the jury. Could it be that as the definition and the operations to get to a more sustainable project have not been clearly defined in the brief, beyond the LEED credits to obtain, the conflicts of interpretation are inevitable? On the one hand, the jury felt that their 'Living Machine' concept was questionable, yet, for this team this strategy represented a way to move beyond LEED.

This project was distinct from the others in that it was inspired by a dominant analogical idea – that of the black hole. The jury felt that this analogy was well developed and provided spectacular sculptural qualities, although the jury felt that the idea was also debatable. This team proved to adopt a critical perspective regarding the way they addressed the site and how the new project would integrate with the existing buildings. They decided that their building would become the central unifying nucleus and not only a building that would be compatible with the other buildings on the site, as was required in the brief. Their intent was to:

> *« ajouter un édifice qui y contribuerait, tel un noyau central unificateur, celle de créer un lieu d'émerveillement, de découverte, de stimulation, d'apprentissage et ce, même en dehors des limites du bâtiment » (Croft Pelletier et al., 2009, p.1)*

So, there was an enormous focus on the symbolism and on the sculptural element of the building. This team was also concerned with the requirement to revitalize the site by adopting the idea of *"absence and presence*". Here they decided to introduce nothing on the site at the level of the passersby so as to improve the permeability and conditions for appropriating the space by all visitors (see Figure 23).

The intent was to have this exterior space become a vast *'piazza'*. This effort on the part of the team demonstrated their concern for community and social revitalization and how these were addressed through architectural elements. Yet the jury deemed this decision as problematic. In the jury report, this is what was stated:

> *« (…) le parti ne propose aucune restauration de l'espace végétal du site, déjà déficient.» (Ville de Montréal, 2009b, p.6)*

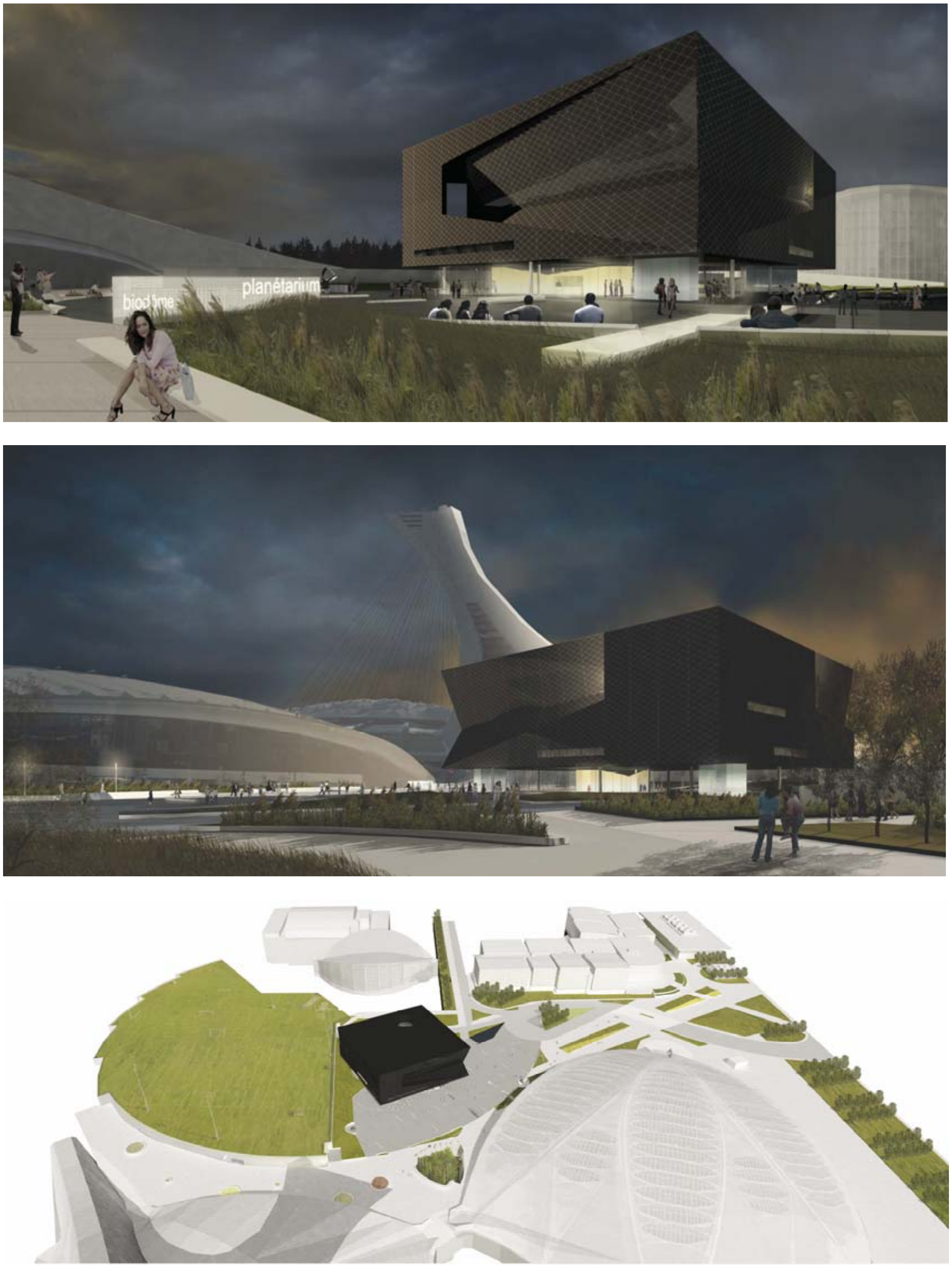

FIGURE 23: FINALIST PROPOSAL BY CROFT PELLETIER FOR THE MONTREAL PLANETARIUM COMPETITION (TOP, MAIN ENTRANCE; MIDDLE, VIEW FROM MAIN AXE; BOTTOM, AERIAL VIEW)

The jury felt that the lack of green space proposed was a major weakness as the site is already deficient of any green space. What was interesting about this proposal was the way in which they challenged some of the brief requirements, in subtle ways but with results that had an impressive impact on the jury. The idea of "absence and presence" showed their capacity to explore dialectical poles in order to come to an idea that encapsulates both - the space is absent of physical elements in order that it may be present of social and community activity.

However, the drawback was that the jury felt that they did not propose any solution regarding the greening of the site, a critique regarding the environmental performance of this project. It is important to emphasise that this site is predominantly surrounded by white cement structures and that the introduction of vegetation on the site is representative of a LEED credit. This team compromised a LEED credit (the greening of the site) so that both social revitalization and cultural activities are encouraged through the introduction of a 'piazza'. Table 21 presents the general data for this project. Table 22 presents the practical tensions for this project.

TABLE 21: GENERAL DATA FOR CROFT PELLETIER OF THE MONTREAL PLANETARIUM COMPETITION

General Descriptive Data for each Finalist	**Data**
City and country of team	Montreal, Canada
Number of LEED points sought and distribution	Total: 59 Ecological site: 12 Water efficiency: 5 Energy and atmosphere: 13 Materials and resources: 9 Quality of interior environment: 15 Innovation and design process: 5
Did they consider the 4 pillars of sustainability in their sustainability strategy?	Only environmental
What were the main sustainable strategies adopted?	Living Machine – black water treatment which was questioned by the jury, compactness (for LEED)
Did they adopt sustainable strategies outside LEED credit requirements?	Their idea of absence and presence was intended to improve the use of the outside space similar to the idea of a 'piazza', so a social concern was addressed here.
Identify elements that would communicate 'green' to the general public – green roofs, windmills, solar panels, organic shapes, etc	none
Interpretation of Approach to SD Inquiry	
General worldview of the team regarding sustainability - preventive (juxtaposed LEED credits) or precautionary (integrated systemic solution)	Preventive (juxtaposed LEED credits)

TABLE 22: PRACTICAL TENSIONS IDENTIFIED FOR CROFT PELLETIER OF THE MONTREAL PLANETARIUM COMPETITION

Categories of Practical Tensions	**Identified Practical Tensions**
Political Objectives/ Cultural Repercussions	None evidenced in jury report or in proposal
Requirements In Brief/ Context Of Site	The idea of absence and presence defied the brief in that they did not propose any green outside space, but was such a requirement. This idea was meant to enhance the social space by constructing a kind of 'piazza'.
Environmental Performance/ Quality of Space	Although the jury stated that the circulation of space was constraining, this did not seem to be related to any LEED credits, so none evidenced.
Environmental Performance/ Constructive Choices	None evidenced.
Environmental Performance/ Aesthetic Quality	In this case, the environmental performance solution proposed for the envelope was synergistic to the aesthetic (sculptural and spectacular) quality and not in tension to the aesthetic quality, as stated by the jury. On the other hand, their idea of 'piazza' meant to encourage social interaction outside the planetarium adopted a strategy where they did not improve the outside green space. Their concern addressed a social concern that was solved with a solution that was directly in contrast with an environmental benefit – improvement of green space.
Diverging views (either among jurors or between the juror and the finalist proposal)	As this project was one of the two final projects left in the final deliberation, the jurors were split between this project and the final winning project by Cardin Ramirez.

WINNING PROJECT : CARDIN+RAMIREZ / AEDIFICA / SNC LAVALIN / DUPRAS-LEDOUX / FAUTEUX ET ASSOCIÉS

The project proposed 53 LEED credits, signifying LEED Platinum. So the winning team sought the least number of LEED credits. However, on the most part, the building was completely immersed underground, so the solutions to attain LEED credits were not based on passive, but on solutions that required expensive technical equipment. However, in the jury report, they stated that this project adopted passive strategies for addressing the environmental strategies. Could it be that the extensive exterior green space was considered a passive strategy for the jury? In the description of this team's strategy for LEED certification (the section describing their strategies for sustainability), solutions comprised, on the most part, state of the art technical equipment – all active environmental solutions.

The winning project, whose main visible components from the street level are its telescopic canon shaped theatres, symbolizing astronomical instruments, is otherwise immersed underground – a conservative visual proposal, since telescopic lenses have been the analogical solutions to planetariums many times in the past[101]. Consequently, the analogy of the telescope according to the jury report was not fully developed and recommended that the team further reflect on the symbolism. It is important to emphasize that this was the main visible architectural element for this project above the street level (see Figure 24).

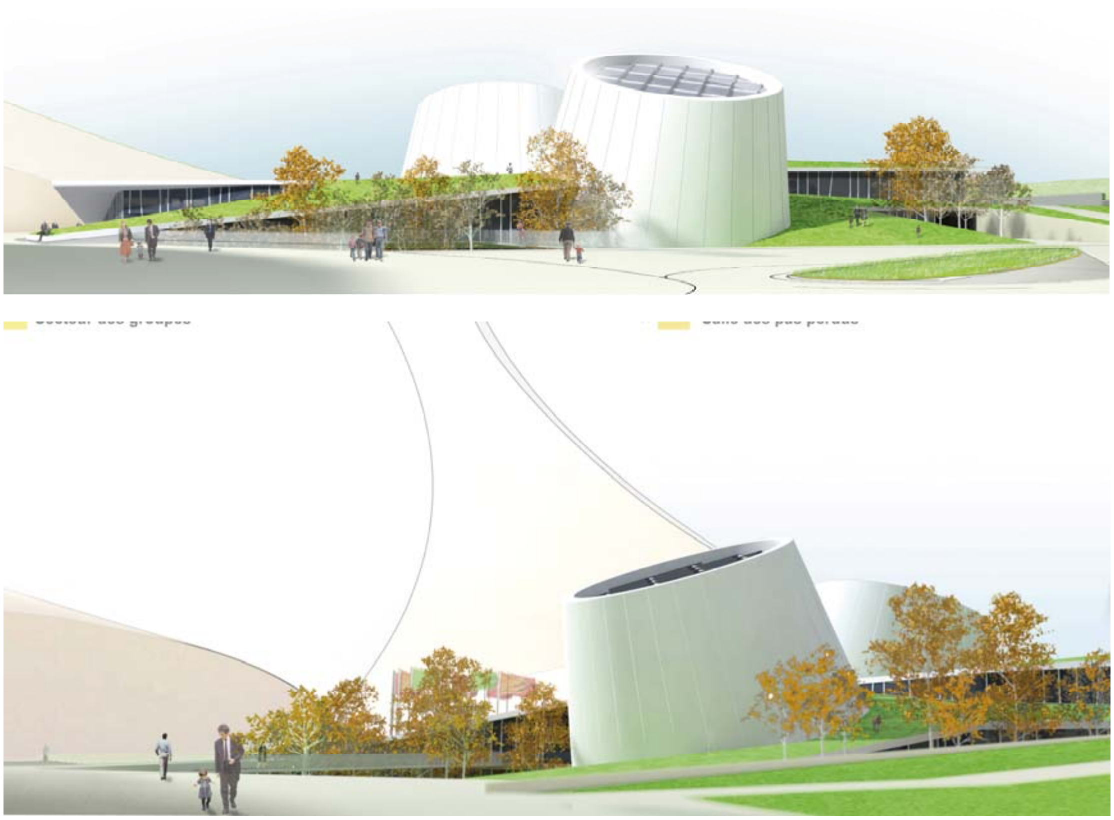

FIGURE 24: WINNING PROPOSAL BY CARDIN-RAMIREZ FOR THE MONTREAL PLANETARIUM COMPETITION (TOP, MAIN ENTRANCE; BOTTOM, VIEW FROM THE STREET VIAU)

101 Some examples of planetariums that have used the telescope as analogy are: Peter Harrison planetarium (Greenwich, London), the Tycho Brahe Planetarium (Copenhagen), Delta College Planetarium (Michigan, USA), BCC Planetarium (Florida, USA).

Comparing this project to that of Croft Pelletier (the black hole project), there is a noticeable difference in terms of land use. The Croft Pelletier project is more compact on the site, whereas this winning project is spread over a large area of the site, albeit, completely underground. Croft Pelletier decided to adopt inexpensive strategies to obtain their LEED Platinum, whereas this team had to resort to expensive infrastructure solutions since the building was almost completely immersed underground. Because of the lack of clarity of the definition of sustainable development in the brief, a conflict resulting from an interpretation of the sustainable development strategies was inevitable, as this example shows.

Consequently, the jury judged that this project was innovative in terms of how it integrated with the site, based on the following quote from the jury report,

> *« Le parti architectural propose une avenue évocatrice d'intégration à la nature, laquelle cadre avec la mission des Muséums nature de Montréal » (Ville de Montréal, 2009b, p.6).*

Yet, the jury also judged as a weakness, the way in which the project was inserted in the site, indicating that the approach was 'timid'. There seems to have been a contradiction in the jury's assessment regarding how the project was inserted onto the site.

This project proposed an extensive exterior green space in order to address the requirement of biodiversity, as the existing site is replete of concrete structures. Their solution was appreciated by the jury since it was an approach that would be clearly visible to the public. The descriptive text by this team describes their sustainable development strategy:

> *« En plus des crédits de ce système, notre proposition offre un nouveau milieu vert appropriable par les usagers : humains, végétaux, insectes, animaux. Les espaces extérieurs proposés permettent une appropriation libre par le public et les employés du Planétarium. Les espaces végétalisés permettent de recréer de petits écosystèmes diversifiés qui redonne place à la vie sous différentes formes. » (Cardin + Ramirez et al., 2009, p.2).*

They addressed the social pillar through the exterior green space and the possibility of encouraging ecosystem diversity by this exterior garden both are not concerns within LEED, yet are benefits as a result of a solution to obtain LEED credits. Here there is a sense of inter-relating the LEED solutions with other elements. However, there was still no attempt to relate the LEED solutions with any of the other more traditional qualitative architectural elements such as aesthetic, constructive choices and quality of space. This is how the jury recommended that the winning team address the symbolism of the project:

> *« (…) Exploration plus poussée de la symbolique des cônes du point de vue iconographique et de la matérialité. » (Ville de Montréal, 2009b, p.7)*

As was mentioned previously, it was important that the solution regarding the environmental sustainability had to be visible and clear to the public - as the first paragraph of the first page of the competition brief stated. The jury considered that this project achieved this:

> *« Le parti architectural intégre, de façon claire, les stratégies environnementales mises de l'avant, dont la stratégie passive » (Ville de Montréal, 2009b, p.6)*

Was this project selected since it would provide the clearest indication to the public that it was the 'greenest' project, based on this team's solution to introduce vegetation? The shows to some extent, that it was more important for the jury to select a winning project that would communicate the idea of sustainability to the public (the vast green space), than to select the most sustainable project.

Let us highlight that this team not only sought the least credits among the other finalists, but also that the majority of their LEED credits were obtained through expensive technical equipment and therefore was at a risk of exceeding the budget as well. Here there is a tension between the political requirements of the city to make sure the winning project projected an image of sustainability and the long-term benefits of the project as a whole.

This project was not voted unanimously. In fact, the president of the jury had to break the tie among the jurors. This was a divided winning project, often considered problematic in the selection of the winning project in the context of an architectural competition. In fact, the jury was unanimous on the need to help the team further develop the idea through a process of architectural design, as the following quote from the jury report states:

« Le jury est unanime sur la nécessité de développer l'idée retenue et d'encadrer l'équipe dans un processus de conception architecturale » (Ville de Montréal, 2009b, p.4).

Table 23 presents the general data for this project. Table 24 presents the practical tensions for this project.

TABLE 23: GENERAL DATA FOR WINNING PROJECT - CARDIN RAMIREZ OF THE MONTREAL PLANETARIUM COMPETITION

General Descriptive Data for each Finalist	Data
City and country of team	Montreal, Canada
Number of LEED points sought and distribution	Total: 53 Ecological site: 12 Water efficiency: 5 Energy and atmosphere: 10 Materials and resources: 9 Quality of interior environment: 13 Innovation and design process: 5
Did they consider the 4 pillars of sustainability in their sustainability strategy?	Environmental, and addresses the social pillar by indicating the social purpose of the exterior space.
What were the main sustainable strategies adopted?	Immersed building covered with green space to improve biodiversity of site.
Did they adopt sustainable strategies outside LEED credit requirements?	Yes, the exterior green spaces are meant as meeting places
Identify elements that would communicate 'green' to the general public – green roofs, windmills, solar panels, organic shapes, etc	Extensive green space and green roof
Interpretation of Approach to SD Inquiry	
General worldview of the team regarding sustainability - preventive (juxtaposed LEED credits) or precautionary (integrated systemic solution)	Preventive (technical solutions)

TABLE 24: PRACTICAL TENSIONS IDENTIFIED FOR WINNING PROJECT - CARDIN RAMIREZ OF THE MONTREAL PLANETARIUM COMPETITION

Categories of Practical Tensions	Identified Practical Tensions
Political Objectives/ Cultural Repercussions	The didactic element of the extensive green space was meant to address the didactic dimension of sustainability and not necessarily the actual environmental sustainability benefits it may provide.
Requirements In Brief/ Context Of Site	None evidenced.
Environmental Performance/ Quality of Space	The jury stated that there was a problem with the fluidity of space between the levels, which could have been a result of the need to integrate in a strict sense, the building with the existing street level – presenting a constraint for the design. This strategy of integrating to the street level was to introduce as much green space as possible.
Environmental Performance/ Constructive Choices	The exterior constructive choice (green roof and green walls) was meant to suggest the idea of sustainability to the public, yet according to the jury, the space was not exploited since there was an ambiguity between the walls and the roof.
Environmental Performance/ Aesthetic Quality	In order that an environmental sustainable message was clear, the envelope selected for this project was entirely made of green space – a solution that the jury felt was also convincing for communicating the idea of sustainability. Yet this resulted in the fact that the only visible exterior elements were the cones, a symbolism that was questioned by the jury.
Diverging views (either among jurors or between the juror and the finalist proposal)	The jurors were split between the winning project and the second place project by Croft Pelletier.

Summary for the Montreal Planetarium Competition

This is an example that illustrates some of the problems resulting from the heavy burden of standard approaches on the design and competition process. As mentioned, the press releases related to this competition seem to indicate that this project would become an example to help position Montreal as a leader in sustainable development, since the requirement for LEED Platinum was clear in all. For example, shortly after the winner was announced, Le Devoir printed the following with regards to this competition:

> *Le concours a mis les choses au clair: le bâtiment devait respecter les normes écologiques les plus hautes, la certification LEED platine. Outre un toit vert, «qui accroche», il fallait, selon Pierre Lacombe, «maximiser la lumière naturelle, penser économie d'énergie et récupération d'eau». (Le Devoir, March 12, 2010, Jerome Delgado, Actualités culturelles)*

Have the use of such standards in competitions become the implicit privileged vehicle of communication for a region's environmental policies instead of using competitions as a way to find the best solution for a public building?

There are already examples of projects adopting the LEED norm with hardly any redeeming architectural qualities. An opportunity to renew the architectural form may have been missed for this competition because of a strict emphasis on sustainability or more specifically on LEED.

The fact that the wining project sought the least credits appears odd, given that the LEED criterion for sustainability was so important. However, when one considers the extensive green space that this project proposed, and that one of the important criteria was the message of sustainable development that the winning project would project, then it becomes clearer why this project, although seeking the least LEED credits rose above the rest. The vast green space will transmit clearly to a public, especially in a society where the term sustainability is so vague, but where green space is already a symbolic norm for sustainable development.

Table 25 on the next page presents a general summary for the finalist proposals of this competition.

TABLE 25: GENERAL DATA FOR ALL FINALISTS OF THE MONTREAL PLANETARIUM COMPETITION

General Description of Data to Collect	Big City /l'OEUF	Chevalier Morales/ FABG	Saucier Perrotte	Croft Pelletier	Cardin Ramirez
City and country of team	Montreal, Canada	Montreal, Canada	Montreal, Canada	Montreal, Canada	Montreal, Canada
Number of LEED points sought and distribution	Total: 62 ES[102]: 14 WE[103]: 5 EA[104]: 17 MR[105]: 14 QIE[106]: 15 ID[107]: 5	Total: 57 ES: 14 WE: 5 EA: 17 MR: 14 QIE: 15 ID: 5	Total: 60 ES: 12 WE: 5 EA: 16 MR: 10 QIE: 12 ID: 5	Total: 59 ES: 12 WE: 5 EA: 13 MR: 9 QIE: 15 ID: 5	Total: 53 ES: 12 WE: 5 EA: 10 MR: 9 QIE: 13 ID: 5
Did they consider the 4 pillars of sustainability in their sustainability strategy?	yes	Only environment	Only environment	Only environment	Only environment
What were the main sustainable strategies adopted?	Mostly passive strategies	Orientation of building to take advantage of natural light, wind, and sun exposure	Compactness – mostly for LEED categories	Living Machine – black water treatment which was questioned by the jury, compactness (for LEED)	Immersed building covered with green space to improve biodiversity of site.
Did they adopt sustainable strategies outside LEED credit requirements?	Yes.	no	no	Yes.	no
Identify elements that would communicate 'green' to the general public – green roofs, windmills, solar panels, organic shapes, etc	Solar panels, green roof	none	Green roof, solar panels	none	Extensive green space and green roof
Interpretation of Approach to SD Inquiry					
General worldview of the team regarding sustainability - preventive (juxtaposed LEED credits) or precautionary (integrated systemic solution)	Precautionary (integrated systemic solution)	Preventive (juxtaposed LEED credits) mostly. One example of a systemic vision (envelope).	Preventive (juxtaposed LEED credits)	Preventive (juxtaposed LEED credits)	Preventive (technical solutions)

102 Refers to Ecological site

103 Refers to Water efficiency

104 Refers to Energy and atmosphere

105 Refers to Materials and resources

106 Refers to Quality of interior environment

107 Refers to Innovation and design process

Summary of Practical Tensions for the Montreal Planetarium Competition

There are several tensions exhibited in this competition as a result of a strict adherence to LEED and the need to communicate a sustainable project. First, a tension between the requirements defined in the brief and the context of site is evident for the Croft Pelletier project, since they reinterpreted some of the requirements, which did not satisfy the jury. Also there was a clear tension between the political context since the project had to have a didactic dimension suggesting its sustainable approach – in other words, a project that had visible elements clearly suggesting it to be the most sustainable.

Since the project by Croft-Pelletier did not propose any significant green space, and therefore did not present a perception of a sustainable project, the jury judged this as a weakness – suggesting a tension between the environmental performance and the symbolic dimension. The project by Saucier Perrotte exhibited an imbalance between its compactness and the quality of space provided. The project by Big City/l'OEUF showed that the requirement to be environmentally efficient presented a conflict with the language they adopted for the form and structure of the building – a contradiction.

Table 26 presents a summary of the tensions for this competition.

TABLE 26: SUMMARY OF PRACTICAL TENSIONS EXHIBITED FOR THE NEW MONTREAL PLANETARIUM COMPETITION WHEN ADOPTING LEED

Practical Tensions	**Big City / l'OEUF**	**Chevalier Morales/ FABG**	**Saucier Perrotte**	**Croft Pelletier**	**Cardin Ramirez**	**Jury**
Political objectives vs. cultural repercussions	None	None. The jury disqualified this team immediately because of its project incoherence – no indication in jury report of political bias. The jury could not understand the project.	The way in which the LEED solutions were proposed appeared to be more of a political statement (agreeing to comply) than an approach that convinced the jury of their commitment towards sustainable solutions. Yet they proposed the second most LEED points.	None	The didactic element of the extensive green space was meant to address the didactic dimension of sustainability and not necessarily the actual environmental sustainability benefits it may provide.	The jury was driven by the LEED requirement. It represented 20% of the total weighting. So it was important that the winning project was the most visibly sustainable so the didactic dimension was important.
Requirements in brief vs. context of site	None	None	None	The idea of absence and presence defied the brief in that they did not propose any green outside space, but was such a requirement. This idea was meant to enhance the social space by constructing a kind of 'piazza'.	None	As the green roof and the greening of the site was important, the jury considered that the team that did not propose any green exterior space even if the reason for not greening the site was abundantly justified.
Environmental performance vs. quality of space	None	According to the jury, the orientation of the building would introduce solar gains that would affect the functionality of the planetarium. This was their main strategy for sustainability	Because the building itself was very compact, according to the jury report, the interior space offered very little varied experiences, therefore compromising the usability of the space.	Although the jury stated that the circulation of space was constraining, this did not seem to be related to any LEED credits, so none evidenced.	The jury stated that there was a problem with the fluidity of space between the levels, which could have been a result of the need to integrate in a strict sense, the building with the existing street level – presenting a constraint for the design. This strategy of integrating to the street level was to introduce as much green space as possible.	The winning project had fluidity problems regarding the interior space between the levels which may have been a result of immersing the entire building underground.
Environmental performance vs. constructive choices	The massiveness of the volume did not marvel the jury (the exterior solar panels contributed to this massive effect).	The envelope selected by the team to reduce solar overheating was problematic for the jury because of risk of overheating.	None	None	The exterior constructive choice (green roof and green walls) was meant to suggest the idea of sustainability to the public, yet according to the jury, the space was not exploited since there was an ambiguity between the walls and the roof.	
Environmental performance vs. aesthetic quality	According to the jury, the green roof was incoherent with the symbolism they proposed.	The envelope was selected for its symbolic (aesthetic) quality but was also used to protect from solar rays, yet the jury felt stated that it would result in solar overheating rendering the planetarium non-functional.	The green roof necessary for LEED credits did not integrate well with the building itself nor the site.	In this case, the environmental performance solution proposed for the envelope was synergistic to the aesthetic (sculptural and spectacular) quality and not in tension to the aesthetic quality, as stated by the jury. On the other hand, their idea of 'piazza' meant to encourage social interaction outside the planetarium adopted a strategy where they did not improve the outside green space. Their concern addressed a social concern that was solved with a solution that was directly in contrast with an environmental benefit – improvement of green space.	In order that an environmental sustainable message was clear, the envelope selected for this project was entirely made of green space – a solution that the jury felt was also convincing for communicating the idea of sustainability. Yet this resulted in the fact that the only visible exterior elements were the cones, a symbolism that was questioned by the jury.	In order to ensure that the building depicted a message of sustainability, a green roof and the greening of the exterior space was an imperative. Yet this resulted in a project that was immersed underground without any visible architectural elements except for the telescopic structures.
Diverging views (either among jurors or between the juror and the finalist proposal)	The celestial imagery selected by the team and the green roof do not correspond; the jury felt that the general aesthetic was too heavy.	Choice of envelope and the choice of form were for the jury contradictory	None	As this project was one of the two final projects left in the final deliberation, the jurors were split between this project and the final winning project by Cardin Ramirez.	The jurors were split between the winning project and the second place project by Croft Pelletier.	The jurors could not agree on the winning project and was selected by the extra vote of the president of the jury

It is interesting that for this project all tensions were evident in the jury report. As the requirement for LEED and the projection of an image of sustainability was important, this was reflected in the way in which the jury judged and selected the winning project.

MUSÉE NATIONAL DES BEAUX-ARTS DU QUÉBEC COMPETITION

The Musée National des Beaux-arts du Québec (MNBAQ) launched in June, 2009 for Quebec City had an objective sustainability, where the LEED certification sought was basic (26-32 credits). For Quebec City, since 2009, all public buildings with a budget of more than $2.5 million have to be LEED certified. The budget of the MNBAQ is $90 million, so LEED certification is a requirement based on the policy of the city.

This was a three-stage (non-anonymous) competition. The museum received 108 dossiers from 19 countries. From this, 76 firms respected the deadline of the August 28, 2009 for the deposition of their candidature. Ultimately 70 were revealed as acceptable (the dossiers were considered complete) and they were all included in an analysis by the jury in function of the various criteria laid out in the competition brief. Fifteen of these were selected to be invited to participate in the first phase of the competition. These fifteen came from a variety of geographic locations: 6 from Quebec, 2 from Germany, 1 from England, 1 from Brazil, 1 from the United States, 1 from Holland, 1 from Japan, and 1 from Switzerland. We can say that the selection of the 15 teams show the international spirit of the proposals as well as the jurors. From these 15, five finalists were selected to submit their detailed designs. All finalist groups were associated with teams from outside Canada: Berlin and New York, London, Rotterdam, Portland (USA) and Madrid. It can be said that for the MNBAQ competition, the finalists represented an interesting spectrum of international perspectives. The 5 finalists were:

1. Barkow Leibinger architeken/Imrey Culbert architects, Berlin/New York
2. Brière, Gilbert et associés/Nieto Sobejano, Montreal, Quebec/Madrid, Spain
3. Fichten Soiferman et Associés Architectes/Allied Works Architecture, Montreal, Quebec / Portland (USA)
4. Groupe ARCOP/David Chipperfield architects, Montreal/London, England

5. OMA, Rem Koolhaas/Provencher Roy et Associés, architectes, Rotterdam, Holland /Montreal, Quebec

The jury consisted of 7 people, ranging from client representatives, architects, and architects representing the academic milieu. Two of the 7 jury members were architects from Europe, and neither of these was considered a LEED expert. The jury member that was considered to be the LEED expert was a Quebec architect and member of the *Ordre des architectes du Québec (OAQ)*, whose LEED expertise was recognised at a local level. Table 27 presents the list of the jurors for the MNBAQ

TABLE 27: LIST OF JURORS FOR THE MNBAQ COMPETITION

Jurors	**Description**
A	General director of the Muséums Nature de Montréal and president of the jury
B	International architect and urbanist and director of l'École nationale supérieure d'architecture de Paris Malaquais
C	Main architect of the firm XDGA Architecten from Brussels
D	Architect and president of the OAQ (considered the green expert)
E	Architect and representative of the academic milieu (director of school of architecture ULaval
F	General director of the MNBAQ
G	President of the Fondation du MNBAQ and commissioner of the expansion project

In the press announcement of the 5 finalists, there was no mention of LEED, but there was mention that the sustainable criterion had to be addressed in the upcoming phase,

> *«Le développement du concept permettra de démontrer également le parti « durable » préconisé ». (Ville de Québec, 2009a, p.2)*

The jury was unanimous in the selection of the winning project, by the consortium OMA, Rem Koolhaas / Provencher Roy et Associés. Table 28 presents a general summary for the MNBAQ competition.

TABLE 28: GENERAL COMPETITION INFORMATION FOR THE MNBAQ

General Descriptive Data to Collect	Data
Name of competition	Musée national des beaux-arts du Québec
Location and date of launch of the competition	Quebec, June 2009
Competition type (one phase, two phase, etc.)	Two-phase, first phase dossier (non-anonymous)
Number of entries for each phase	76 dossiers received, 70 dossiers considered complete for first phase, 15 invited to participate in second phase, 5 finalists selected for second phase
Number of jury members, number of architects, number of city representatives, etc.	7 jury members comprising of: 4 architects, 2 representatives of the client (MNBAQ, 1 director of the Natural Museums of Montreal
Position or background of the president of the jury	General director of the Muséums Nature de Montréal
Number of LEED experts on the jury and what level of recognition (regional, national, international)	1 regionally known LEED expert (from Quebec)
LEED certification level required for the competition	LEED Basic
Criteria defined for sustainable development	IDP LEED categories Neighbourhood revitalization Non-vehicle accessibility
Is LEED a sustainable development policy for the municipality in which the competition project will be built	Yes for public buildings exceeding 2.5 million dollars
Type of building (cultural center, library, museum, etc)	Museum

MAIN OBJECTIVES FOR THE MNBAQ COMPETITION

Before beginning with a description of the objectives for this competition, it is important to highlight that a survey was conducted in March 2010 asking the residents of the neighbourhood Saint-Sacrement, Montcalm and Vieux-Québec and 82% of the residents supported this project (Ville de Québec, 2010a). The Dominican Monastery that occupies a part of the site will be demolished. This was already public knowledge at the time that the survey was conducted.

There were three main phases for this competition. An initial phase was done where dossiers were submitted of which 15 teams were selected for invitation for the next stage before selecting the finalists. These dossiers were selected based on the following criteria, as stated in the *Règlement du concours* (Ville de Québec, 2009c, p.24):

• Description of the architectural firm or group	10%
• Project portfolio	15%
• Cultural experience	15%
• Sustainable development experience	15%
• Architectural, urban and landscaping vision	20%
• Make-up of the team for the present project	10%
• Experience of the proposed team	15%

There was 15% given to experience related to sustainable development. The rest was for architectural experience, and vision of the project. The 15 groups were invited to submit a clearly defining idea. From these 15 ideas, 5 would be selected as finalists based on the following criteria, also taken from the *Règlement du concours* (Ville de Québec, 2009c, p.25):

- Overall image, identification and identity of the Museum through the addition of a new pavilion;
- Urban integration: the impact on the site's heritage buildings (the church and presbytery) and on the Grande Allée;
- Balance between the architectural identity and integration of the new pavilion in the physical and historic setting of the Parc des Champs-de-Bataille and its impact on the main entrance to the park;
- Volumetric modulation of the new extension and its overall contribution to a general understanding of the different parts of the museum complex (the schematic functioning of the space);
- Sustainable development possibilities;
- A concept that is within the budget.

The weighting was not provided in this document. From the 5 finalists, the winner was selected based on the following criteria from the *Règlement du concours* (Ville de Québec, 2009c, p.25-26):

- Urban insertion (the impact on the combined heritage – Presbyterian church – and on the main axe of the Grande Allée);

- The coherence with the concept submitted in 2009 (phase 1);
- The quality of the functional organization and its contribution to the museum complex;
- The clarity of the organization of the access, of the circulation and the circuit of the museum visits;
- The quality of the interior spaces of the new pavilion generated by the architectural concept of their evocative potential;
- The pertinence of the architectural treatment with respect to the LEED certification sought;
- The technical feasibility and the respect of the construction budget;
- The quality of the multidisciplinary team.

The weighting was not provided for the phase 2.

FINALISTS FOR THE MNBAQ COMPETITION

In the jury report for phase 2, the words LEED and sustainable development were not used interchangeably. There was a clear distinction regarding the objectives of LEED and those of sustainable development. Each of the projects obtained the LEED Basic accreditation based on the solutions presented, yet not all finalists addressed all other elements identified in sustainable development criterion of this competition (see Table 28 for the list of elements defined in the sustainable development criterion of the MNBAQ competition).

FICHTEN SOIFERMAN ASSOCIÉS/ALLIED WORKS ARCHITECTURE

This team is from Montreal. This project proposed 26 credits with an extra 10 credits of reserve. This team proposed the least LEED credits (when compared with the other finalist proposals) while still satisfying the LEED requirement for this competition. Their discourse on sustainability was limited to the categories and arguments based on obtaining LEED credits. In fact, in their descriptive text, they did not have a section that discussed the more general concerns related to sustainability as required in the brief. In addition, when they presented their solutions, they did not relate them to other architectural qualities. The following is an example of one of this team's discourses related to the facades and roof:

> *« Les façades et toitures exposées au sud et à l'ouest seront composées d'une cavité située entre le parement métallique et l'isolant. L'air chaud à l'intérieur de cette cavité montera par effet de cheminée et sera évacué à l'extérieur pendant la période estivale. Pendant les saisons froides, l'air chaud pourrait être récupéré dans la partie supérieure du bâtiment et mis en réserve dans une voûte technique souterraine isolée (excavée le long de la façade ouest) de manière à la réintroduire selon les besoins du système mécanique. » (Allied Works Architecture / Fichten Soiferman et Associés Architectes, 2010, p.4)*

This argument was closed to the considerations of energy efficiency alone. The critique here is that the team did not make an effort in relating these decisions to other architectural considerations. Yet, as they met the LEED Basic criteria easily based on the number of credits proposed, the jury did not comment on their proposal regarding sustainable development for phase 2. The requirements of an IDP and the need to consider neighbourhood redevelopment were important sustainable development criteria in the brief. The way in which this team addressed neighbourhood redevelopment was through local business opportunities (a predominant socio-economic perspective):

> *« L'usage de matériaux locaux, durables, renouvelables, contenant un pourcentage de matériel recyclé et émettant peu ou pas de COV est favorisé. » (Allied Works Architecture / Fichten Soiferman et Associés Architectes, 2010, p.4)*

Regarding some of the arguments related to sustainability, in the phase 1 comments for this team, the jury report read (Ville de Québec, 2010b, p.8-9),

> *« Les notions de développement durable demeurent au niveau conceptuel. (...) Le concept propose la récupération de la pierre; les tests de sol démontrent un roc réagissant à l'air, donc inutilisable. (…) Au plan du développement durable, le principe isolant de la neige est faux. »*

So here there were 2 tensions between the solutions proposed by the team and their interpretation by the jury. The first solution of the recuperation of stones and the second solution of using the snow as an effect in the winter were solutions that did not hold as sustainable development strategies for the jury. Although the jury did not agree, there was not enough information to assess which assessment was more accurate. These diverging views are difficult to resolve because of the lack of available data. These ideas were not reiterated or proposed in the team's description for their phase 2 proposal. This demonstrated to some extent their compliance with the perspective of the jury (see Figure 25).

FIGURE 25: FINALST PROPOSAL BY FICHTEN SOIFERMAN FOR THE MNBAQ COMPETITION

Consequently, the jury was split regarding the bold volume of this project. Some felt that the aesthetic was rich and audacious, while others felt that the repetitive nature was rigid and lacked contextual roots. Yet, even if they were divided by the basic aesthetic, they all agreed that the simplicity of this project resulted in an efficient and clear organization of the space. The tensions here stemmed from the fact that the jurors could not agree on the form of the project, as different values system regarding the aesthetic quality of the building were involved in their judgment.

Table 29 presents a summary of some of the general information regarding this finalist project. Table 30 presents some of the identified tensions.

TABLE 29: GENERAL DATA FOR FICHTEN SOIFERMAN OF THE MNBAQ COMPETITION

General Descriptive Data for each Finalist	Data
City and country of team	Montreal, Quebec / Portland (USA)
Number of LEED points sought and distribution	Total: 29 (+16?) so a possible total of 45 credits Ecological site: 8 (+3?) Water efficiency: 3 Energy and atmosphere: 5 (+3?) Materials and resources: 3 (+4?) Quality of interior environment: 7 (+4?) Innovation and design process: 3 (+2?)
Did they consider the 4 pillars of sustainability in their sustainability strategy?	Only environmental
What were the main sustainable strategies adopted?	LEED categories
Did they adopt sustainable strategies outside LEED credit requirements?	no
Identify elements that would communicate 'green' to the general public – green roofs, windmills, solar panels, organic shapes, etc	none
Interpretation of Approach to SD Inquiry	
General worldview of the team regarding sustainability - preventive (juxtaposed LEED credits) or precautionary (integrated systemic solution)	Preventive.

TABLE 30: PRACTICAL TENSIONS IDENTIFIED FOR FICHTEN SOIFERMAN OF THE MNBAQ COMPETITION

Categories of Practical Tensions	Identified Practical Tensions
Political Objectives/ Cultural Repercussions	None
Requirements In Brief/ Context Of Site	None
Environmental Performance/ Quality of Space	None, their sustainable development strategy was based on LEED, and therefore essentially disconnected from the rest of the project. But as the LEED requirement basic, it did not seem to affect the constructive, functional or aesthetic choices made.
Environmental Performance/ Constructive Choices	None
Environmental Performance/ Aesthetic Quality	None
Diverging views (either among jurors or between the juror and the finalist proposal)	1. The jury and the team had diverging views on the benefit of the snow as an isolating material and the recuperation of stones. 2. There was a tension among the jury members regarding the aesthetic of the building, where some felt it was bold and others felt it was rigid.

David Chipperfield/Groupe Arcop

This team sought 33 LEED credits plus an additional 9 credits – meaning a minimum of LEED silver with a possible LEED Gold if necessary. Therefore the environmental sustainability criteria defined by LEED credits was met. In their descriptive text, this team states that:

> *« Une approche holistique de la durabilité réelle est essentielle à notre processus de conception, influençant l'architecture, les matériaux et les systèmes, avec des caractéristiques durables intégrées à même l'architecture. » (David Chipperfield Architects / Le groupe Arcop Architectes, 2010, p.4)*

Yet in the discourse that follows, all the arguments refer to energy efficiency strategies (a preventive approach to sustainability) even if some of them refer to strategies that are passive (for example: the use of wood instead of cement because wood is more insulating, is an example of a passive strategy, whereas the use of solar energy is an example of an active strategy). The following is a quote that can show their preventive approach to design for sustainability:

> *« Plus important encore, celle-ci oriente la conception vers une réduction des émissions de gaz à effets de serre (GES) à un niveau inférieur à celui recommandé par le standard Défi 2030, un guide de réduction d'émissions de GES, qui recommande une réduction de 60% de l'usage des combustibles fossiles pour 2010. (David Chipperfield Architects / Le groupe Arcop Architectes, 2010, p.4)*

It is essentially an approach to design for sustainability that focuses on performance optimizations based on energy efficiency (and therefore the accumulation of LEED credits) and does not consider neighbourhood redevelopment (one of the sustainable development criteria defined in the brief). Consequently, this team had not yet adopted an IDP, but plans to adopt this approach to design in the next phases, as the following quote shows:

> *« Pour définir le niveau de certification finale du projet, un processus de design intégré doit être entrepris impliquant tous les professionnels de toutes les disciplines. » (David Chipperfield Architects / Le groupe Arcop Architectes, 2010, p.4)*

However, it is at the very beginning of the design project where the synergies among the various professionals will make the largest difference to the final project, since the farther the project is, the harder it is to make significant changes that cut across the work of the various professionals. The focus on performance optimizations may have had an impact on the aesthetic since the jury considered that:

> *« En résumé, le projet répond à tous les critères sans recherche ni surprise. Il n'est pas conforme au niveau de la superficie globale, principalement pour les fonctions au sous-sol. Cette amputation a été rendue nécessaire pour respecter le budget.» (Ville de Québec, 2010c, p.4)*

Therefore this project also presented other deficiencies as they did not conform to the global superficial area defined in the brief. According to the jury, this had to be done in order that this team respect the budget. Here, there was a tension between the need to meet the budget and the functioning of the museum, since this resulted in a lack of functionality in the basement (see Figure 26).

FIGURE 26: FINALIST PROPOSAL BY DAVID CHIPPERFIELD FOR THE MNBAQ COMPETITION

Could it be that they focused so heavily on trying to surpass the LEED requirement that they neglected other important criteria stated in the brief? The paradox is that even if they did have a very strong technical program for LEED, they did not try to link any of these within the broader perspective of the architectural project, and in focusing so heavily on the technical LEED aspects, some important functional elements (total available area) may have been compromised, as the above quote shows.

Table 31 presents the general data for this finalist related to LEED and sustainability. Table 32 presents a summary of the tensions observed.

TABLE 31: GENERAL DATA FOR DAVID CHIPPERFIELD OF THE MNBAQ COMPETITION

General Descriptive Data for each Finalist	Data
City and country of team	London, England/Montreal, Canada
Number of LEED points sought and distribution	Total: 33 (+9?) Ecological site: 8 (+2?) Water efficiency: 3 (+1?) Energy and atmosphere: 3 Materials and resources: 5 (+3?) Quality of interior environment: 10 (+3?) Innovation and design process: 4
Did they consider the 4 pillars of sustainability in their sustainability strategy?	Only environmental
What were the main sustainable strategies adopted?	Energy efficiency for the reduction of greenhouse gas emissions
Did they adopt sustainable strategies outside LEED credit requirements?	no
Identify elements that would communicate 'green' to the general public – green roofs, windmills, solar panels, organic shapes, etc	No clear visible elements
Interpretation of Approach to SD Inquiry	
General worldview of the team regarding sustainability - preventive (juxtaposed LEED credits) or precautionary (integrated systemic solution)	Preventive (energy efficiency)

TABLE 32: PRACTICAL TENSIONS IDENTIFIED FOR DAVID CHIPPERFIELD OF THE MNBAQ COMPETITION

Categories of Practical Tensions	Identified Practical Tensions
Political Objectives/ Cultural Repercussions	None
Requirements In Brief/ Context Of Site	None, based on explicit argumentation
Environmental Performance/ Quality of Space	The functionality of the basement was compromised because the superficial areas did not meet the requirements. This was done by the team in order to meet the budget.
Environmental Performance/ Constructive Choices	None
Environmental Performance/ Aesthetic Quality	The jury felt that all the requirements were met, yet the spaces are not dynamic and there is no element of surprise.
Diverging views (either among jurors or between the juror and the finalist proposal)	None

BARKOW LEIBINGER/GLCRM

This team proposed 38, with 10 credits that were undecided. This refers to a LEED silver and LEED Gold certification, therefore far beyond the LEED Basic criteria required in the brief. What is interesting is that in this team's design text, the title describing the sustainable development strategies was the following:

> *« Développent Durable. Efficacité et précision: dans une économie des moyens mis en œuvre » (Barkow Leibinger + Imrey Culbert, 2010, p.5)*

The title of their section on sustainable development indicates that their approach is predominantly preventive, since the focus is on an efficiency and precision – "doing the thing right" and not necessarily "doing the right thing"[108]. To confirm this approach for their sustainable development strategy is the first sentence of this section, which states that:

> *« Système d'éclairage et de ventilation naturels, géothermie, dalles radiantes, eau de pluie récupérée, ce nouvel édifice intègre plusieurs innovations en matière de développement durable et d'éco-ingénierie dépassant les exigences de la norme Argent du système LEED. » (Barkow Leibinger + Imrey Culbert, 2010, p.5)*

In this quote, their direction of leading edge technology to solve the problem of sustainable development based on a strategy of efficiency and therefore a preventive approach to design for sustainability is confirmed. In fact, this team states that they would like to arrive at LEED Platinum, but this requires the integration of the whole team, including, of which they only state the signature of a contract with Energie verte, as the following quote shows:

> *« Afin de viser l'obtention du LEED d'or, voire Platine, l'implication de l'ensemble de l'équipe avec par exemple la signature d'un contrat Energie verte est essentiel. » (Barkow Leibinger + Imrey Culbert, 2010, p.5)*

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108 As mentioned in the first chapter of thesis, according to Strahel (2001), sufficiency refers to "doing the right thing", while efficiency refers to "doing things right".

Consequently, they state that they address the three pillars of sustainable development, but their approach to these three domains is again preventive, based on the elements they will consider in each:

> *« Développement durable prendra donc en compte les trois éléments suivant: l'économie (coût global), l'environnement (réduction des impacts énergétique et environnemental du bâtiment), et le social (qualité et confort du bâtiment). » (Barkow Leibinger + Imrey Culbert, 2010, p.5)*

Their mention of the 3 pillars of sustainability demonstrates that they are aware that sustainability is not only about the environment. However, they way in which they propose to address the three pillars is limited and based on a preventive approach. Having said this, it is reasonable since the brief also proposes a very limited perspective of sustainability. Just to illustrate the limitations of this perspective based on a precautionary approach, for the economic pillar, they are concerned with the cost of their project instead of a more global concern of the economic development that this project may engender for the community, and therefore an equitable distribution of wealth based on this project. The same kind of argument can be said regarding the environmental concern, since their approach is focused on the reduction of energy and environmental impacts, again a preventive efficiency approach. As for the social pillar, they focus on quality and comfort of the building, an approach that is founded on measurable and provable solutions to comfort, instead of a more global perspective would also include the concern of social revitalization and inclusion. The following quote clarifies their approach to the social pillar of sustainability, as this is their only mention of comfort in this section:

> *«**Confort acoustique :** les moyens ont été mis en œuvre pour garantir une qualité acoustique d'un excellent niveau.» (Barkow Leibinger + Imrey Culbert, 2010, p.5)*

What is interesting is that for this project, as mentioned before, the sustainable development criteria defined in the brief is not limited to LEED, but IDP, neighbourhood redevelopment and alternative transport to cars are also included in the set of criteria. This team did not mention neighbourhood redevelopment, nor alternative transport in their discourse related to sustainability (see Figure 27).

FIGURE 27: FINALIST PROPOSAL BY BARKOW LEIBINGER FOR THE MNBAQ COMPETITION

In addition, this team defied some requirements specific to the brief (absence of an entry on the city, the uniformity of the facades, the use of the entire space, etc.), which would be fine and welcoming, with sufficient justification and convincing argumentation. In other words, that the team was actually able to reveal elements that the brief may have overlooked. This was not the case however. The jury report stated that:

> *« Ce projet propose une approche valable à caractère expérimental, à l'encontre de certaines évidences dont : l'absence d'entrée sur la ville; l'uniformité des façades; l'utilisation de tout le terrain; l'allégorie industrielle dans un contexte muséal urbain. » (Ville de Québec, 2010c, p.5)*

The jury felt that this project was too experimental since some main architectural elements defied basic assumptions for the museum context. In fact, some of these basic assumptions, according to the jury, were in the brief:

> *« Il génère des espaces qui diffèrent du programme: l'entrée principale à l'arrière, l'auditorium transparent, l'exposition temporaire sur la rue, et sur deux (2) niveaux, la toiture englobant celle du presbytère ». (Ville de Québec, 2010c, p.5)*

Although, these characteristics that defied the brief could have been justified by the team, the jury was not convinced. The overwhelming roof that overtook that of the church and the building structure that occupied the entire site resulted in an imposing structure. On this point, the imposing aesthetic and the lack of the building's integration with the existing site and therefore its lack of contextual consideration is questionable, as was stated by the jury. It seems that their focus on technology and the need to go beyond the LEED Basic requirement impacted the aesthetic and the functionality of the project.

Table 33 presents a summary of the general data regarding this finalist. Table 34 presents a summary of the identified practical tensions.

TABLE 33: GENERAL DATA FOR BARKOW LEIBINGER OF THE MNBAQ COMPETITION

General Descriptive Data for each Finalist	**Data**
City and country of team	Berlin, Germany/New York, USA
Number of LEED points sought and distribution	Total: 38 (+10?) Ecological site: 7 (+2?) Water efficiency: 4 Energy and atmosphere: 6 (+4?) Materials and resources: 5 (+3?) Quality of interior environment: 12 Innovation and design process: 4 (+1?)
Did they consider the 4 pillars of sustainability in their sustainability strategy?	They mentioned 3, economy, environment and society.
What were the main sustainable strategies adopted?	Efficiency and economy of means
Did they adopt sustainable strategies outside LEED credit requirements?	no
Identify elements that would communicate ‘green’ to the general public – green roofs, windmills, solar panels, organic shapes, etc	none
Interpretation of Approach to SD Inquiry	
General worldview of the team regarding sustainability - preventive (juxtaposed LEED credits) or precautionary (integrated systemic solution)	Preventive (strategy of efficacy based on the leading edge technology)

TABLE 34: PRACTICAL TENSIONS IDENTIFIED FOR BARKOW LEIBINGER OF THE MNBAQ COMPETITION

Categories of Practical Tensions	Identified Practical Tensions
Political Objectives/ Cultural Repercussions	None
Requirements In Brief/ Context Of Site	There were many examples in this project where the requirements in the brief were defied, but as the contextual relevance of their proposal was questioned (the massive structure), then the tension here was between the requirement in the brief and the experimental quality of the project.
Environmental Performance/ Quality of Space	The functionality was comprised since for the jury, the priority was given to secondary elements.
Environmental Performance/ Constructive Choices	None
Environmental Performance/ Aesthetic Quality	The focus on the environmental performance (the roof design was essential in the energy efficiency of the building) resulted in an aesthetic that was imposing and not adapted to the site.
Diverging views (either among jurors or between the juror and the finalist proposal)	None

Nieto Sobejano/Brière Gilbert

This team sought 30 credits, with four undecided credits. This is a LEED Basic accreditation with possible LEED silver. In the first paragraph describing their sustainable development strategies, they claim to adopt a global perspective, as this quote indicates:

> *« Considérant la vocation du projet, l'histoire du lieu et les critères spécifiques LEED à rencontrer; le concept architectural et l'ensemble des stratégies proposées s'inscrivent dans une perspective globale de développement durable. » (Nieto Sobejano & Brière, 2010, p.2)*

Yet, they follow this by stating their main concern and strategy for sustainable development to be:

> *« L'enjeu principal du développement durable appliqué à notre concept est de faire autant, surtout mieux, avec moins. Les défis techniques, fonctionnels et esthétiques se résument par la réduction de la consommation de nos ressources. » (Nieto Sobejano & Brière, 2010, p.2)*

Their strategy is therefore one of eco-efficiency, albeit, in a perspective where they seek to relate the idea of eco-efficiency with the technical, functional and aesthetic dimensions of the project. But their strategy of efficiency will adopt the idea of compactness,

> *« Le caractère compact de l'implantation et de la volumétrie du projet; les principaux matériaux mettant l'emphase sur leur spécificité locale, le recyclage et la récupération (aluminium, bois et pierre); l'utilisation de la géothermie dans une perspective de performance optimisée; le toit-jardin; et le concept d'une structure mixte minimisant les hauteurs et la matière; sont toutes des stratégies qui visent à réduire (…). » (Nieto Sobejano & Brière, 2010, p.2)*

This approach will undoubtedly affect the functionality and aesthetic, just as the jury pointed out in the following statement from the jury report:

> *« Le parti formel a créé des contraintes fonctionnelles insolubles; il est limité et enfermé dans son architecture (...) L'entrée n'est pas à l'échelle d'un musée ni de la ville alors que le volume du hall n'invite pas le public vers les expositions permanentes (…). » (Ville de Québec, 2010c, p.5)*

So the strategy of compactness impacted both the aesthetic and the functionality in a negative way according to the jury – a strategy that was adopted to obtain the LEED credits (see Figure 28).

FIGURE 28: FINALIST PROPOSAL BY NIETO SOBEJANNO & BRIÈRE FOR THE MNBAQ COMPETITION

Having said this, there is also an attempt on the part of this team to make a link between the technical solutions they propose because of energy efficiency and the aesthetic dimension of the project. This is done through one of their sustainable strategies, which is to make use of 3 materials that are abundantly available in Quebec. In their text, they state,

> *« (…) Cette valorisation de trois (3) matériaux fondateurs permet d'accroître autant la performance LEED du projet, que les repères visuels accessibles pour la population et les visiteurs, qui illustrent de façon manifeste, les efforts techniques (et esthétiques) déployés pour engager le projet dans l'application assumée et concrète du développement durable. » (Nieto Sobejano & Brière, 2010, p.2)*

This indicates that they sought to make a link between the aesthetic and socio-cultural. However, with the other sustainable strategy they adopted, that of compactness (as mentioned before), they failed to make this link. A strategy of compactness, although very powerful in some contexts, resulted in a compromise of functionality, space and overall scale. Following this observation, this project failed to consider the museum experience because the compact structure resulted in an interior space that was functionally limiting. In fact the jury judged this project in the following way:

> *« Parti d'une intention urbaine généreuse, le concept a généré une solution des plus valables pour un concours mais non adaptée aux attentes du Musée. » (Ville de Québec, 2010c, p.5)*

Had they adopted a more global approach in trying to comprehend how this strategy of compactness would affect the functionality they may have been able to at least identify these issues and at best, identify alternatives.

On a final note, this team mentioned in their descriptive text that the historical context of the site was also an important consideration for sustainability and that their approach transcended many levels of the architectural project, as this quote shows:

> *« La durabilité est l'une des principales exigences conceptuelles du projet du MNBAQ, non seulement quant à l'utilisation de matériaux recyclés et réutilisés, mais également quant au respect de l'histoire du lieu et du monastère. Dans ce sens, notre concept est centré sur une approche de développement durable qui se transcende à différentes échelles, dans l'ensemble des interventions du projet d'architecture, incluant les critères*

de certification LEED, tout en priorisant la performance globale du projet pour les prochaines décennies. » (Nieto Sobejano & Brière, 2010, p.2)

This team is aware that the historical context is a fundamental concern for sustainability, yet according to the jury, their concern resulted in a project that focused more on the neighbouring buildings than on the cohesion of the museum experience. This is their statement in the jury report regarding this:

« Quoique le projet ait évolué positivement, et que sa présence sur Grande-Allée soit plus affirmée, il ne réussit pas à créer une cohésion muséale, le dialogue se faisant avec les voisins. » (Ville de Québec, 2010c, p.5)

Table 35 presents a summary of the general data related to their sustainability approach. Table 36 presents a strategy of the tensions in this project.

TABLE 35: GENERAL DATA FOR BRIÈRE AND NIETO OF THE MNBAQ COMPETITION

General Descriptive Data for each Finalist	**Data**
City and country of team	Montreal, Canada/Madrid, Spain
Number of LEED points sought and distribution	Total: 30 (+4?) Ecological site: 8 Water efficiency: 4 Energy and atmosphere: 4 (+2?) Materials and resources: 6 (+2?) Quality of interior environment: 6 Innovation and design process: 2
Did they consider the 4 pillars of sustainability in their sustainability strategy?	Their main focus was environmental performance optimizations, but also considered the historical context within a perspective of sustainability.
What were the main sustainable strategies adopted?	Compactness, local materials, energy efficiency
Did they adopt sustainable strategies outside LEED credit requirements?	Yes, their concern for the respect of the historical dimension of the site
Identify elements that would communicate 'green' to the general public – green roofs, windmills, solar panels, organic shapes, etc	Garden roof
Interpretation of Approach to SD Inquiry	
General worldview of the team regarding sustainability - preventive (juxtaposed LEED credits) or precautionary (integrated systemic solution)	Both preventive and precautionary, for their concern regarding the respect of the historical dimension.

TABLE 36: PRACTICAL TENSIONS IDENTIFIED FOR BRIÈRE AND NIETO OF THE MNBAQ COMPETITION

Categories of Practical Tensions	Identified Practical Tensions
Political Objectives/ Cultural Repercussions	None
Requirements In Brief/ Context Of Site	None
Environmental Performance/ Quality of Space	1. The strategy of compactness resulted in functional constraints that seemed to have no resolution for the jurors. 2. Their focus on respecting the historical dimension of the site, compromised the cohesiveness of the museum experience
Environmental Performance/ Constructive Choices	None
Environmental Performance/ Aesthetic Quality	None
Diverging views (either among jurors or between the juror and the finalist proposal)	None

WINNING PROJECT: OMA / PROVENCHER ROY ET ASSOCIÉS, ARCHITECTES

The winning project sought the most LEED credits - 40 credits with an additional 15 possible credits – a minimum of LEED Gold with possible LEED Platinum. The jury report did not mention this in their jury report since LEED Platinum is in fact 3 levels of certification more than necessary. In other words, there were enough extra "backup" credits in this project to ensure that LEED Basic would be obtained.

Having said that, the envelope choice of this project is almost entirely glass, a material often questioned in regards to its lack of energy performance quality. This team knew that this choice of envelope would be challenged by the jury, as this quote from this team's descriptive text highlights:

> *« L'enveloppe du nouveau MNBAQ est constituée d'une peau de verre érigée à l'aide de profilés de verre autoporteurs. Les hivers sévères du Québec constituent un défi pour tout bâtiment de verre. » (Office for Metropolitan Architecture (OMA), 2010, p.2)*

They defended this choice of envelope by claiming that it was a glass that was technically enhanced and thereby offering a superior thermal performance. The following quote is from their descriptive text:

« Dans son application comme élément translucide le système est constitué de profilés de verre double face, intégrant des panneaux isolants de type Nanogel. Cet isolant offre une performance thermique supérieure, tout en permettant la transmission de la lumière naturelle dans le bâtiment. » (Office for Metropolitan Architecture, 2010, p.2)

Yet the jury did not agree with their choice of glass, and therefore the jury's and the team's view on this feature diverged, highlighting a tension. The following quote from the jury report states this diverging opinion:

« Le jury se questionne sur la transparence et la translucidité de l'enveloppe et sa performance énergétique. » (Ville de Québec, 2010c, p.4)

On this note, this team sought 6 out of a maximum of 17 credits in the category of energy and atmosphere, while still achieving a minimum LEED Gold certification. This shows that LEED Platinum is attainable even when the energy performance is not optimal.

Consequently, the main goal for the criteria of sustainability for this team was to ensure that any technical solutions needed to obtain LEED accreditation would also seek to improve the museum experience and reduce user fatigue. The following quote from this team's descriptive text describes the overall sustainable approach:

« Notre but principal est une réduction de l'empreinte carbone du musée, et la réduction de l'utilisation d'énergie de 55% par rapport à un musée moyen, tout en intégrant ces stratégies afin d'améliorer l'expérience muséale et d'en alléger la fatigue. » (Office for Metropolitan Architecture, 2010, p.2)

Therefore there was an attempt to integrate the technical solutions adopted to acquire LEED credits with the overall design of the museum based on a museum experience. On this point, the jury's comments regarding the museum experience for this project was:

« Les accès et la circulation proposent une expérience riche en découvertes, grâce à des percées visuelles sur l'extérieur et l'intérieur. » (Ville de Québec, 2010c, p.4)

Here the relationship between the aesthetic quality related to the constructive choice of the envelope and the criteria for sustainability was positive and not one of tension.

In addition, this team added a green roof, not only because it represents a LEED credit, but also because they felt that a green roof is symbolic of sensitivity to sustainable concerns. Consequently, according to this team, the green roof also allows for additional quality exterior space for the users (see Figure 29). The following is a quote from their text describing the necessity for the green roof,

> *« De plus, le toit vert améliore l'insonorisation, protège les membranes de la toiture des dommages physiques et des rayons ultra-violets, et réoxygène l'air et le filtre des toxines aériennes. Finalement, les toits verts sont le symbole visible de l'engagement environnemental du musée et deviennent des espaces de qualité pour les utilisateurs. » (Office for Metropolitan Architecture, 2010, p.2)*

FIGURE 29: WINNING PROPOSAL BY OMA FOR THE MNBAQ COMPETITION

Here we can see that the technical solution was integrated with the functional (leisure space for users, didactic dimension) as well as the aesthetic (symbolic – perception). The jury stated as a concluding remark for this project,

> *« En conclusion, ce projet est le plus spécifique au site, ce qui en fait un projet unique et distinctif. Il répond le mieux aux quatre (4) attentes suivantes : un projet qui va dialoguer avec son temps et son environnement; un projet complet; une bonne utilisation du bois; une ouverture et un dialogue architecte/client. » (Ville de Québec, 2010c, p.5)*

The arguments used by the jury to justify this project as the winning project were largely based on its aesthetic and cultural impetus, its ability to dialogue at once with the city and the park, its space, both interior and exterior, and the team's ability to evolve, indicating their flexibility and openness for the client's concerns. The jury was unanimous in the selection of this winner.

The main tension observed for this group was that the choice of material for the envelope (glass) was seen to be in contradiction to the energy efficiency sought. However, in summary, on the most part, this team adopted a global perspective of the project and therefore the adoption of LEED was taken as an opportunity and not as a form of constraint for the design process. Table 37 presents a general summary of the general approach for sustainability by this team. Table 38 presents a summary of the tensions exhibited by this team.

TABLE 37: GENERAL DATA FOR OMA OF THE MNBAQ COMPETITION

General Descriptive Data for each Finalist	**Data**
City and country of team	Rotterdam, The Netherlands/Montreal, Canada
Number of LEED points sought and distribution	Total: 40 (+16?) Ecological site: 9 (+6?) Water efficiency: 3 (+2?) Energy and atmosphere: 6 (+2?) Materials and resources: 7 (+2?) Quality of interior environment: 10 (+4?) Innovation and design process: 5
Did they consider the 4 pillars of sustainability in their sustainability strategy?	Not specifically
What were the main sustainable strategies adopted?	Fusing performance enhancements with the museum experience
Did they adopt sustainable strategies outside LEED credit requirements?	No, but considered the interrelationships of the LEED credits with other architectural qualities
Identify elements that would communicate 'green' to the general public – green roofs, windmills, solar panels, organic shapes, etc	Green roof
Interpretation of Approach to SD Inquiry	
General worldview of the team regarding sustainability - preventive (juxtaposed LEED credits) or precautionary (integrated systemic solution)	Precautionary (in the way that their strategies were interrelated)

TABLE 38: PRACTICAL TENSIONS IDENTIFIED FOR OMA OF THE MNBAQ COMPETITION

Categories of Practical Tensions	Identified Practical Tensions
Political Objectives/ Cultural Repercussions	None
Requirements In Brief/ Context Of Site	None
Environmental Performance/ Quality of Space	None
Environmental Performance/ Constructive Choices	The choice of envelope (glass) was in tension with the environmental performance it could provide.
Environmental Performance/ Aesthetic Quality	No
Diverging views (either among jurors or between the juror and the finalist proposal)	The jury disagreed with the teams description of the thermal benefits of the glass envelope.

Summary for the MNBAQ Competition

The international competition for the Musée national des Beaux-arts du Québec illustrated that it is possible to adopt such environmental standards while maintaining a global perspective of the winning project. In this competition, the LEED required was the basic certification - the jurors felt that all teams had easily addressed this requirement. In this sense, this objective was taken off the table, and the jurors were able to focus on the more qualitative dimensions of each of the finalist projects.

In addition, as this was an international competition, the main focus was to select a winning project that would place this project and in turn, Quebec City on the international cultural map, especially since the project was a major cultural center for the capital city of the province of Quebec.

So the political context of the province and the importance of adopting LEED as a way to communicate the sustainable expertise of the province was not the focus. So, in the end, it was not the standard evaluation method that drove the selection of the winning project, but instead the jurors were concerned with quality and excellence above all. Table 39 presents a summary of the general information for each finalist for this competition.

TABLE 39: GENERAL DATA FOR ALL FINALISTS OF THE MNBAQ COMPETITION

General Data	Fichten Soiferman	David Chipperfield	Barkow Leibinger	Nieto Brière	OMA
City and country of team	Montreal, Canada / Portland, USA	London, England/Montreal, Canada	Berlin, Germany /New York, USA	Montreal, Canada/Madrid, Spain	Rotterdam, The Netherlands, Montreal, Canada
Number of LEED points sought and distribution	Total: 29 (+16?) ES: 8 (+3?) WE: 3 EA: 5 (+3?) MR: 3 (+4?) QIE: 7 (+4?) ID: 3 (+2?)	Total: 33 (+9?) ES: 8 (+2?) WE: 3 (+1?) EA: 3 MR: 5 (+3?) QIE: 10 (+3?) ID: 4	Total: 38 (+10?) ES: 7 (+2?) WE: 4 EA: 6 (+4?) MR: 5 (+3?) QIE: 12 ID: 4 (+1?)	Total: 30 (+4?) ES: 8 WE: 4 EA: 4 (+2?) MR: 6 (+2?) QIE: 6 ID: 2	Total: 40 (+16?) ES: 9 (+6?) WE: 3 (+2?) EA: 6 (+2?) MR: 7 (+2?) QIE: 10 (+4?) ID: 5
Did they consider the 4 pillars of sustainability in their sustainability strategy?	Only environmental	Only environmental	They mentioned 3, economy, environment and society.	Not specifically	Not specifically
What were the main sustainable strategies adopted?	LEED categories	Energy efficiency for the reduction of greenhouse gas emissions	Efficiency and economy of means	Compactness, local materials, energy efficiency	Fusing performance enhancements with the museum experience
Did they adopt sustainable strategies outside LEED credit requirements?	no	no	no	Yes, their concern for the respect of the historical dimension of the site	No, but considered the interrelationships of the LEED credits with other architectural qualities
Identify elements that would communicate 'green' to the general public – green roofs, windmills, solar panels, organic shapes, etc	none	No clear visible elements	none	Garden roof	Green roof
Interpretation of Approach to SD Inquiry					
General worldview of the team regarding sustainability - preventive or precautionary	Preventive	Preventive	Preventive	Both preventive and precautionary, for their concern regarding the respect of the historical dimension	Precautionary (in the way that their strategies were interrelated)

Practical Tensions for the MNBAQ Competition

As the environmental performance of each of the projects was hardly mentioned in the jury report, there did not seem to be any observable practical tensions regarding the adoption of LEED by the jury. Most finalists went far beyond the required LEED Basic certification, and may be why it was not mentioned in the jury report. The projects were deliberated in terms of the quality of space, constructive choices, overall form and envelope quality, on the most part, qualitative concerns regarding functionality, aesthetic and structure.

So in terms of the jury, the use of quantitative environmental evaluations methods did not seem to affect the outcome of the jury process, as the deliberation focused on the general qualities of the architectural projects in their entirety – constructive choices, quality of space, envelope quality, etc., and not by the need to select the winner by a focus on the most efficient building performance.

However, the impact that LEED may have had on the design of the projects by the finalists was not as seamless as the way the jury adopted it. Table 40 presents a summary of the practical tensions observed in this competition.

TABLE 40: SUMMARY OF PRACTICAL TENSIONS EXHIBITED FOR THE MNBAQ COMPETITION WHEN ADOPTING LEED

Practical Tensions	Fichten Soiferman	David Chipperfield	Barkow Leibinger	Nieto Brière	OMA
Political objectives vs. cultural repercussions	None	None	None	None	None
Requirements in brief vs. context of site	None	None, based on explicit argumentation	There were many examples in this project where the requirements in the brief were defied, but as the contextual relevance of their proposal was questioned (the massive structure), then the tension here was between the requirement in the brief and the experimental quality of the project.	None	None
Environmental performance vs. quality of space	None	The functionality of the basement was compromised because the superficial areas did not meet the requirements. This was done by the team in order to meet the budget.	The functionality was comprised since for the jury, the priority was given to secondary elements.	1. The strategy of compactness resulted in functional constraints that seemed to have no resolution for the jurors. 2. Their focus on respecting the historical dimension of the site, compromised the cohesiveness of the museum experience	None
Environmental performance vs. constructive choices	None	None	None	None	The choice of envelope (glass) was in tension with the environmental performance it could provide.
Environmental performance vs. aesthetic quality	Their choice of	The jury felt that all the requirements were met, yet the spaces are not dynamic and there is no element of surprise.	The focus on the environmental performance (the roof design was essential in the energy efficiency of the building) resulted in an aesthetic that was imposing and not adapted to the site.	None	No
Diverging views (either among jurors or between the juror and the finalist proposal)	1. The jury and the team had diverging views on the benefit of the snow as an isolating material. 2. There was a tension among the jury members regarding the aesthetic of the building, where some felt it was bold and others felt it was rigid.	None	None	None	The jury disagreed with the team's description of the thermal benefits of the glass envelope.

In this competition, the jury seemed to have placed equal importance on all technical and expert evaluations, namely LEED, budget and quantitative functional requirements. It can be deduced then that the use of LEED did not have much impact on the outcome of the judgment process for this competition; even if the individual finalist proposals may have exhibited some tensions between their environmental performance strategies and other architectural qualities.

SAINT-LAURENT LIBRARY COMPETITION

The Saint-Laurent Library organized in 2009 for the borough of Saint-Laurent in Montreal had a strong emphasis on sustainable development. This competition sought LEED-NC v.1 Gold (39-51 credits) certification (LEED Canada, 2004) in order to comply with the sustainable development policy for the city of Montreal for municipal buildings[109] (Saint-Laurent, 2010a; City of Montreal, 2008). The adoption of LEED as the privileged evaluation method for sustainability presented some difficulties in the judgment process. This was a two-stage competition process, where the first stage was a dossier submission. In order to be considered as a finalist, it was necessary that the team had a strong engineering LEED expertise, otherwise they could not be considered as a finalist. So the groups were selected based on their past experience and their LEED representation. This in itself may be problematic, as groups that are too young or inexperienced were omitted.

The jury comprised 7 members, ranging from architects, to architects related to the university, to client representatives and a journalist/author. All jury members are based in Montreal, Quebec. Out of the 7 jurors, 4 were architects, and one of these 4 was a LEED expert who contributed to the Canada Green Building Council (CaGBC) initiative, an initiative that advocates LEED as the standard for green buildings in Canada. Table 41 lists the jury members for the Saint-Laurent Library competition.

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109 According to the Federation of Canadian Municipalities (http://fmv.fcm.ca/Capacity_Building/Municipal-sustainable-bylaw-collection/Energy.asp), since 2009: "The City of Montréal's Politique de développement durable pour les bâtiments municipaux requires all new municipal buildings to be Leadership in Energy and Environmental Design (LEED®) Gold certified and all major renovations to be LEED® Silver certified. This policy applies to all municipal buildings in the downtown area and could be adopted by any interested boroughs in Montréal."

TABLE 41: LIST OF JURORS FOR THE SAINT-LAURENT LIBRARY COMPETITION

Jurors	Description
A	Representative of the cultural milieu, journalist, author, previous president/general director of the Bibliothèque et Archives nationales du Québec, president of the jury
B	Representative of the borough of Saint-Laurent, architect
C	Representative of the borough of Saint-Laurent, urbanist
D	Representative of the university milieu, full professor, School of Architecture of the Université de Montréal (Faculté de l'aménagement)
E	Architect and landscape-architect
F	Architect
G	LEED accredited architect

In the first phase, 28 dossiers were received from which four finalists would be selected. The four finalists for this competition were:

- Provencher Roy + associés / Anne Carrier, architectes / Les consultants S.M. inc. / Bouthillette Parizeau et associés inc.
- Cardinal Hardy / Labonté Marcil/ Éric Pelletier, architectes / Leroux Beaudoin Hurens et associés inc. / SDK et associés inc.
- ACDF* Architecture (Allaire Courchesne Dupuis Frappier), architectes / SNC Lavalin / CLA ingénieurs.
- Chevalier Morales/FABG architectes/Les architectes FABG / Tecsult-AECOM inc.

All of the finalists are design teams from Quebec. Each team was required to have a LEED accredited professional on their team. Table 42 presents some general information for this competition.

TABLE 42: GENERAL COMPETITION INFORMATION FOR THE SAINT-LAURENT LIBRARY

General Descriptive Data to Collect	Data
Name of competition	Saint-Laurent Library
Location and date of launch of the competition	Montreal, Canada, July 8, 2009
Competition type (one phase, two phase, etc.)	Two phase, first phase dossiers
Number of entries for each phase	Phase 1 – 28 dossiers Phase 2 – 4 finalists
Number of jury members, number of architects, number of city representatives, etc.	7 jury members: 4 architects (of which 1 is a national LEED expert) 2 representatives of the city (of which 1 is an architect) 1 academic representative 1 cultural expert
Position or background of the president of the jury	Representative of the cultural milieu, journalist, author, previous president/general director of the Bibliothèque et Archives nationales du Québec
Number of LEED experts on the jury and what level of recognition (regional, national, international)	1, recognized at a national level, contributor to the CaGBC-LEED
LEED certification level required for the competition	LEED Gold
Criteria defined for sustainable development	Even if their definition of SD included the 3 pillars, the objectives were based on LEED categories (water, materials and energy performance optimizations)
Is LEED a sustainable development policy for the municipality in which the competition project will be built	yes
Type of building (cultural center, library, museum, etc)	library

MAIN OBJECTIVES FOR THE SAINT-LAURENT LIBRARY COMPETITION

In the « Reglement du concours » (Saint-Laurent, 2009c, p.20), the phase 1 selection criteria were defined. This set of criteria was used by the jury to make the selection from the 28 dossiers received to a set of four finalists. The following is the list of criteria:

1. Description of a pluridisciplinary team 10 %
2. Dossier of their projects 15 %
3. Cultural experience 15 %
4. Bioclimatic architectural experience 15 %
5. Architectural, urban and landscape vision 20 %

6. Organisation of the team for this project	10 %
7. Experience of the pluridsciplinary team and the project lead	15 %

For the phase 2, the four finalists had to propose a functional program and an innovative potential while respecting the budget (Saint-Laurent, 2009c). Over and above the prevalant requirement for LEED Gold certification, the main concepts underlying the project, as stated in the brief were,

> *« (…) à toutes les étapes du projet, et dans toutes ses composantes, trois notions fondamentales – et intimement liées – transparaissent : une bibliothèque humaine, plurielle et verte » (Saint-Laurent, 2009a, p.4).*

So the proposals had to properly address the human scale (a social concern), the plurality of the needs, uses and habits (a cultural concern) and the green concern (an environmental concern) – an integrated perspective.

The wooded area was a main focus and the requirements to maintain its integrity, valorize it and make it accessible were highly sought. In fact, the project was to act as a door or entrance to the wooded area,

> *« (…) l'édifice crée une nouvelle porte d'entrée au Boisé du parc Marcel-Laurin et met en valeur le site » (Saint-Laurent, 2009a, p.1).*

One final important criterion was the visibility of the building from the main road,

> *« La visibilité et l'accessibilité du bâtiment devront être accentuées sur le boulevard Thimens » (Saint-Laurent, 2009a, p.29).*

Before enumerating the list of criteria provided in the brief, it is important to highlight the way in which the competition brief emphasized the importance of LEED for this competition, based on this statement from the "Programme du concours":

> *« Conformément à la Politique montréalaise de développement durable, l'arrondissement veut obtenir la certification LEED Or pour la nouvelle construction. Cette action découle de l'orientation prioritaire : pratiquer une gestion responsable des ressources. » (Saint-Laurent, 2009b, p.29)*

LEED was therefore an unquestioned priority stemming from a political commitment. In the « Règlement du concours » (Saint-Laurent, 2009c, p.20), the criteria used as a guide by the jury to select the winning project were:

- global distinctive image that makes the library an exhibition center and a museum, a cultural space;
- innovative approach for the functional dimension;
- quality of the spatial organization;
- quality of interior spaces;
- integration of urban plan to the building, wooded area and parks;
- integration of the team's concept to sustainable development;
- respect the budget.

The weighting was defined during the pre-selection session and transmitted to the finalists.

It is interesting that this list enumerates many of the elements that comprise the list of practical tensions, and which will be analysed for each finalist. In particular as sustainable development is addressed in this competition by LEED accreditation only, the environmental performance is the only strategy used for sustainable development in this competition. This list of criteria therefore does not in itself perpetuate any tensions, yet the way in which LEED credits (the main strategy for sustainable development in this competition) will be adopted by the finalists and the jury may result in such tensions.

As a final note regarding the objectives for this competition, the section in the brief dedicated to sustainable development consisted of three main sub-sections (Saint-Laurent, 2009b, p.65). First, a sub-section providing a general description of sustainable development, which included the three pillars of economy, environment and society, yet the only objectives identified were performance optimizations based on categories of LEED. Second, a sub-section that described the integrated design process (IDP), but did not identify any clear objectives with respect to this process. Finally, a sub-section consisted of a list of environmental performance optimization objectives based on LEED categories. So for this competition, even if they defined sustainable development based on the classic definition from the Brundtland Report[110], the objective they stated was based on LEED categories of performance optimizations. This in itself presents a tension regarding the gap between the definition of sustainable development adopted by this competition and the objectives they sought.

FINALISTS FOR THE SAINT-LAURENT LIBRARY COMPETITION

For this competition, the LEED accreditation was very important. In fact, according to the jury report of phase 2, not only was LEED accreditation important, it was equally important that the project convey an image of sustainable development. This is what they stated with regards to this requirement with respect to LEED Gold certification:

> *« Dans la mesure où l'arrondissement veut transmettre un message éco-responsable, il importe aussi que le projet choisi en donne l'image, tant par son concept énergétique que par l'enveloppe du bâtiment choisi. » (Saint-Laurent, 2010b, p.4)*

So the winning project also had to communicate an ecological responsible message, yet they did not define what this would entail in any of the documents provided to the finalists. In the jury report for phase 2, the jury chose to highlight the main objectives that the borough defines as imperatives for this project. The following are this set of objectives that were highlighted during the jury deliberation (Saint-Laurent, 2010b, p.3):

1. Functionality of the library and innovation;
2. Valorization of the wooded area;
3. Visible and remarkable building based on its signature and its contribution to the valorization of the main civic axe; and
4. LEED Gold certification.

No weighting was provided in the jury report. The jury used these four general essential criteria to judge the four finalist projects.

110 This report was discussed in the section of this thesis entitled: What is Sustainable Development?

This competition was won by a split vote of 4-3. In the final deliberation, two of these criteria - that of the visibility of the building from the main civic axe and the valorization of the wooded area - were questioned by two jury members. However, the functionality remained an essential criterion, as the jury stated:

> *« Pour les deux (2) projets à égalité, la présidente du jury réitère l'importance du facteur fonctionnalité et revient sur la qualité des bibliothèques proposées par Chevalier Morales/FABG architectes/Les architectes FABG et Cardinal Hardy/ Labonté Marcil/ Éric Pelletier, architectes, deux équipes expérimentées dans les bibliothèques. » (Saint-Laurent, 2010b, p.7)*

Although the team of Cardinal Hardy won because of it functional quality and its visibility from the main civic axe, the jury had several suggestions for improvement before going on to the next phase, most of them regarding the heaviness of the envelope and structural elements (roof, entrance, ramp connecting to wooded area). The winner for this competition was therefore not unanimous.

PROVENCHER ROY + ASSOCIÉS/ANNE CARRIER ARCHITECTES EN CONSORTIUM/LES CONSULTANTS S.M. INC./BOUTHILLETTE PARIZEAU ET ASSOCIÉS INC.[111]

This project sought 46 LEED credits. Only 36 are required to obtain LEED Gold. The jury claimed that the LEED solutions were well integrated, but with the budget, as the following quote shows:

> *« Le concept de développement durable apparaît bien intégré et respectueux du budget; en contrepartie, sa généralité le rend peu innovant. » (Saint-Laurent, 2010b, p.5)*

No mention was made to how well they integrated the LEED solutions to the other architectural requirements and qualities.

Based on this team's description of their sustainable development strategies, this project adopted an approach to sustainability based on the categories of LEED, but where the

111 The proposal text and images were obtained from http://bibliotheque.saintlaurent.ville.montreal.qc.ca/home.html

solutions within each of these categories were isolated to the category and were not linked with other elements of the project. In other words, their discourse adopted towards solutions for addressing sustainability is directly inspired by the 6 categories of LEED. They are primarily focused on the performance optimization of the building, without considering the impacts on other architectural elements, as the following quote from their proposal shows:

> *« Le bâtiment, extrêmement compact, avec les réserves muséales au niveau inférieur est fort peu énergivore. Une enveloppe très performante (valeur R élevée et verre performant) combinée à une installation géothermique, à du chauffage radiant et à un éclairage efficace, assureront non seulement une bonne performance selon les critères LEED mais également une consommation réduite en valeur absolue. » (Provencher Roy + Associés et al., 2009, p.4)*

This is but one example from their descriptive text, but is representative of their entire discourse related to sustainable development, where the LEED category is the driver and the discourse then focuses only on the elements of optimization within that category without seeking to understand how the solution may affect other architectural elements.

Consequently, this team did not mention in their descriptive text the four pillars of sustainable development either. So not only did their proposal fail to consider the links with other architectural elements, but they also failed to consider the links with other sustainable development pillars.

This was the first project to be eliminated by the jury as it was deemed the least innovative. In the phase 2 jury report, the jury stated that:

> *« Le parti du projet est jugé simple et fonctionnel mais peu audacieux en raison du manque de découverte, d'innovation et d'un intérieur clair mais anonyme; le concept n'est pas distinctif. » (Saint-Laurent, 2010b, p.5)*

So, although it was a completely functional solution, this team did not propose an innovative solution. It is important to recall that an innovative approach for the functional solution was one of the 7 requirements identified in the brief for the phase 2 finalist projects. Therefore, this project failed in this regard:

> *« Le projet de Provencher Roy/Anne Carrier, architectes, propose une solution fonctionnelle, sans surprise ni innovation. » (Saint-Laurent, 2010b, p.3).*

In fact, according to the jury report, this project also failed with regards to the visibility from the main boulevard and with regards to the connection it sought with the wooded area; both important requirements stated in the brief (see Figure 30).

FIGURE 30: FINALIST PROPOSAL BY PROVENCHER ROY FOR THE SAINT-LAURENT LIBRARY COMPETITION

In summary, this team adopted a fragmented, technical approach towards the sustainable development requirement as well as towards the functionality of the project, as each was met, yet the project failed on many other qualities. As a result, the jury judged this project as an energy efficient building meeting the budget, yet not very audacious or adventurous.

This lack of adventurousness in their proposal may have been related to the fact that they focused so heavily on the technical solutions, especially those related to LEED, as this was an important requirement, even from a political perspective, as the brief had stated. Table 43 presents a general summary of the general approach for sustainability by this team. Table 44 presents a summary of the tensions exhibited by this team.

TABLE 43: GENERAL DATA FOR PROVENCHER ROY OF THE SAINT-LAURENT LIBRARY COMPETITION

General Descriptive Data for each Finalist	**Data**
City and country of team	Montreal, Canada
Number of LEED points sought and distribution	Total: 44 Ecological site: 12 Water efficiency: 5 Energy and atmosphere: 4 Materials and resources: 7 Quality of interior environment: 11 Innovation and design process: 5
Did they consider the 4 pillars of sustainability in their sustainability strategy?	Only environmental
What were the main sustainable strategies adopted?	Compactness and LEED categories
Did they adopt sustainable strategies outside LEED credit requirements?	Sound (they addressed the airplane noise), but this was a LEED credit in the category of 'Innovation and design process'
Identify elements that would communicate 'green' to the general public – green roofs, windmills, solar panels, organic shapes, etc	None
Interpretation of Approach to SD Inquiry	
General worldview of the team regarding sustainability - preventive (juxtaposed LEED credits) or precautionary (integrated systemic solution)	Preventive

TABLE 44: PRACTICAL TENSIONS IDENTIFIED FOR PROVENCHER ROY OF THE SAINT-LAURENT LIBRARY COMPETITION

Categories of Practical Tensions	**Identified Practical Tensions**
Political Objectives/ Cultural Repercussions	The strict focus on LEED (because of the political requirement in the brief) may have resulted in a project that lacks a distinctive image and therefore a project that may not contribute to the cultural regeneration of the community.
Requirements In Brief/ Context Of Site	None that were intentional on the part of the proposal
Environmental Performance/ Quality of Space	The functionality was met, yet with little innovation which may have been due to the focus on environmental performance – trying to get the most for the least.
Environmental Performance/ Constructive Choices	None
Environmental Performance/ Aesthetic Quality	The environmental performance strategies may have impacted the aesthetic of the project as it was judged as not audacious yet easily met the LEED credits.
Diverging views (either among jurors or between the juror and the finalist proposal)	None, this team was the first to be omitted and was a unanimous decision by the jury based on its lack of surprise and innovation.

ACDF* ARCHITECTURE (ALLAIRE COURCHESNE DUPUIS FRAPPIER ARCHITECTES)/SNC LAVALIN/CLA INGÉNIEURS[112]

This team sought 45 LEED credits. Only 39 were required. This team sought the second highest LEED credits next to Provencher Roy. This project was driven by the need to address the four pillars of sustainable development, and these by ensuring that other architectural qualities were not compromised. On the first page their descriptive text this team presented their objectives for this project which were the following:

> *« A l'échelle du site, créer un pôle d'attractivité et assurer l'échange en repensant les connexions urbaines; diversifier les moyens de déplacement en privilégiant les mobilités douces en alliant protection confort et plaisir; Penser une approche responsable autant économiquement que socialement; créer un projet exemplaire en terme de développement durable, tant au niveau environnemental que par sa possibilité à créer des environnements de grande qualité pour les usagers et les occupants; composer un projet riche et varié à l'image du quartier et de ses habitants. » (acd f * architecture urbanisme intérieur et al., 2009, p.1)*

From this description of their objectives, it can be seen that their focus was not only on LEED credits, but in seeking to integrate their various sustainable development strategies into the other architectural dimensions of the project. Therefore this team adopted a solid environmental strategy; they adopted the strategy of compactness and oriented the building east-west so that they may capture the most solar energy possible (see Figure 31). This orientation also allowed them to minimise the amount of interventions on the site, all while adhering to LEED.

So it is important to emphasise that the concept of sustainability drove the project, and this may explain why there may have been some deficiencies, as observed by the jury. How did the focus on these strategies influence the other architectural components such as interior space, circulation, etc? In the jury report, they stated that:

> *« Au plan du développement durable, le volume compact et le réalisme des crédits assurent à la fois l'image et la certification Or. » (Saint-Laurent, 2010b, p.6)*

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112 The proposal text and images were obtained from http://bibliotheque.saintlaurent.ville.montreal.qc.ca/home.html

FIGURE 31: FINALIST PROPOSAL BY ACDF FOR THE SAINT-LAURENT LIBRARY COMPETITION (TOP, VIEW FROM MAIN AXE; BOTTOM, PLAN VIEW)

According to the jury, this team achieved both the LEED accreditation as well as an image communicating sustainability. However, the question remains as to what is meant by an image of sustainability. Did the jury imply that the energy efficiency projected by the strategy of compactness projected the notion of sustainable development? On this note, the jury also stated that:

> *« L'implantation de ce volume compact tout en permettant l'avancée du boisé vers la rue, répond à la double volonté de mise en valeur du boisé et de la visibilité; le design urbain, des plus structuré, renforce cette visibilité. » (Saint-Laurent, 2010b, p.6)*

In this sense, this team's strategy of sustainable development had far reaching positive consequences. Nevertheless, the jury also claimed that the minimalist strategy adopted by this team compromised the functionality and the circulation of the project – fundamental criteria for this project. The following quote from the jury report shows the jury's concern:

> *« Ce projet, très élégant dans son traitement architectural minimaliste, soulève de nombreuses questions au plan du fonctionnement et de la circulation. Le plan, générateur d'expériences réparties sur trois (3) niveaux, crée la confusion pour le visiteur et complique l'aménagement de la bibliothèque; son élégance n'annonce pas la fonction principale qu'est la bibliothèque mais met l'accent sur la circulation, le café et la salle d'exposition, situés au rez-de-chaussée. » (Saint-Laurent, 2010b, p.6).*

Because the building was rotated, the functionality was compromised on other levels as well, according to the jury report:

> *« L'entrée et le hall ne répondent pas au concept d'accès universel. » (Saint-Laurent, 2010b, p.6).*

This team's strategies were promising, but their strict focus on sustainable development may have resulted in a compromise of important architectural elements, such as the functionality. This may be why this team was the second team to be eliminated. By placing so much emphasis on the strategy of compactness, have they bypassed important architectural elements other that environmental? Table 45 presents a general summary of the general approach for sustainability by this team. Table 46 presents a summary of the tensions exhibited by this team.

TABLE 45: GENERAL DATA FOR ACDF OF THE SAINT-LAURENT LIBRARY COMPETITION

General Descriptive Data for each Finalist	Data
City and country of team	Montreal, Canada
Number of LEED points sought and distribution	Total: 45 Ecological site: 10 Water efficiency:5 Energy and atmosphere: 5 Materials and resources: 8 Quality of interior environment: 11 Innovation and design process: 6
Did they consider the 4 pillars of sustainability in their sustainability strategy?	Yes, the four pillars were presented in the first paragraph of the objectives they set out for themselves
What were the main sustainable strategies adopted?	Compactness, orientation of building, reduce site disturbance and adaptability
Did they adopt sustainable strategies outside LEED credit requirements?	Sustainability was the basis of their project inspiring all aspects of the project
Identify elements that would communicate 'green' to the general public – green roofs, windmills, solar panels, organic shapes, etc	Photovoltaic cells to power the games of the adolescents , elevated central terrace garden
Interpretation of Approach to SD Inquiry	
General worldview of the team regarding sustainability - preventive (juxtaposed LEED credits) or precautionary (integrated systemic solution)	In many ways, precautionary, as they linked their sustainable strategies to many other architectural elements as well as other sustainable pillars.

TABLE 46: PRACTICAL TENSIONS IDENTIFIED FOR ACDF OF THE SAINT-LAURENT LIBRARY COMPETITION

Categories of Practical Tensions	Identified Practical Tensions
Political Objectives/ Cultural Repercussions	The high priority given to the sustainable development objective for this project in the brief was driven by a political context.
Requirements In Brief/ Context Of Site	The main functional elements of the library (location of registration desk) were defied in order to accommodate their strategies of sustainability.
Environmental Performance/ Quality of Space	The functionality was compromised in a large part because of their strategy of compactness.
Environmental Performance/ Constructive Choices	None
Environmental Performance/ Aesthetic Quality	None
Diverging views (either among jurors or between the juror and the finalist proposal)	The jury did not agree with their focus on the cafe (situated on the main floor) instead of the registration desk (situated on the 2nd floor) – the jury felt their project did not address the priorities of the library properly.

Chevalier Morales Architectes/Les Architectes FABG/Tecsult-AECOM inc.[113]

This team sought 42 LEED credits, the least of all finalists. It was one of the two teams left in the final standoff. From the four criteria identified by the jury as imperatives for the borough, decided by the jury before deliberation, this team is the only team that differentiated itself from the other teams on all four criteria. For example, for the criteria of 'Functionality of the library and innovation', the jury judged this project one of the two best projects. For the criteria of 'Valorizing the wooded area', the jury judged this team as:

> *Trois (3) des quatre (4) concepts proposent une architecture en dialogue avec la rue, le côté urbain et le boisé. Le projet de Chevalier Morales/FABG, architectes, a pris le parti d'organiser le bâtiment dans le boisé, l'empreinte au sol du bâtiment étant déterminée par les arbres existant à préserver. (Saint-Laurent, 2010b, p.4)*

The jury recognized that this team valorized the wooded area from a different perspective – one that sought to save as many trees on the site as possible. In fact, this team went much further in this thinking in their descriptive text. On this point, they stated on the first page of their text:

> *Pour y parvenir, nous avons tout d'abord fractionné la volumétrie du bâtiment pour se glisser dans la forêt existante en préservant 86% des arbres dont le calibre est supérieur à 20 cm. On ne peut prétendre à l'exemplarité en matière de développement durable en rasant une partie substantielle du boisé. (…) Afin de contribuer à la régénération du boisé composé majoritairement de peupliers deltoïdes dont l'espérance de vie avoisine douze ans et d'en augmenter la diversité biologique nous proposons un programme de plantation de nouveaux arbres présentant un intérêt supérieur tel que le micocoulier. (Chevalier Morales Architectes et al., 2009a, p.1)*

This quote from this team's descriptive text is not from the section describing their sustainable development solutions. It is from the second and third paragraphs on the first page. So this team proposed a project that was, at its base, concerned with important sustainable issues. In fact, the first paragraph of their descriptive text immediately

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113 The proposal text and images were obtained from http://bibliotheque.saintlaurent.ville.montreal.qc.ca/home.html

discussed the relevance of the nature-culture dichotomy with regards to concerns for sustainability; this team stated that:

> *« La dichotomie nature-culture qui conduit à penser les parcs comme des oasis de verdure séparés du milieu urbain par une frontière bien définie ne correspond plus aux aspirations des citoyens montréalais. Le désir de verdir la ville déborde de ce cadre pour s'étendre aux rues, ruelles, cours et toitures en associant développement durable, qualité de vie et amélioration du couvert végétal. » (Chevalier Morales Architectes et al., 2009a, p.1)*

Finally, regarding the imperative criteria of 'Remarkable building and visibility from the main civic axe', the jury stated that:

> *Trois des quatre (4) concepts se démarquent par une signature architecturale forte dont la visibilité varie selon les partis d'implantation : le projet de Chevalier Morales/FABG architectes, en priorisant la mise en valeur du boisé, réduit sa visibilité vue du boulevard Thimens. (Saint-Laurent, 2010b, p.4)*

Again, here the jury recognized that this team placed much emphasis on the wooded area, even at the cost of defying an important criterion – the visibility of the building from the main civic axe. Finally, regarding the criterion of LEED Gold, the jury stated that:

> *« Tous atteignent les points pour la certification LEED Or mais certains présentent plus de risques, dont ceux de Chevalier Morales/FABG, architectes, dont le budget est le plus serré et qui dispose de peu de crédits excédentaires. » (Saint-Laurent, 2010b, p.4)*

So the jury claimed that this project was the riskiest regarding LEED Gold certification. However, LEED is a rating system that is laden with much uncertainty, especially in the context of a competition, when the evaluations done early in the design process[114] and therefore the difference of a few points cannot determine whether a group is more or less risky. Yet, this was one of the reasons why they did not win.

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114 In a competition, the proposals are submitted after the system design phase (based on the design process model by Ulrich and Eppinger, 2008), and much before the detailed design phase. This implies that the concept is still not final and that the uncertainties in the LEED results are high, since at this early phase of evaluation there are still many unknowns in the design itself.

Consequently, to emphasise the importance that this team placed on the wooded area, the first line of their descriptive text stated:

> *« Plutôt que de considérer la nouvelle bibliothèque de Ville Saint-Laurent comme "une porte d'entrée au parc Marcel-Laurin" nous préférons imaginer qu'elle soit perçue comme faisant partie intégrante de celui-ci, au cœur du boisé. » (Chevalier Morales Architectes et al., 2009a, p.1)*

Therefore, this team did something that none of the other teams did. They challenged two important criteria from the brief: that the library should be a door to the park, and that the building should be visible from the main civic axe. Why would they challenge criteria that are clearly defined in the brief? It may be because both these criteria opposed their integrated philosophy of sustainable development and that the library should instead integrate with and become the heart of the wooded area (and not a door to the forest) (see Figure 32).

Consequently, the envelope choice for this project also was a source of contention for the jury. The envelope was selected by the team in order to filter out the excess light and the noise from the passing airplanes. This quote from their descriptive text presents this team's vision:

> *Une seconde peau composée de panneaux de bois perforés suspendus à l'horizontale au plafond et à la verticale derrière le vitrage agit comme le feuillage de la forêt qui diffracte la lumière trop vive du jour et contribue à étouffer le bruit ambiant; elle constitue un filtre lumineux et acoustique contribuant à produire l'atmosphère de calme et de recueillement propice à la lecture. (Chevalier Morales Architectes et al., 2009a, p.1)*

Yet the jury was split regarding the choice of envelope. They claimed it was both a subtle and contemporary vision, yet represents a maintenance issue for the borough, as the following quote from the jury report shows:

> *« Le concept propose un parti fort et mature dénotant une grande sensibilité dans sa simplicité, sensibilité tant au niveau des espaces intérieurs qu'à celui de la notion de filtre végétal lumineux; le langage est actuel et le geste fin. (…) Le morcellement de la toiture et du volume représente un enjeu d'entretien pour l'arrondissement. » (Saint-Laurent, 2010b, pp.6-7)*

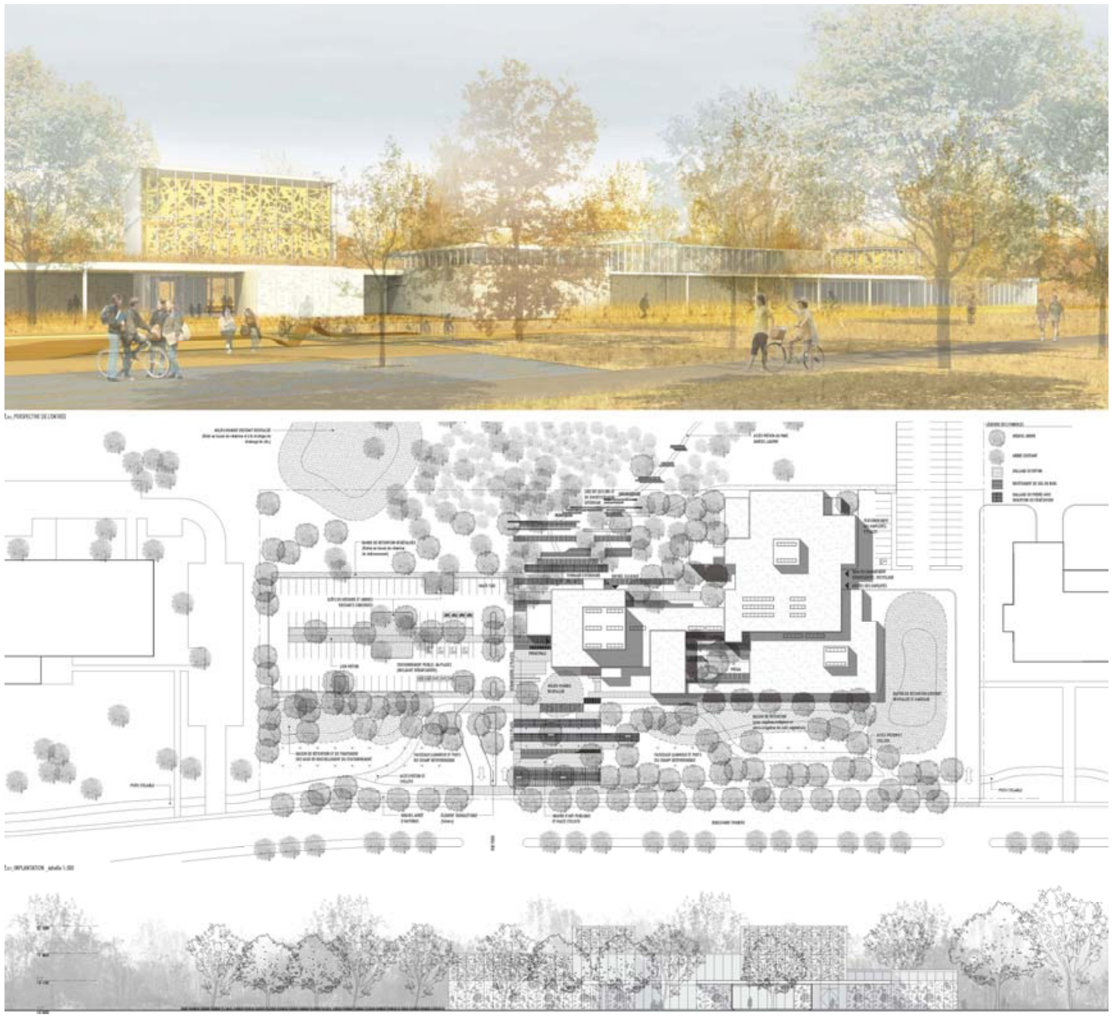

FIGURE 32: FINALIST PROPOSAL BY CHEVALIER MORALES/FABG FOR THE SAINT-LAURENT LIBRARY COMPETITION (TOP, VIEW FROM MAIN AXE; MIDDLE, TOP VIEW; BOTTOM, FRONT VIEW)

It is important to note that the vision regarding sustainable development by this team encompasses the four pillars, as the following quote from the section entitled 'Développement durable' states:

> *« L'argent a un pouvoir de développement durable très grand dans la mesure où les sommes économisées pour opérer et entretenir un bâtiment peuvent être investies, par exemple, à des initiatives sociales et environnementales où les ressources financières manquent cruellement. (…) Toute la valeur de l'architecture et de l'ingénierie durables du projet est donc concentrer à trouver une réponse unique et performante pour la vie utile de l'édifice dans ce site d'une sensibilité tout aussi unique que la valeur sociale et environnementale du bâtiment à y déposer. » (Chevalier Morales Architectes et al., 2009a, p.3)*

This is the only team that mentioned specific social, environmental and economic concerns as repercussions of architectural projects. This is also a great example of a systemic perspective for seeking sustainability – where the aesthetic elements cannot be disconnected from the technical solutions and from the social and cultural aspects. This team's comment on LEED to assess sustainable development was the following (from their descriptive text):

> *« LEED n'est pas une mesure complète de développement durable, mais permet de quantifier des éléments précis pour évaluer une performance technique. Il est donc important de conserver une perspective globale entre les critères spécifiques de LEED et les enjeux de développement durable pour mieux apprécier la pertinence et la portée des stratégies proposées par notre concept. » (Chevalier Morales Architectes et al., 2009a, p.4)*

One reason this team did not win was that it was considered by the jury the riskiest project with regards to LEED credits; the paradox is that this team discussed about concerns related to their sustainable development approach right from the beginning, therefore inseparable from the rest of their concerns for this proposal. They had the most encompassing perspective of sustainability, both from a philosophical and pragmatic view.

Table 47 presents a general summary of the general approach for sustainability by this team. Table 48 presents a summary of the tensions exhibited by this team.

TABLE 47: GENERAL DATA FOR CHEVALIER MORALES/FABG OF THE SAINT-LAURENT LIBRARY COMPETITION

General Descriptive Data for each Finalist	Data
City and country of team	Montreal, Canada
Number of LEED points sought and distribution	Total: 42 Ecological site: 6 Water efficiency: 4 Energy and atmosphere: 9 Materials and resources: 7 Quality of interior environment: 11 Innovation and design process: 5
Did they consider the 4 pillars of sustainability in their sustainability strategy?	They specifically stated 3 pillars, yet the cultural pillar was evident in their desire of cultural renewal from their innovative design
What were the main sustainable strategies adopted?	Biodiversity regeneration of site, protection of site, functional adaptability
Did they adopt sustainable strategies outside LEED credit requirements?	Yes
Identify elements that would communicate 'green' to the general public – green roofs, windmills, solar panels, organic shapes, etc	None
Interpretation of Approach to SD Inquiry	
General worldview of the team regarding sustainability - preventive (juxtaposed LEED credits) or precautionary (integrated systemic solution)	In many ways, precautionary, but also addressed the LEED credits from a preventive approach

TABLE 48: PRACTICAL TENSIONS IDENTIFIED FOR CHEVALIER MORALES/FABG OF THE SAINT-LAURENT LIBRARY COMPETITION

Categories of Practical Tensions	Identified Practical Tensions
Political Objectives/ Cultural Repercussions	None
Requirements In Brief/ Context Of Site	This team defied two criteria that were stated in the brief, where the jury did not agree with their arguments.
Environmental Performance/ Quality of Space	None
Environmental Performance/ Constructive Choices	The placement of the building to ensure minimum site disturbance was considered by the jury to defy the criteria of visibility by the main civic axe. The jury felt that the envelope presented a maintenance problem, yet the envelope was designed to be a filter for light and noise (as stated by the team).
Environmental Performance/ Aesthetic Quality	None
Diverging views (either among jurors or between the juror and the finalist proposal)	As the team defied two main criteria, the jury and the teams had diverging views on these.

WINNING PROJECT : CARDINAL HARDY/LABONTÉ MARCIL/ÉRIC PELLETIER ARCHITECTES EN CONSORTIUM/LEROUX BEAUDOIN HURENS ET ASSOCIÉS INC/SDK ET ASSOCIÉS INC[115]

This team sought 44 credits. For this team, the notion of sustainable development appeared to be separated from the rest of the architectural concerns, as there was much less evidence in their descriptive text that the concerns and approaches towards sustainability can be interconnected with other architectural dimensions. The following is the sustainable development strategies they propose in their descriptive text:

> *« Plusieurs stratégies sont alors mises en place, elles sont présentent (sic)tout au long du processus de découverte, d'appropriation, et de cheminement, du paysage au livre. À l'échelle du site, le renforcement du cadre végétal, les bassins de rétention exprimés et mis en valeur, le stationnement responsable et les aménagements connexes ont mis en place les prémisses de base. La matérialité propre du bâtiment contribue grandement à la compréhension d'un bâtiment exceptionnel mais c'est principalement par ses systèmes mécaniques qu'il innovera. La mise en place d'un système de récupération des eaux de pluies et d'alimentation du milieu humide, d'un système de géothermie relié à une boucle d'échange thermique, de mesures diverses d'économie d'énergie etc...(sic) Mais principalement, l'introduction d'un système passif de chauffage utilisant la chaleur accumulée dans le prisme de verre référentiel et redistribué dans la boucle géothermique. La ventilation à faible vélocité par les planchers permet une réduction du nombre de conduits requis. Des rayonnages verts filtrants les C02, installés à quelques endroits à travers les collections, etc...(sic) De plus, un souci important tant pour le confort des usagers que pour les économies d'énergie est apporté aux éclairages. L'éclairage naturel étant privilégié et combiné à un éclairage de tâches adapté et permettant d'importantes économies d'énergie. » (Cardinal Hardy et al., 2009, pp.3-4)*

Therefore their main approach is one of prevention through a strategy of efficiency, basing their discourse on the LEED categorization of concerns. There is no other mention of concerns regarding sustainable development in their descriptive text other than the categories of LEED. We can see that the environmental strategy is not embedded within the overall design but rather an addition of the technical phenomena onto the project, directly caused by the fragmentation if indicators induced by LEED. On this note however, the jury states that:

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115 The proposal text and images were obtained from http://bibliotheque.saintlaurent.ville.montreal.qc.ca/home.html

> *« Le concept de développement durable est innovateur, clair et pédagogique; l'orientation solaire est bien exploitée. » (Saint-Laurent, 2010b, p.6)*

As the descriptive text from this team did not present any dominant overarching sustainable development strategy other than that of efficiency (water, energy and light) directly referring to LEED credits without linking to other architectural qualities or other sustainable development pillars, it is difficult to see understand what part of this proposal is innovative. However, the term *pedagogical* that the jury uses, better reflects this team's approach.

Unlike the proposal by Chevalier Morales/FABG, this team did not seek to challenge any elements from the brief. They sought to make the library a "lieu perméable" (permeable space) between the city and the forest – exactly as the brief required. This may seem fine, yet it is not clear that this was achieved for this team's project.

Consequently, as mentioned previously, in the final jury deliberation, two jury members questioned two essential criteria as identified by the borough, one of which Chevalier Morales/FABG defied because of their broader concerns related to sustainability. This criterion was to ensure that the project was visible from the main civic axe (Boulevard Thimens). In fact, in the Bulletin de Saint-Laurent of Februrary 2010, the winning project was described as:

> *« The building will consolidate the role of the Boulevard Thimens civic axis and also help enhance the value of the Parc Marcel-Laurin woodland by providing it with a new point of entry." (Saint-Laurent, 2010a, p.5).*

And the winning team was quoted in this publication, describing their project as:

> *"This isn't a project about architecture alone: it's also about landscape. Located between Boulevard Thimens and Parc Marcel-Laurin, the new library integrates into the site by drawing on the major elements of the park" (Saint-Laurent, 2010a, p.5)*

However, this criterion of visibility from Boulevard Thimens (the main civic axe) seems to be in direct contradiction to another essential criterion identified by the borough - that of ensuring that the project valorizes the wooded park behind the building. It is difficult to ensure that the building is visible from the main civic axe without at the same time, obscuring the view of the wooded area behind the building. On this point, one can therefore question the monumentality of the winning project, since it creates an immense wall to the forest as it hides much of it from the street – and instead of valorizing the wooded area it completely masks it. In fact, one of the reasons why this project won was because of is visibility from the main road, yet, the image shown on most press releases is an image of the back of the building – the side facing the park and not the side facing the street (see Figure 33).

FIGURE 33: WINNING PROPOSAL BY CARDINAL HARDY FOR THE SAINT-LAURENT LIBRARY COMPETITION (TOP, BACK VIEW; BOTTOM, FRONT VIEW FROM MAIN AXE)

One reason for this may be that if an image of the front of the building is shown, then the criterion stating that the project had to valorize the wooded area by acting like an opening is not adhered to. In fact, regarding this winning project, the jury stated that:

> *« Le projet propose une réponse efficace au défi du site et au programme fonctionnel; il répond, par sa volumétrie imposante, à la volonté de visibilité et de consolidation de l'axe civique de Saint-Laurent. La position de l'entrée priorise le piéton tout en réglant l'emplacement du stationnement. Le geste, très monumental, assure une visibilité urbaine mais risque de créer un effet de lourdeur, effet accentué par les jeux du sol, la toiture et la surenchère des éléments composant l'ensemble. » (Saint-Laurent, 2010b, p.5)*

The jury did not mention that the building fails to valorize the wooded area, but in their list of recommendations to the winning project, they state the following:

> *« (…) - un allègement de l'effet de masse généré par le sol, les volumes et la toiture;*
>
> *- un raffinement du traitement de l'enveloppe et de l'esthétique de l'ensemble; (…)*
>
> *- un allègement de l'entrée de la bibliothèque fortement alourdis par les nombreux éléments structurant l'espace. » (Saint-Laurent, 2010b, p.7-8)*

So the imposing structure was a source of contention among the jurors and that this then became an issue to be addressed by the winning team. Important to remember that Chevalier Morales/FABG decided against an imposing structure visible from the main civic axis because they wanted their project to be immersed within the wooded area so as to minimize the destruction of existing trees and vegetation on the site. On that note, the eco-responsible message transmitted by the winning architectural project was an important consideration for the jury, as was mentioned previously.

It is not clear what is meant by an 'eco-responsible message', only that the choice of envelope is an indicator, according to this jury. However, Guy and Farmer (2000), who have written extensively on the limitations of the strategy of efficiency as the main approach for sustainable architectural design, have stated that:

> "The role of green buildings is (…) not simply to reduce the energy consumption or the ecological footprint of buildings, but to inspire and convey an increasing identification with Nature and the non-human world" *(Guy & Farmer, 2000, p.80).*

From this perspective, it is not clear if the winning project transmitted an eco-responsible message. The fact that the project overpowers the wooded area through its massive structure, could be read by some as a building that proposes a long-term durable solution, but for others this same project may be read as a building that does not express its surroundings because of its same imposing structure that does not express the essence nature but instead of trying to express the essence of its natural surroundings.

In general this team provided very little information regarding their LEED strategies and no information regarding how the LEED strategies would or could be obtained. Because of this lack of information regarding both a philosophy of sustainable development and more specifically, their LEED approach; it is not clear how the LEED strategies may have affected their design. So even if there are no observed tensions in this competition between environmental performance and utility, structure or aesthetic, it is only because there is a lack of information in their descriptive text to find such tensions, and not because none actually exist.

Table 49 presents a general summary of the general approach for sustainability by this team. Table 50 presents a summary of the tensions exhibited by this team.

TABLE 49: GENERAL DATA FOR CARDINAL HARDY OF THE SAINT-LAURENT LIBRARY COMPETITION

General Descriptive Data for each Finalist	Data
City and country of team	Montreal, Canada
Number of LEED points sought and distribution	Total: 44 Ecological site: 9 Water efficiency:4 Energy and atmosphere: 5 Materials and resources: 9 Quality of interior environment: 12 Innovation and design process: 5
Did they consider the 4 pillars of sustainability in their sustainability strategy?	Only environmental
What were the main sustainable strategies adopted?	Efficiency (water, energy and light)
Did they adopt sustainable strategies outside LEED credit requirements?	No
Identify elements that would communicate 'green' to the general public – green roofs, windmills, solar panels, organic shapes, etc	Roof garden
Interpretation of Approach to SD Inquiry	
General worldview of the team regarding sustainability - preventive (juxtaposed LEED credits) or precautionary (integrated systemic solution)	Preventive

TABLE 50: PRACTICAL TENSIONS IDENTIFIED FOR CARDINAL HARDY OF THE SAINT-LAURENT LIBRARY COMPETITION

Categories of Practical Tensions	Identified Practical Tensions
Political Objectives/ Cultural Repercussions	The fact that the winning project was considered less risky in term of obtaining LEED accreditation, and as LEED was such an important requirement for the city, this requirement may have overridden other important cultural considerations
Requirements In Brief/ Context Of Site	None, intentionally, but this team failed to create an opening to the wooded area, as their building was massive and resulted in an obstruction instead of an opening.
Environmental Performance/ Quality of Space	None
Environmental Performance/ Constructive Choices	Many constructive choices were considered by the jury to be massive and they recommended these to be lightened. It is not clear if these constructive choices were a result of concerns related to sustainability.
Environmental Performance/ Aesthetic Quality	The aesthetic of the building was considered overpowering and suggested to be lightened in the jury recommendations, but is not clear how the aesthetic quality related to the environmental performance since there was no information regarding how this team would obtain the LEED credits.
Diverging views (either among jurors or between the juror and the finalist proposal)	This project produced many diverging views among the jurors with regards to its massive structure, where some jurors felt it responded to the brief, while others felt it defied the brief.

Summary for the Saint-Laurent Library Competition

The Saint-Laurent Library competition represents an example where the environmental evaluation method was problematic in selecting the winning project. The certification requirement for this competition was LEED Gold. The winning team addressed the objective of sustainability through a series of technical solutions based solely on LEED categorizations, without providing arguments of the wider impacts of the project, on the cultural or social levels. With respect to the aesthetic and symbolic aspects of architectural projects addressing concerns of sustainability, Guy and Farmer (2000) state that architects, in a context of sustainability, have a responsibility to create a new architectural iconography that may help change the way in which humans relate to nature.

Consequently, because of the heavy emphasis on LEED on the part of the client[116], with a LEED Gold certification requirement, most projects focused heavily on the techniques for obtaining the credits. One of the observations in this competition that is important to highlight is that the only project that provided an innovative solution for addressing a 'new architectural iconography' through its aesthetic details inspired by the nature surrounding the site was also considered by the jury as the riskiest in terms of attaining the required LEED credits.

It is important to reiterate that LEED is an imprecise tool[117] at this phase of the design process as the details of the proposal may engender unforeseen surprises, and therefore the statement indicating that it was the 'riskiest' project in terms of attaining the LEED Gold credits is questionable. This was an example of a Montreal municipal building project, where attaining LEED Gold was an unquestioned imperative. Is the prominence of LEED in architectural competitions forging a path for avoiding the very crucial architectural questions of urban form? Table 51 presents a summary for the Saint-Laurent Library competition.

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116 The heavy emphasis was evidenced not only through the requirements stated in the brief, but through the reiteration of this requirement in every press release related to this competition – where the press releases stated that LEED accreditation was now a policy for all public Montreal projects.

117 As was mentioned previously, LEED strategy development and evaluations for a competition are done fairly early, and therefore unforeseen problems are likely to arise. This is why it is considered to be imprecise at this phase in the design project.

TABLE 51: GENERAL DATA FOR ALL FINALISTS OF THE SAINT-LAURENT LIBRARY COMPETITION

General Data	Provencher Roy	ACDF	Chevalier Morales/ FABG	Cardinal Hardy
City and country of team	Montreal, Canada	Montreal, Canada	Montreal, Canada	Montreal, Canada
Number of LEED points sought	Total: 44	Total: 45	Total: 42	Total: 44
Did they consider the 4 pillars of sustainability in their sustainability strategy?	Only environmental	Yes, the four pillars were presented in the first paragraph of the objectives they set out for themselves	They specifically stated 3 pillars, yet the cultural pillar was evident in their desire of cultural renewal from their innovative design	Only environmental
What were the main sustainable strategies adopted?	Compactness and LEED categories	Compactness, orientation of building, reduce site disturbance and adaptability	Biodiversity regeneration of site, protection of site, functional adaptability	Efficiency (water, energy and light)
Did they adopt sustainable strategies outside LEED credit requirements?	Sound (they addressed the airplane noise), but this was a LEED credit in the category of 'Innovation and design process'	Sustainability was the basis of their project inspiring all aspects of the project	Sustainability was the basis of their project inspiring all aspects of the project	No
Identify elements that would communicate 'green' to the general public – green roofs, windmills, solar panels, organic shapes, etc	None	Photovoltaic cells to power the games of the adolescents, elevated central terrace garden	None	Roof garden
Interpretation of Approach to SD Inquiry				
General worldview of the team regarding sustainability - preventive or precautionary	Preventive	In many ways, precautionary, as they linked their sustainable strategies to many other architectural elements as well as other sustainable pillars.	In many ways, precautionary, but also addressed the LEED credits from a preventive approach	Preventive

Practical Tensions for the Saint-Laurent Library Competition

In this competition, the imperative of LEED Gold was an essential objective, emphasized by the preoccupations of municipal council of the city of Montreal, introduced the tension between the use of such quantitative environmental evaluation approaches for communicating political objectives (i.e. Montreal as a leader in sustainable development) and the cultural repercussions based on an outcome of a competition.

As this was an incontestable imperative for the winning project, in selecting the winning project, the jury was not only concerned with the risk (or lack of) for achieving LEED certification, but that the winning project would have to also emit a message of sustainability, even if it is not clear what is meant by this[118]. In addition, the way in which the finalists adopted this norm was interesting in the sense that the strict adherence resulted in observable practical deficiencies in other architectural qualities.

Table 52 presents a summary of the practical tensions observed for this competition.

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118 There is yet no symbolic norm that would emit an image of sustainability. In fact, for some, a massive structure symbolizes sustainability as it portrays a sense of durability and long-term strength, while for others a massive structure contradicts the idea of sustainability as it perpetuates an idea of overconsumption of materials. These two diverging views are but two examples of many other perspectives. In fact, for many, objects like fluorescent compact bulbs, green roofs, solar panels, are all symbolic of sustainability. This therefore becomes a source of contention as the symbolism that is desired for this competition is not the same for all members of the jury.

TABLE 52: SUMMARY OF PRACTICAL TENSIONS EXHIBITED FOR THE SAINT-LAURENT LIBRARY COMPETITION WHEN ADOPTING LEED

Practical Tensions	Provencher Roy	ACDF	Chevalier Morales/ FABG	Cardinal Hardy	Jury
Political objectives vs. cultural repercussions	The strict focus on LEED (because of the political requirement in the brief) may have resulted in a project that lacks a distinctive image and therefore a project that may not contribute to the cultural regeneration of the community.	The high priority given to the sustainable development objective for this project in the brief was driven by a political context.	None	The fact that this team has worked extensively with the city may have played some role for being selected as the winning project.	The many press releases mentioning the LEED Gold requirement placed much pressure on the jury to ensure that the winning project would not only achieve the certification but also project an image of efficiency
Requirements in brief vs. context of site	None that were intentional on the part of the proposal	The main functional elements of the library (location of registration desk) were defied in order to accommodate their strategies of sustainability.	This team defied two criteria that were stated in the brief, where the jury did not agree with their arguments.	None, intentionally, but this team failed to create an opening to the wooded area, as their building was massive.	The monumentality of the winning project adhered to the brief (visibility from the boulevard) but no longer seemed a relevant criterion after deliberation (for some jurors).
Environmental performance vs. quality of space	The functionality was met, yet with little innovation which may have been due to the focus on environmental performance – trying to get the most for the least.	The functionality was compromised in a large part because of their strategy of compactness.	None	None	The functionality remained a priority for the jurors, as the two last projects (before selecting winner) were both innovative in this respect.
Environmental performance vs. constructive choices	None	None	The placement of the building to ensure minimum site disturbance was considered by the jury to defy the criteria of visibility by the main civic axe. The jury felt that the envelope presented a maintenance problem, yet the envelope was designed to be a filter for light and noise (as stated by the team).	Many constructive choices were considered by the jury to be massive and they recommended these to be lightened. It is not clear if these constructive choices were a result of concerns related to sustainability.	The team Chevalier-Morales decided to position the building with respect to the existing position of the trees on the site, further valorizing the wooded area, and reducing site disturbance, yet the jury still considered this the riskiest project regarding LEED
Environmental performance vs. aesthetic quality	The environmental performance strategies may have impacted the aesthetic of the project as it was judged as not audacious yet easily met the LEED credits.	None	None	The envelope choice was selected to ensure energy efficiency. However, the aesthetic of the building was considered overpowering and the jury suggested it be lightened in their list of recommendations to the winner.	The envelope choice adopted by the winning project assured the LEED points related to energy efficiency but presented a contradiction between its imposing structure and the way in which it overpowered the site and therefore did not seem to valorize the wooded area as the brief required.
Diverging views (either among jurors or between the juror and the finalist proposal)	None, this team was the first to be omitted and was a unanimous decision by the jury based on its lack of surprise and innovation.	The jury did not agree with their focus on the cafe (situated on the main floor) instead of the registration desk (situated on the 2nd floor) – the jury felt their project did not address the priorities of the library properly.	(1) As the team defied two main criteria, the jury and the teams had diverging views on these. (2) Their sustainable development philosophy and approach was the most encompassing, yet this team was considered as the riskiest in regards to LEED accreditation. (3) As LEED evaluation has great uncertainties at this point in the design process, the view by the jury indicating that this was the riskiest project was questionable.	This project produced many diverging views among the jurors with regards to its massive structure, where some jurors felt it responded to the brief, while others felt it defied the brief.	Two jurors did not agree with some of the requirements stated in the brief as a further reflection of their contextual relevance did not render them significant, yet the other jury members felt that the requirements must remain as stated. This caused a resulting split vote.

In summary, during the jury process, the most notable tension was that between the requirements set out in the brief and the context of the site, since the winning project had to be visible from the main boulevard. However, after the jury assessed the project by Chevalier Morales, two members of the jury reconsidered this requirement as it no longer seemed relevant to them. As mentioned previously, the project by Chevalier Morales/FABG defied this requirement because their approach to sustainable development sought to address issues related to site specificity and symbolism of nature as a didactic and sensitizing element – as their approach to sustainability was far more encompassing than the winning project, which remained within the confines of environmental technical solutions.

This raises an important question regarding the freedom that the jury or the competitors have in terms of defying the criteria in the brief, in the case where they are found to be problematic with their own vision of a winning project. Especially for this competition, two criteria could easily be in opposition, and was not evident how they could co-exist. The jury had difficulty in resolving their priority within the whole project, and some of the finalists defied them altogether because they were in contradiction with their vision of the site and project. The freedom to defy the criterion that may seem to be problematic for either the competitors or jurors raises an important issue for the competition process, since the finalists are judged on their ability to respond to the brief. This research does not propose a solution to this dilemma of defying requirements in a brief in a context of competitions. However, the realization that this has impacts on the outcomes of a competition can be seen from this example.

Finally, it should be emphasized that the tension regarding the political objectives vs. cultural repercussions can be deduced from the way in which the decision was taken by the jury. In this case, of the two projects remaining, namely the projects of Chevalier Morales/FABG and Cardinal Hardy, the project selected as the winner was the one that presented the least risk regarding the potential for obtaining the necessary LEED credits and the one that seemed to project a message of sustainability, as perceived by the jury. Let us emphasise that the criterion regarding the functionality of the library was equally met by both finalists and therefore was no longer a concern in the judgment at that point. However, the points of contention that remained were the LEED risk and the visibility from the main civic axe, both deficiencies of Chevalier Morales/FABG. However, the vision of sustainable development by Chevalier Morales/FABG was far more encompassing than that of Cardinal Hardy. As was mentioned in the analysis, Chevalier Morales/FABG's entire descriptive text sought to inter-relate the various qualitative architectural dimensions with sustainable development concerns. However, this team presented the least LEED attainable credits and defied the requirement that this project is visible from the main civic axe because they wanted to ensure that their project would integrate with the wooded area that surrounded the site – a concern regarding the symbolism of sustainability. It is important to highlight that the risk embedded within the LEED credits is of concern and not only the number of credits themselves. The difficulty was that the jury could not easily evaluate the project by Chevalier Morales/FABG as they did not have any tools or framework to assess the sustainability of this project outside LEED. This is why the project by Cardinal Hardy was considered a lesser risk in terms of attaining LEED accreditation. The project by Cardinal Hardy presented a strong set of LEED credits, although there was no explanation as to how these credits would be realized, a deficiency that the jury never brought up in the jury report. In addition, their project was massive and therefore very visible from the main civic access, which meant that they satisfied the requirement that was so important for the client. In the final deliberation, some jury member judged the Cardinal Hardy project to be the best project, yet others judged the Chevalier Morales/FABG to be the best.

Here it can be deduced that the tension regarding the use of LEED for the jury process originated from the fact that obtaining LEED certification was now so important for the client since it had become a public policy and therefore non-negotiable as a requirement. This represents the most intense tension for this competition, the tensions between political objectives and the consideration of the cultural repercussions for selecting a project based on LEED.

In the next chapter, the practical tensions identified in this chapter will be related to the theoretical tensions identified in at the beginning of this chapter. This will be followed by a summary of the three competitions, which will include a discussion of the benefits that this research presents to stakeholders of competition processes. A reflection of the importance of the theoretical framework for this research will conclude the next chapter.

CHAPTER FIVE: DISCUSSION OF TENSIONS STUDIED, THE PRECAUTIONARY PRINCIPLE AND DESIGN THINKING FOR SUSTAINABILITY

In this chapter I will seek to demonstrate the pertinence of the theoretical model founded on the precautionary principle as a way to complement current reductive methods of evaluation and judgment of design projects for sustainability. The way in which this demonstration will take place is to show how a precautionary lens for evaluation and judgment of design projects for sustainability enables a global perspective of the design project that considers the project in its entirely in contrast to a fragmented vision of the project based on the indicators provided by evaluation methods adopted for sustainability. It will also be shown that the tensions observed in the design competition for evaluating and judging the projects represent the epistemological gaps between preventive and precautionary approaches to evaluation and judgment and to what Schön (1983) refers to as technical rationality and reflection-in-action.

In order to present the interpretation and discussion of the data, this chapter is comprised of three main parts. In the first part, the tensions identified in the previous chapter for each of the three architectural competitions will be presented in light of their relationship to the theory. This will be done by categorizing these within the theoretical tensions presented in Chapter 4, which, as previously mentioned, are based on a reflection of the precautionary principle for design in a context of sustainability. The categorizing of practical tensions into theoretical tensions will not be mutually exclusive, meaning that the practical tensions may be related to one or more of the theoretical tensions.

The second part will comprise a discussion of these observed tensions with regards to the various elements identified in the theoretical framework. This is where the tensions discussed, both practical and theoretical, will be related to: (1) ease of comparison of projects; (2) richness of the deliberation in jury report and competitor descriptive texts; (3) ability to reach a collective and global understanding of the winning project; (4) way in which the criteria in brief is defined regarding the sustainability axe; and (5) diversity of juror backgrounds and their implications on the focus on the jury deliberation.

The last part in this chapter will present the pertinence of the theoretical model as a function of the observations presented in Chapter 4. Each of the main elements that comprise the theoretical model will be discussed in light of the empirical study. This research therefore seeks to contribute to the knowledge of design thinking in a perspective of moving towards sustainability using a theoretical model based on the precautionary principle, through an analysis of the judgment process for architectural competitions that adopt quantitative environmental evaluation methods for sustainability.

RELATING PRACTICAL TENSIONS TO THEORETICAL TENSIONS

The theoretical tensions that will be considered in this chapter are: (1) the tension between analogical/logical conceptualization; (2) the tension between epistemological/methodological uncertainty; (3) the tension between interpretive/analytic comparability; and (4) the tension between universal/contextual relevance of proposal. These tensions were defined in Chapter 4.

This analysis will relate some specific examples in the competitions to each of these theoretical tensions in order to be able to identify the gap or difficulty that is revealed. They each represent a significant component of design thinking, whether it is the conceptualization process, the projection process where uncertainty must be dealt with, the evaluation or judgment process or the sensitivity of the solutions. In essence, they represent the epistemological gap between technical rationality and reflection-in-action.

ANALYSIS OF THE TENSION BETWEEN ANALOGICAL/LOGICAL CONCEPTUALIZATION

An example in the competition that can be used to relate to this tension is the project by Croft Pelletier for the Montreal Planetarium. This project was named by the design team 'Black Box'. This represents an analogical conception of the project of which the design team related directly to the essence of the project to design; a planetarium where users would look at the skies and where holes would be an immense point of interest. Here the idea of the 'Black Box represents a cognitive tool to conceptualize the project. The jury in their jury report stated this about this project:

> *« La création d'une boîte noire propose une belle transition entre la clarté du jour et la noirceur de la voûte céleste. Le jury souligne la qualité spatiale exceptionnelle de même que la qualité sculpturale et sa réponse spectaculaire au site. (…) Au plan du développement durable, plusieurs stratégies sélectionnées sont discutables dont le « Living Machine » en raison de la présence de services municipaux, de même que les points d'innovation. » (Ville de Montréal, 2009b, p.6)*

The analogical proposal of the 'Black Box' was judged by the jury as providing an exceptional sculptural quality that also provided a spectacular response regarding the site. Yet the 'Living Machine' analogy that the team adopted regarding their sustainability proposal was judged weak since it presented too many obstacles. For the 'Black Box' example, the argument remained an interpretive argument as they referred to the experiential space and sculptural quality. Yet for the 'Living Machine'[119] example, the argument shifted from the analogical concept to the logical analysis of the situation where this proposal was judged weak and ineffective from a sustainability perspective. In fact, the jury stated that the LEED credits of innovation related to this proposal had to be questioned based on the phrase *"plusieurs stratégies sélectionnées sont discutables (…) de même que les points d'innovation"* of the above quote.

Yet in the Saint-Laurent Library competition, the project by Cardinal Hardy, the winning project, proposed a logical solution for sustainability that had no analogical component. The descriptive text of this team's sustainability solution was the following:

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119 The 'Living Machine' is proposal by the team Croft Pelletier for a system of grey water treatment. This proposal was to address some of the LEED credits. It will be further discussed in this chapter.

> *À l'échelle du site, le renforcement du cadre végétal, les bassins de rétention exprimés et mis en valeur, le stationnement responsable et les aménagements connexes ont mis en place les prémisses de base. La matérialité propre du bâtiment contribue grandement à la compréhension d'un bâtiment exceptionnel mais c'est principalement par ses systèmes mécaniques qu'il innovera. La mise en place d'un système de récupération des eaux de pluies et d'alimentation du milieu humide, d'un système de géothermie relié à une boucle d'échange thermique, de mesures diverses d'économie d'énergie etc...(sic) (…) L'éclairage naturel étant privilégié et combiné à un éclairage de tâches adapté et permettant d'importantes économies d'énergie. » (Cardinal Hardy et al., 2009, pp.3-4)*

There is no attempt to make any analogical conception of the sustainability concept. As LEED was the driving motor behind the sustainability dimension for this project, then this form of argument was well suited and in fact was judged as a 'pedagogical' solution by the jury as this was the word they used in the jury report. This therefore represents the tension between analogical and logical conceptualization.

Analysis of the Tension Between Epistemological/Methodological Uncertainty

As previously mentioned, epistemological uncertainty[120] refers to indeterminate knowledge of future consequences – a type of uncertainty typically related to the repercussions of cultural or social milieus, since the models representing such systems are so complex that predictions are unreliable. Risk assessment and judgment of these types of situations are not evident when committed to the more traditional forms of risk assessment and judgment, those based on an attitude of prevention. Judgment, when based on a paradigm of prevention relies on statistically calculated uncertainty. This type of uncertainty is a result of a methodological or data inadequacy, where the project or situation at hand is divided into parts that are solvable, yet these parts are essentially indissociable and this is why a precautionary approach may help adopt an approach to risk assessment and judgment that is more integrated and systemic. Precaution allows a critical distance from the details, it allows challenging the preconceptions, and is

120 The term epistemological uncertainty was described in the chapter entitled, *Modernity, Risk and the Precautionary Principle*.

therefore a reflective approach, much like Schön's reflection-in-action (1983). In fact, we can say that a precautionary approach to design inquiry, where the expectation is epistemological uncertainty, is a form of critical design practice based on the ideas of critical theory.

An example of a practical tension that is related to this theoretical tension is from a project from the Saint-Laurent Library competition. The first paragraph in the descriptive text of this team's proposal states that:

> *« Le désir de verdir la ville déborde de ce cadre pour s'étendre aux rues, ruelles, cours et toitures en associant développement durable, qualité de vie et amélioration du couvert végétal. (…) Ici, l'architecture est paysage et le paysage est architecture. L'architecture se déforme, se déploie, se soulève, afin de réduire les limites entre le bâti et le site. Ses accès sont multiples et prennent plusieurs formes, tantôt simple sentier contemplatif, tantôt parvis minéral, tantôt passerelle suspendue à travers les arbres ou tantôt "place enceinte" au cœur du projet. » (Chevalier Morales Architectes et al., 2009a, p.1-2)*

This team stated the importance of addressing the nature-culture dichotomy by seeking to integrate their building into the forest so that the forest can be felt by the users of the library – an experiential proposal for addressing this dichotomy. In addition, for this team the architecture and the surrounding site were inseparable, where one was a representation of the other. Here their sensitivity to the forest surrounding the site and the relationship it had to their project proposal is evident. However, in terms of sustainable evaluation, there are no current tools or methodologies that can be used today to assess this intent of their building. Consequently, this team was judged, by the jury as the weakest team regarding their ability to attain the LEED accreditation. The jury report stated that:

> *« Tous atteignent les points pour la certification LEED Or mais certains présentent plus de risques, dont ceux de Chevalier Morales/FABG, architectes, dont le budget est le plus serré et qui dispose de peu de crédits excédentaires. » (Saint-Laurent, 2010b, p.4)*

This shows that the jury considered the statistical uncertainty regarding this team's ability to attain the LEED Gold certification and was enough to judge it the riskiest. The jury would have to adopt a cognitive shift in terms of how it sought the sustainable solutions to be able to understand the depth of their sustainability vision. The 'perceived' certainty of the results provided by the LEED rating system was in tension with the uncertainty of a sustainable development vision that was more qualitative and projective, and where the risks could not be quantified. Here there was also a parallel tension between the methodological focus of LEED for addressing sustainable development by the jury and the systemic vision of the architectural project regarding sustainability by the finalist team.

On this point however, since the brief did not have any further criteria regarding sustainability besides LEED, the jury was not equipped to assess the sustainability dimensions beyond LEED, and therefore the strategy adopted by Chevalier Morales/FABG could not be considered the most sustainable.

Regarding the Montreal Planetarium competition, the finalist project by Croft Pelletier proposed an innovative approach to the ecological sustainability of their project – an approach they called the "Living Machine". This is a short explanation of the Living Machine concept by this team from their descriptive text:

> *« Le visiteur se trouve alors face à la grande vitrine verte du LIVING MACHINE TM, à la fois poumon et système de traitement des eaux grises. Cet élément environnemental important, situé au cœur de l'espace, permet dès les premiers instants une exploration des divers principes intégrés au bâtiment. » (Croft Pelletier et al., 2009, p.2)*

This approach was innovative and unorthodox in that the solution required intervention from the municipal level. The jury deemed this proposal too ambiguous and presented too many uncertainties that were not easily quantifiable yet the finalist team considered this proposal as a way to move beyond the constraining framework of LEED.

ANALYSIS OF THE TENSION BETWEEN INTERPRETIVE/ANALYTIC COMPARABILITY

The LEED rating system is a checklist format, resulting in a number that evaluates the 'greenness' of a building. The uncertainties are also quantified. This implies that those credits that the expert evaluators deem uncertain are given a score indicating this. The jury takes the LEED evaluations provided by the expert evaluators and embeds it into their own field of expertise and knowledge in order to arrive at a global judgment of the project. This judgment does not consist of an analysis of quantified results alone, but one that integrates both quantified results with their own qualitative assessments.

For example in the competition for the MNBAQ, and in the case of the winning project that OMA proposed, the jury had to consider both the questionable choice of envelope with regards to energy efficiency, with the qualitative assessment of the rich experience that the project presented with respect to the planned circulation. Therefore the jury was considering a decision based on a quantitative assessment of the energy efficiency of the building with a decision that is not based on a quantitative or statistical assessment.

If we relate this situation to the idea of prevention and precaution as defined by Ewald (1996), then for the competition process, ideally, we can say that the expert evaluators are embedded within the paradigm of prevention. This represents an analytic approach to comparability with the search for a statistical level of certainty of knowledge. Whereas the jury members, in their effort to synthesize and to understand the alternative projects presented, which represents a qualitative approach to comparability, reside in a paradigm of precaution, particularly when they are judging the projects.

This synthesis of both quantitative and qualitative considerations in the judgment process by the jury represents an approach that is in line with a precautionary approach rather than a preventive approach because it considers a global perspective that encapsulate any available quantitative data with their own knowledge. In other words, as a precautionary approach adopts a global perspective of the situation, in order that a project may be compared, then a precautionary approach to assessment of the various projects is coincident with the way in which the jury ideally compares projects. This is in contrast to looking at a set on quantified indicators that cannot provide a whole picture of the project.

Yet, within the judgment process, there may be a tendency to shift from an analytical approach of comparison using the technical reports from the various technical committees (i.e. LEED evaluation, budget, space requirements), to an interpretive comparative approach adopting a global perspective of the projects. This oscillation between these two modes of evaluation and judgment represents the essence of this tension. An example of this oscillation is represented in the following quote from the jury report for phase 2 of the MNBAQ competition[121]:

> *« Le jury se questionne sur la transparence et la translucidité de l'enveloppe et sa performance énergétique. (…) Les accès et la circulation proposent une expérience riche en découvertes, grâce à des percées visuelles sur l'extérieur et l'intérieur. » (Ville de Québec, 2010c, p.4)*

This dialectic is related to the tension between the perceived transparency provided by the analysis of the technical reports and the richness of deliberation. Here, the combined subjective ("*la circulation proposent une expérience riche en découvertes*"), normative ("*se questionne sur la transparence et la translucidité de l'enveloppe")* and objective ("*Le jury se questionne sur (…) sa performance énergétique"*) arguments, from a Habermasian perspective are evident regarding the qualitative dimensions of the projects. The problem with such a discourse is that for the jury members adopting a worldview of prevention, these arguments may be too opaque.

For example, in the quote just presented from the MNBAQ competition jury report, when the jury report states that *« Le jury se questionne sur la transparence et la translucidité de l'enveloppe et sa performance énergétique »,* the jury is presenting both an objective and normative claim. When the jury refers to the rich experience of the space resulting from the proposed circulation for the project, the jury is presenting a reflective argument, which in a Habermasian perspective, is referred to as a subjective claim. In the case of the MNBAQ, the results of the expert evaluation committees were not the primary focus of the arguments presented and therefore this tension was in fact a positive form in that the two sides of the dialectic nourished each other in the final judgment.

On the other hand, when the results of the expert evaluation committees are the primary focus of the jury deliberation, this may be perceived as transparent information for some of the jury members. The reason for this is because the quantified results provide a level of certainty and objectivity. If we relate this to a Habermasian argument format, this again only represents an objective perspective of the object of the argument. However, when jurors are focused on the interpretation of the projects, where the arguments are

121 This quote was presented in Chapter 4 for the MNBAQ competition analysis.

based on their experience or their worldview, then this exchange may at times be perceived more opaque as there is no quantitative grid or explicit framework from which to ground the judgments. An example that may show the difference of these two forms of argument is represented in the following quote from the Saint-Laurent Library jury report:

> *«Le concept propose un parti fort et mature dénotant une grande sensibilité dans sa simplicité, sensibilité tant au niveau des espaces intérieurs qu'à celui de la notion de filtre végétal lumineux; le langage est actuel et le geste fin. (…) L'implantation déterminée pour le respect du boisé, soulève des questions quant à la visibilité du bâtiment sur le boulevard Thimens, quant au coût lequel exclut les pieux et quant au message en développement durable en regard d'une enveloppe très morcelée, d'implantation étalée et de crédits (LEED) risqués. » (Saint-Laurent, 2010b, p.6)*

The part of this quote that can be verified in an objective manner is the LEED credit risk since this is quantified and is therefore considered transparent in this sense. The rest of this argument can be considered opaque in that there is no way in verifying its objectivity. The opaqueness of this form of argumentation, although a rich form of discourse and deliberation, may be in tension with jurors that may be more comfortable with the perceived transparency of the more quantitative forms of evaluation.

In fact, by relying primarily on the LEED rating system results to assess the sustainability of the project, the jury fails to interpret the more qualitative dimensions that the Chevalier Morales/FABG project offered regarding their vision of sustainable development. In the above quote, the jury recognized the sensibility of the proposal but was equally concerned with the LEED risk they presented. This is indicated from the following quote from the jury report of the Saint-Laurent Library project:

> *« Trois des quatre (4) concepts se démarquent par une signature architecturale forte dont la visibilité varie selon les partis d'implantation : le projet de Chevalier Morales/FABG architectes, en priorisant la mise en valeur du boisé, réduit sa visibilité vue du boulevard Thimens. (...) Tous atteignent les points pour la certification LEED Or mais certains présentent plus de risques, dont ceux de Chevalier Morales/FABG, architectes, dont le budget est le plus serré et qui dispose de peu de crédits excédentaires. » (Saint-Laurent, 2010b, p.4)*

The jury felt that the Chevalier Morales/FABG project was not visible enough from the main boulevard. However, this finalist project was more concerned with the integration of their project into the nature surrounding the site than just the LEED credits they would promise. In fact, this integration with the site is an example of a systemic vision for sustainability, yet it was in contradiction with the criteria specified in the brief regarding the visibility of the project from the main boulevard.

In addition, the methodology that the jury adopted for assessing sustainability was through the quantitative approach of LEED, a reduced vision of sustainability[122], and not through a consideration of other qualitative aspects of the project and their interrelationships with the LEED solutions. However, the brief specified the sustainability dimensions only through the LEED Gold requirement. Therefore it is important to highlight that this was a direct result of the way in which the sustainability dimension was defined in the brief, since the only element within the sustainability criterion was LEED Gold accreditation for the Saint-Laurent Library. This implies that the concerns of sustainable development were reduced to the LEED methodology for those that prepared the brief. This reductive perspective of sustainability is limiting for the judgment process of a competition especially for those finalist projects that went beyond a LEED approach. With regards to the theory of counter-productivity as defined by Illich (1978), this represents a good example, since even if some finalists went beyond LEED, this was not considered by the jurors as they had no way of assessing this more encompassing approach.

This is an example of the tension between the interpretive and the analytical oscillations of a jury process for comparing projects, specifically, when these poles are not reconciled in a manner that allows their coexistence. This competition resulted in a split vote, meaning that the jurors could not reach a consensus and that a vote had to be taken in order to select the winning project.

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122 This reduced vision of sustainability through the adoption of only the categories of LEED was discussed in Chapter 3.

In the example of the Montreal Planetarium competition, this tension was also present regarding the judgment process of the final two projects – the projects by Croft Pelletier (the second place winner) and by Cardin Ramirez (the winning project). The only specification for the sustainable development criterion for this competition was the LEED Platinum accreditation. In the brief for the Montreal Planetarium, the sustainability dimension was described as:

> *«Développement durable*
>
> *La certification LEED Platine exige un total de points entre 52-70. La Ville de Montréal a fait faire une analyse d'avant-projet sur la faisabilité de cet objectif et sur les coûts impliqués. Dans le cadre d'un concours d'architecture, il est fortement recommandé de cibler 58 points afin de tenir compte des imprévus de conception en cours d'évolution du dossier. » (Ville de Montréal, 2009a, p.33)*

Both projects adopted an approach to sustainable development that was focused on LEED categories, just as the brief requested (see Figure 23 and Figure 24). The extended green space proposed by the winning project – that of Cardin Ramirez – provided a strong visual element for sustainable development since the existing site, which was predominantly concrete, would now be transformed into an extensive green space. This does not necessarily contribute to a more sustainable solution, although it may appear to be a 'greener' solution.

On the other hand, the second place project by Croft Pelletier did not propose an extensive green space surrounding the site. According to the jury report, this was a weakness:

> *« (…) le parti ne propose aucune restauration de l'espace végétal du site, déjà déficient. » (Ville de Montréal, 2009b, p.6)*

Yet according to the descriptive text for the project by Croft Pelletier, the reason for this lack of green space was that the team wanted to create a 'piazza' instead of a green space so that people would be encouraged to gather and socialize. So this team was addressing the idea of social revitalization on a space that currently lacked any social activity.

The outcome of this jury process was a deadlocked vote. This means that no consensus could be reached. In fact, the deadlocked vote among the jurors was broken by the extra vote that the president of the jury can use in cases of deadlock. The jurors did not resolve this tension collectively, as they failed to construct a common vision of the winning project through a collective interpretation and analysis of the projects.

Analysis of the Tension between Universal/Contextual Relevance of Proposal

The project proposed by the team Chevalier Morales/FABG for the Saint-Laurent Library decided to position their building with respect to the existing trees on the site so as to cause the least site disturbance as possible. The jury report stated the following regarding this decision:

> *« L'implantation déterminée pour le respect du boisé, soulève des questions quant à la visibilité du bâtiment sur le boulevard Thimens, quant au coût lequel exclut les pieux et quant au message en développement durable en regard d'une enveloppe très morcelée, d'implantation étalée et de crédits (LEED) risqués. » (Saint-Laurent, 2010b, p.6)*

For the jury, the practical tension between the environmental evaluation method used and the constructive choices was clear. The contextual sensitivity of positioning the building so that the wooded area could be respected was deemed less important that the risk they presented in terms of LEED credits. The practical tension translated into a theoretical tension between universality and contextual relevance of proposals.

Main Issues Arising from the Analysis of the Tensions

Before beginning a discussion regarding the main issues arising from this analysis, it is important to present a summary of the important contextual data regarding the three competitions. Table 53 presents a summary of the contextual information for each competition. Also a summary of the tensions that had a profound impact on the final outcome on the competitions is presented in Table 54 on page 306.

TABLE 53: SUMMARY OF CONTEXTUAL INFORMATION FOR EACH OF THE THREE QUEBEC COMPETITIONS

Contextual Information of each Competition	Saint Laurent Library	New Montreal Planetarium	MNBAQ
Sustainability criteria definition in brief	LEED categories IDP Health and work safety issues (related to quality of air, etc)	LEED categories	LEED categories IDP Neighbourhood revitalization Non-vehicle accessibility
LEED certification level required	LEED Gold (39-51 points)	LEED Platinum (52-70 points)	LEED Basic (26-32 points)
Number of LEED Credits of Winning Project	44 possible credits Semi-finalist: 42	53 possible credits Semi-finalist: 59	56 possible credits (yet the jury was not convinced of some of their credits – use of wood structure) Semi-finalist: non-known
LEED credit Ranking among Finalists (1 indicates best)	3/4 (others: 46, 45, 42)	5/5 (others: 62, 60, 59, 57)	1/5 (others: 45, 42, 48, 34)
Comments on winning project regarding the criterion of sustainability	Among the two projects left, the winning project was deemed the least risk regarding LEED and budget	Winning project had the most visible extensive green space and green roof, often read as sustainable	None
Characteristic that communicates to the public the environmental dimension	Winner: roof garden Second place: none	Winner: extensive green space covering building Second place: none	Winner: garden roof Second place: not known
Competition format	2-phase non-anonymous (1st phase 28 dossiers, 2nd phase 4 finalists)	2 phase anonymous ideas (1st phase 62 ideas, 2nd phase 5 finalists)	3-phase non-anonymous (1st phase 108 dossiers, 2nd phase 15 invited , 3rd phase 5 finalists)
Finalists from outside Quebec	0/4	0/5	5/5
Total members in jury	7	9	8
Level of recognition of LEED expert in jury	National (contributor to the CaGBC)	International (member of the iiSBE - International Initiative for a Sustainable Built Environment) (only in phase 1 not in phase 2)	Regional
Jury members from outside Quebec	0	2	2
Selection of winning project	Split decision (vote)	Split decision (vote)	Unanimous (consensus)

With regards to a split vote, which was the result of the jury for two of the three competitions (refer to Table 53); it is usually an indicator of a judgment process where many issues remained open and where no collective understanding was possible. A collective understanding or a common vision of a situation can be obtained when the members of the deliberation process are open, and where the communication situation is an ideal speech situation as defined by Habermas (1984). Several elements may hinder a collective understanding or construction of the winning project in an architectural jury deliberation, from a Habermasian perspective. These are: (1) the lack of clarity or coherence of jurors' arguments; (2) the lack of a sense of truthfulness; (3) the lack of conviction in their discourse; or (4) a coercive communication situation (Habermas, 1984).

As participant observations were not conducted in this research, it is not possible to state that any of these were present in the speech situation of the jury deliberation. However, we can state that the deliberation process for these two competitions did not succeed in constructing a common view of the winning project, since they were split along different finalist projects. Unanimity or better consensus would have been the ideal outcome for the judgment process of an architectural competition.

The two competitions with a split vote, the Saint-Laurent Library and the Montreal Planetarium both had LEED experts on the jury that are nationally and internationally renowned. A world leader in any field will be highly respected and his arguments will be taken as strong since the arguments will be considered as objective and truthful. However, objectivity and truthfulness are only one aspect of a strong argument according to Habermas. The other two elements in a strong argument are subjective and normative components.

Could it be that the arguments of an internationally LEED expert are heavily weighted during a jury deliberation compared to an architect with no recognised LEED expertise? As the possibility of observing the jury process or interviewing the jury members was not possible for either of these two competitions, it cannot be stated that coercion was present in their deliberation processes. However, if we consider an ideal speech situation as defined by Habermas (1984), the presence of a LEED world leader may have introduced a dimension of coercion in the jury deliberation.

The LEED certification level required was highest for the two competitions that had a split vote – Saint-Laurent Library and the Montreal Planetarium (refer to Table 54). The heavy burden placed on the jurors to ensure that, not only such a requirement would be met, but that it could also be clearly communicated to the public, may have pulled the focus of the deliberation away from the more general qualitative dimensions of the architectural projects. So the jury had to seriously consider in their judgment the more technical concerns of performance optimizations and the greening (or appearance of greening) of sites. Here it can be hypothesised that a high LEED certification requirement places an equally heavy burden on the jury in terms of ensuring that the winning project satisfies the requirement and therefore shifts the focus away from the more qualitative dimensions of the project.

For the Montreal Planetarium, the LEED requirement represented 20% of the entire project in the final judgment (refer to Table 54). As the green roof and the greening of the site are important visual elements that transmit a message of sustainability of which LEED was the main component, some of the members of the jury considered that the team that did not propose any green exterior space presented a fundamental weakness, even if the reason for not greening the site was abundantly justified. As was mentioned before, this was the second place project by Croft Pelletier who proposed the 'piazza' instead of a green space to encourage social and community activity'. However, a green roof and the greening of the exterior space was an imperative of which the second place proposal by Croft Pelletier did not present.

Table 54 presents the highlights for the three competitions.

TABLE 54: HIGHLIGHTS OF THE TENSIONS OBSERVED IN EACH OF THE THREE QUEBEC COMPETITIONS FOR THE SELECTION OF THE WINNING PROJECT

Tensions	Saint Laurent Library	New Montreal Planetarium	MNBAQ
Political objectives (communicating sustainable expertise) vs. cultural repercussions	From the last two projects left, the project selected as the winning project presented less LEED risk and the jury felt the envelope of the second place winner did not communicate a sustainable vision.	The jury was driven by the LEED requirement. It represented 20% of the total weighting. So it was important that the winning project was also the most visibly sustainable and that this didactic dimension was obvious.	None
Requirements in brief vs. context of site (defying the brief)	The winning project was monumental, satisfying the requirement in the brief, but given the contextual relevance of this criterion, it was questionable for one of the finalists and for some of the jurors.	As the green roof and the greening of the site are important visual elements that transmit a message of sustainability, part of the jury considered that the team that did not propose any green exterior space presented a fundamental weakness, even if the reason for not greening the site was abundantly justified.	None
Environmental performance vs. quality of space	Two of the four finalists adopted strategies of compactness to attain the highest LEED credits, which in both cases compromised the quality of space.	The winning project had fluidity problems regarding the interior space between the levels which may have been a result of immersing the entire building underground.	None
Environmental performance vs. constructive choices	The second place winner team adopted an envelope that proposed an iconography of reflecting nature and lightness, yet was deemed a riskier project regarding LEED for the jury.	The winning project chose to build an almost entire green space of the site by immersing the building completely underground, in order to give an image of sustainability – and the jury felt that the selection of the envelope of the exposed structure (the telescopes) was still in a preliminary phase. Yet this was the only visible part of the project.	The jury recognized that the use of wood would not guarantee LEED accreditation for the winning project, but as the winning team had already shown their capacity to achieve LEED Basic, this was not an issue.
Environmental performance vs. aesthetic quality	The runner up team decided to defy the requirement of monumentality and visibility and instead opted to immerse the project within the wooded area in order to valorize the forest. This was penalized by the jury since the visibility criterion remained non-negotiable.	In order to ensure that the building depicted a message of sustainability, a green roof and the greening of the exterior space was an imperative. Yet this resulted in a project that was immersed underground without any visible architectural elements except for the telescopic structures, which are not structures of urban renewal when compared to the 'black hole' project.	None
Diverging Views	The jury was split because two members of the jury questioned two criteria in the brief, causing contention. Also the second place's approach to sustainability (a systemic approach) was not considered by the jury as a global approach.	The jury was split between two final projects. The president of the jury used his vote to break the tie. However, the jury was unanimous on the need to develop the winning project through by working with the team in an architectural design process.	The jury was unanimous on the winning project.

Another interesting observation regarding the two competitions that had a high LEED requirement was that the LEED certification requirement was also highly publicized through the media (call for proposals, announcement of winning projects for various phases), implying that the LEED certification must not only be obtained, but that it must also be visible to the public. The two competitions that had a high LEED rating were the Saint-Laurent Library (Gold) and the Montreal Planetarium (Platinum) competitions. The difficulty in comparing the basis of the LEED credits and the difficulty in the comparison of the 'normative' visible characteristics (i.e. green roof, green space, etc.) that may not necessarily result in a more sustainable project as a whole represented the core of the difficulty in deliberation for both these projects.

In fact, the lack of a global vision regarding what constitutes an architectural project seeking sustainability were also a source of difficulty that occurred during the jury deliberations. A global vision of an architectural project seeking sustainability would require a systems perspective, where the main LEED elements, their interrelationships, the relationship with the intention of the whole project and the other qualitative dimensions of the project, must all be considered in a systems approach[123].

For the winning projects, the LEED elements were related with each other, but there was no relationship made with the LEED solutions and other qualitative elements of the whole project. For the Cardinal Hardy project of the Saint-Laurent Library, their strategies for a sustainable library were enumerated as follows:

> *A l'échelle du site, le renforcement du **cadre végétal**, les **bassins de rétention** exprimés et mis en valeur, le **stationnement responsable** et les aménagements connexes ont mis en place les prémisses de base. La **matérialité** propre du bâtiment contribue grandement à la **compréhension d'un bâtiment exceptionnel** mais c'est principalement par ses **systèmes mécaniques** qu'il innovera. La mise en place d'un **système de récupération** des **eaux de pluies** et d'alimentation du milieu humide, d'un **système de géothermie** relié à **une boucle d'échange thermique**, de mesure diverses d'économie d'énergie etc... Mais principalement, l'introduction d'un **système passif** de chauffage utilisant la **chaleur accumulée dans le prisme** de **verre référentiel** et redistribué dans **la boucle géothermique**. La ventilation à faible vélocité par les*

123 This global vision and systemic approach was described in Chapter 2.

planchers permet une ***réduction du nombre de conduits*** *requis. Des rayonnages verts filtrants les C02, installés à quelques endroits à travers les collections, etc... De plus, un souci important tant pour* ***le confort des usagers*** *que pour les* ***économies d'énergie*** *est apporté aux* ***éclairages****. L'éclairage* ***naturel*** *étant privilégié et combiné à un éclairage de tâches adapté et permettant d'importantes économies d'énergie. (Cardinal Hardy et al., 2009, p.3-4, researcher's highlighting)*

The highlighted words in this above quote identify the main elements, and it can be seen from these words, that on the most part, the various solutions related to LEED credits were related among themselves. In other words, the technical solutions were proposed and juxtaposed on the project and therefore only considered elements related to LEED in their system of a vision of a sustainable architecture. For example, in this above quote, some 'elements' when adopting a systemic vision are: *« ses systèmes mécaniques (...) La mise en place d'un système de récupération des eaux de pluies et d'alimentation du milieu humide, d'un système de géothermie relié à une boucle d'échange thermique, de mesure diverses d'économie d'énergie »*. These elements are not related to each other and are also not related to other architectural qualities. There is only an enumeration of elements. This is therefore not a systemic vision.

One other interesting observation is that the difficulty of assessing LEED during the competition process is due to the fact that the proposals for adopting LEED credits have not yet reached the detail design phase. In other words, there are still uncertainties in the proposal that can only be revealed during the course of the project. Therefore the evaluations are not completely reliable at the phase in which the competitor projects are submitted to the competition (refer to Figure 34).

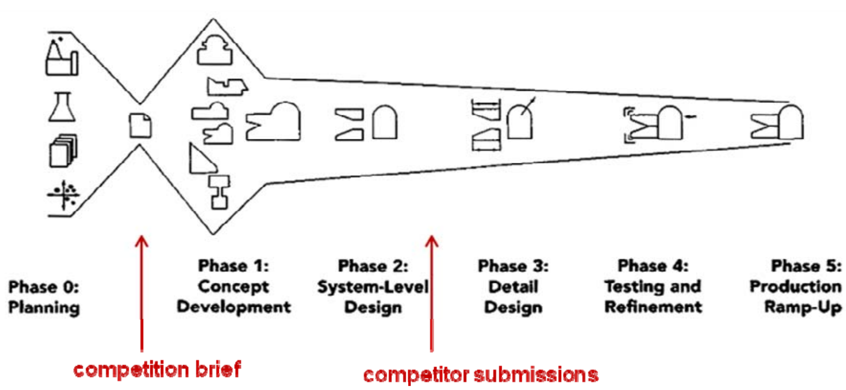

FIGURE 34: MODEL ILLUSTRATING THE PHASE WITHIN THE DESIGN PROCESS WHEN THE COMPETITION BRIEF AND COMPETITOR PROPOSALS ARE SUBMITTED.

It is not reasonable to assess a project as a riskier project regarding LEED at this phase since the uncertainty is still too great to be able to reach such a conclusion. The riskiest project judged by the jurors for the Saint-Laurent Library proposed 42 credits (the second place project) whereas the winning project proposed 44 credits. When using only an objective argument to make such a judgment regarding a project as it is based on the number of LEED credits, without looking at the broader implications of the project, then the disjunction between technical rationality and reflective thinking becomes obvious.

In this example, the judgment was based only on instrumental rationality (technical rationality) circumventing reflective thinking, since it was only based on evidential facts from LEED. Dewey (1933) claims that the three components: evidential data, principles and tacit knowledge are needed to arrive at a judgment that is based on reflection. This was not done in this example.

When comparing the paradigm of the project to the paradigm of using LEED, there is a disjunction in this example. Here, the concept of paradigm is that defined by Kuhn (1970) and project is that defined by Boutinet (2005). The way in which the jurors use the LEED results is within a mechanist paradigm; a cause-effect worldview. However, the project paradigm adopts a type of thinking and knowledge construction that is based on global, recursive worldview. These two different worldviews were not reconciled in this example. The judgment of this project was a direct result of the LEED evaluation. It shows that the LEED strategies are treated outside the scope of the project perspective, disconnected from the project. This represents another example of a counter-productive (Illich, 1978) effect when adopting LEED in a disconnected manner to the rest of the architectural project.

Finally, although the IDP was a requirement for the sustainable development criterion for two of the competitions (Montreal Planetarium and MNBAQ), the evaluation of this process was not reported in any of the jury reports, nor was it present in the discourse of most finalists. Some indicators can point to the existence of such a process. One such indicator is the way in which the discourse is developed in the descriptive text of the finalist. If the descriptive text describes the interrelations between the technical solutions and the qualitative aspects of the architectural project, then some discussion within the design team may have occurred in order to obtain such an integrated perspective of the project. An example of a text that may show the existence of an IDP is the descriptive text by Big City/l'Oeuf for the Montreal Planetarium competition:

> *Dès le départ, une première idée s'est imposée clairement, il s'agissait de **cartographier l'univers**, d'édifier le ciel en quelques sortes et de **traduire en architecture** l'émerveillement que l'on peut ressentir sous la **voûte céleste**, sa profondeur et son échelle impalpable pour le communiquer subtilement. Cette idée a orienté un travail de conception de **l'espace**, où le brouillage des **limites** et de la **profondeur** des espaces construits et de **l'enveloppe** prennent une grande importance. Par ailleurs, à partir d'une analyse rationnelle du **site** et du **programme** et pour réaliser la meilleure **connexion** au **Biodôme** un parcours qui, paradoxalement, mène de la clarté à la pénombre s'est dessiné du niveau 100, qui est en réalité celui du sous-sol, vers les niveaux supérieurs. Dans une perspective d'étirement vertical de notre planète vers l'espace, ce paradoxe n'est toutefois pas dénudé de logique.*
>
> *Des stratégies élémentaires de **développement durable** ont rapidement cristallisé la **géométrie** de **l'édifice** et établi l'importance d'un **mur solaire** qui, en traversant l'intérieur sur trois niveaux, devient, un **repère architectural** et un **élément scénographique** fort autour et dans lequel s'organisent la **distribution** et le pré-conditionnement des **flux d'air** : L'approche au développement durable est **indissociable de l'architecture**; elle est partie prenante de la scénographie. (Atelier Big City & L'Oeuf, 2009, p.1, researcher's highlighting)*

The highlighted words are the main elements and form a system when adopting a global vision of the project specific for sustainability. The way in which these elements are related in this text, where the analogy of a celestial map is the basis of their design, and how this celestial map is projected in their envelope choice as well as in the geometry of the building, and how the solar panel becomes not only an element of energy efficiency but also an scenographic element for the project based on the celestial map, is indicative of a systems approach to design. This quote also shows evidence that an IDP process was adopted since the qualitative architectural elements are related to LEED solutions which are in turn related to structural proposals. This quote also shows that a global and systemic vision was adopted in their approach to design for sustainability.

It is important to note here that the ideal way to evaluate such a process is through an observation of the design process of each finalist. But within the context of a competition this is not a possibility as the work done by each finalist is highly confidential. Therefore an observation of their design process is not possible within a context of a competition.

These tensions confirm the difficulty in the judgment process as well as in the design process when adopting LEED. However, the difficulty is not always present, as the MNBAQ competition testified – it resulted in a unanimous decision.

An awareness of these tensions and an elaboration of the projects using a systemic vision may help overcome some of the difficulties encountered by the two competitions that resulted in a split vote, namely that of Saint-Laurent Library and the Montreal Planetarium. In addition, a better understanding of how these tensions play themselves out in the MNBAQ competition may help us address some of the difficulties encountered in the other two competitions. In the next section the pertinence of the results of this research will be discussed.

PERTINENCE OF AN UNDERSTANDING OF THESE TENSIONS FOR THE ARCHITECTURAL COMPETITION

The analysis of the various tensions identified and studied may be useful for a variety of stakeholders of an architectural competition. A systemic approach can be used to help the jurors conceptualize and model the various dimensions and their relations regarding each of the finalist projects. What this means is that if the jurors go through the exercise of identifying the main elements in their sustainability proposals and understand the relationships between these, as well as the relationship between these and the general intention of the project, then they have adopted a systemic vision of the project for sustainability. This does not imply that the designer adopts a systemic vision of their project, but the jurors have interpreted it through a systemic vision, and therefore in turn, providing a global perspective of the finalist project. This exercise may help the jury collectively obtain a global understanding of each of the finalist projects, even if they may not all agree on the significance of the individual elements within each of the projects.

In addition, a systemic approach may help some jurors realize that a higher LEED score must be considered from a worldview of complexity. This implies that a more encompassing philosophy for sustainable development may be far more promising in terms of the actual benefits they may engender. A complex worldview refers to the fact that LEED should not be used only as a checklist to be filled out, but instead should represent one part that is integrated with the rest of an architectural project, that itself is a projection of a series of intentions. A more encompassing philosophy refers to a worldview of sustainability that is not based on efficiency alone, as LEED purports to, but one that is based on strategies of among others, effectiveness, sufficiency, regeneration and revitalization, etc.

For example, in the Saint-Laurent Library competition, the second place and winning projects – the projects of Chevalier-Morales and of Cardinal Hardy – presented very different approaches regarding the sustainability dimensions of each of their projects. The project by Chevalier Morales/FABG, as indicated earlier, proposed a systemic vision of sustainability. This quote from the descriptive text of Chevalier Morales/FABG proposal for the Saint-Laurent Library shows some evidence of this vision.

> *Plutôt que de considérer la nouvelle **bibliothèque** de ville Saint-Laurent comme "une **porte d'entrée** au parc Marcel-Laurin" nous préférons imaginer qu'elle soit perçue comme faisant **partie intégrante** de celui-ci, au **cœur du boisé**. La dichotomie **nature-culture** qui conduit à penser les **parcs** comme des **oasis de verdure** séparés du **milieu urbain** par une **frontière** bien définie ne correspond plus aux aspirations des citoyens montréalais. Le désir de verdir la ville **déborde** de ce cadre pour s'étendre aux **rues, ruelles, cours** et **toitures** en **associant développement durable, qualité de vie** et **amélioration du couvert végétal**. La **fréquentation** de la bibliothèque peut être une **expérience immersive** qui contribue à exaucer ce souhait tout en fournissant un **cadre propice à la lecture**.*
>
> *Pour y parvenir, nous avons tout d'abord fractionné **la volumétrie** du bâtiment pour se **glisser dans la forêt** existante en **préservant** 86% des arbres dont le calibre est supérieur à 20 cm. (...) Le **périmètre du boisé sera agrandi** jusqu'au boulevard Thimens pour faire en sorte que la bibliothèque se **retrouve au milieu des arbres**. (Chevalier Morales Architectes et al., 2009a, p.1, researcher's highlighting)*

Their sustainability vision is inseparable from the constructive choices, from social considerations, from questions of regeneration, to quality of space. They have in this paragraph related each of these elements through a proposal for sustainability.

On the other hand, the team of Cardinal Hardy for the Saint-Laurent Library proposed a very isolated solution to their concerns regarding sustainability. They presented a one paragraph description of the various technical solutions regarding LEED Gold certification (see quote on page 307-308). This was done without any explanation how these would be manifest in the architectural project and without any concern about how other qualitative architectural dimensions (aesthetic, constructive choices or quality of space) would be affected by these technical parameters. A systemic conceptualization of the sustainability considerations of each of these projects by the jurors may have revealed the more encompassing proposal regarding sustainability by Chevalier Morales/FABG, instead of deeming this project the riskiest project with respect to attaining LEED certification. This is another example of a counter-productive effect, as defined by Illich (1978), when adopting a technical rationality.

With respect to design thinking, the proposal for sustainability by Cardinal Hardy adopts a way of thinking based on technical rationality. This proposal presents universal solutions, that can be easily analysed using the LEED rating system, and therefore the uncertainty related to their sustainability proposal is minimal with respect to this type of thinking. However, this vision of sustainability for architectural projects is reductive.

The sustainability proposal by Chevalier Morales/FABG on the other hand does not reside predominantly within technical rationality, but seems to oscillate between reflection-in-action and technical rationality since their solutions is not founded on universal readymade proposals, but rather on a sensitivity to site within a perspective of sustainability.

A phase of the competition process that may be improved by adopting a systemic vision is the construction of the brief, particularly for the sustainability dimension of the project. A systemic model of the client's vision of sustainability may reduce the ambiguity that often results when sustainability is reduced to a rating or evaluation system. Table 7 on page 161 depicts an example of a systems approach for defining sustainability criteria based on a combined preventive and a precautionary approach. The criteria on this table are only examples of design inquiries. This table could be constructed by the evaluators or the jurors of a competition process in which case, the methodology of fourth generation evaluation, as defined in Chapter 2 would be helpful.

In addition, the way in which sustainability was specified for each of the competitions differed (refer to Table 53). For the Saint-Laurent Library competition they specified LEED Gold, the IDP process, and health and safety issues related to air quality. For the Planetarium project the only specification was LEED Platinum (and its respective categories), and no other specifications. This is a paradox since by specifying the highest LEED rating requirement it seems that the notion of sustainability is of utmost importance, yet no other concerns regarding the other pillars of sustainability were specified, such as social, cultural or economic. For the MNBAQ project, the project that required the lowest LEED rating (LEED Basic) defined the sustainability dimension as: LEED categories, IDP, neighbourhood revitalization, non-vehicle accessibility. This was the only competition that included a social dimension (neighbourhood revitalization) in their list of criteria for sustainability. The MNBAQ's was the most global definition among the three competitions.

A systemic description of sustainability in the brief that includes the four pillars identifying the main objectives, concerns and visions could be used by the competitors as a basis of their own reflection for their projects instead of as a checklist to fill out. There are at least two benefits of providing a more comprehensive description of sustainability in the brief. First, all competitors will be working from the same description of sustainability. This may help avoid the situation where each of the competitors adopt very different definitions of sustainability and where the intense efforts regarding sustainability of one team are not considered by the jury as they go beyond that which was required by the competition organizers. Second, the jury process may be eased, since the set of criteria necessary for judgment regarding sustainability will be the same for all competitors.

As was shown in Table 7 on page 161 there can be an infinite list of concerns regarding sustainable design for architectural projects. In this table, there are many ways to envision the intended building within the preventive approach, such as:

> (1) the green building can be seen as a form of organizational growth for the economic pillar;
>
> (2) it can be seen as a way to optimize performance while reducing impacts from an environmental perspective (i.e. LEED);
>
> (3) it can be seen as a way to increase local business opportunity from a socio-economic perspective; and

(4) it can also be seen as a way to increase local tourism from a cultural-economic perspective.

If a precautionary form of design inquiry for sustainability is adopted, then the architectural project can be seen as:

(1) a form of organizational and community development;

(2) a means for environmental regeneration;

(3) a means for social cohesion and equity, enhancing community life; and

(4) a means for cultural impetus.

From this list of questions, it can be seen that the variety of concerns for an architectural project within a sustainable context are varied and go far beyond a LEED performance and efficiency approach as it is defined today. Therefore, if LEED is the only benchmark or tool proposed for the criterion of sustainable development for a competition, then it should be made clear in the brief that environmental performance optimization is the only important aspect of sustainable development that will be considered for the project by the jurors. Otherwise, specific aspects important to the client and community should be clearly stated, of which the above lists are an example.

An exploration of the relationships between the environmental optimization strategies adopted for LEED and the benefits they may provide to the members of the community or how this would improve the cultural fabric of the community and how these relate to qualitative aspects of the architectural projects, suggests that a global vision of the project regarding the concerns of sustainability have been adopted. This is what is termed in this research as a precautionary form of design inquiry. This would therefore require that the finalists identify how these relationships regarding the technical solutions for LEED relate to the more qualitative dimensions of their projects (quality of space, experiential quality, etc.). For example, the team by BIG City/L'Oeuf adopted such an approach in their proposal for the Montreal Planetarium. The following quote taken from their descriptive text indicates their global perspective regarding the solutions for LEED and other qualitative elements of the project:

« La proposition d'une ***architecture holistique*** *qui* ***intègre structure, électricité*** *et* ***mécanique*** *n'est pas en soi nouvelle, cependant la* ***tension*** *entre* ***la juxtaposition et l'intégration*** *est aujourd'hui exacerbée par les* ***exigences LEED*** *et la prolifération des dispositifs* ***électro-mécaniques*** *que l'on souhaite faire* ***participer au fonctionnement*** *du bâtiment (et* ***même de la ville****), cela dans une* ***perspective d'économie d'énergie*** *et de plus* ***grand confort des usagers****. Un des principaux défis que pose cette approche est de conserver une* ***perspective globale du projet*** *et d'éviter* ***les pièges du simple collage*** *ou* ***de la juxtaposition où la technique*** *est appliquée sans* ***compréhension globale*** *de l'ensemble sans poursuivre ou renforcer l'idée de ce qu'est le projet. (…) Dans le projet,* ***plusieurs stratégies*** *sont combinées qui impliquent la collecte et le* ***recyclage des eaux****, la* ***collecte de l'énergie solaire****, la* ***géothermie et l'éclairage naturel****. Le projet du planétarium favorise la double voire la triple fonction de différents éléments: par exemple,* ***le jardin*** *en coupant dans le sol permet* ***d'exploiter la géothermie et l'éclairage naturel*** *et* ***d'augmenter les dimensions du mur solaire****. La cour et le* ***mur solaire jouent également*** *un rôle important dans la* ***scénographie globale*** *du bâtiment. Ils en présentent le* ***caractère durable****, l'un* ***renforce la dimension écologique végétale*** *des Muséums nature de Montréal, alors que l'autre contribue à* ***la lecture du ciel*** *» (Atelier Big City & L'Oeuf, 2009, researcher's highlighting).*

The highlighted words in the above quote provide evidence that a global perspective of the project was adopted. A global perspective would require that the system is defined by identifying the elements in it, the relationships between the elements and to the whole. This quote succeeds in this task. For example, the architectural project is the main system, where the garden, one element in the system, is central since it serves as a way to exploit the geothermal energy, as a way to exploit natural lighting and as a way to augment the dimensions of the solar panel wall. The solar wall also plays an important role in the whole project. It is the basis of the global scenography of the building (the cartography analogy). Therefore these two elements contribute not only to the ecological vegetation, but also to the reading of the sky, representing at once an environmental, an aesthetic, and a functional role in the whole system. This example represents a systemic conceptualization of the design project for sustainability, particularly with regards to the LEED solutions.

A systemic conceptualization however cannot be developed by one architect alone, as the elements to consider are immense: energy systems, water systems, mechanical systems, and their relationship to the functionality, the structure, the aesthetic, the symbolism, and the comfort. Here the integration of many experts in the initial conceptualization phase is evident because there is a comprehensive understanding of the interrelationships between each of these systems and elements. This is how an IDP is defined, the participation of all experts early on in the conceptualization phase so that a synergy of their expertise and ideas can be maximised. Therefore, this indicates that the IDP had been adopted since a systemic vision of this kind requires that various experts of the design team work closely together. Here elements of design expression are combined with technical parameters for sustainability based on LEED in a critical reflective approach, where technical rationality is embedded within reflective thinking, just as Schön (1983) had defined reflection-in-action.

This example shows that the two approaches of prevention and precaution have been resolved through an analogical, intuitive, yet logical and analytical approach considering site specificity as well as solutions that are universally available. In this sense, not only did they focus on efficiency strategies for sustainability, but they also adopted strategies of sufficiency. Efficiency refers to optimizing the performance of the building where LEED is the model, whereas sufficiency refers to satisfying the most human needs for the users of the project with the least material solutions. Sufficiency relies more on an axiological form of judgment, rather than on a deontological form of judgment. LEED, and therefore the objective of efficiency relies on a deontological form of judgment.

In summary, the relationship between the practical tensions and the theoretical tensions is represented in Table 55 on the next page. Only some practical tensions are highlighted in an effort to show the most evident difficulties encountered in the jury deliberation process and how these are related to the theoretical tensions which were themselves a reflection of the gap between prevention and precaution.

TABLE 55: HIGHLIGHTS OF TENSIONS OBSERVED BETWEEN THE USE OF LEED AND DESIGN THINKING FOR THE JURY DELIBERATION AND THEIR THEORETICAL DIALECTICAL FOUNDATION

Practical → Tensions **Theoretical Tensions ↓**	political objectives/ cultural repercussions	requirements in brief / context of site	environ performance/ quality of space	environ performance / constructive choices	environ performance / aesthetic quality	Diverging views
epistemological/methodological uncertainty	The certainty that the winning project had to be LEED certified and that it had to project an image of 'greenness' for both the Saint-Laurent Library and the Montreal Planetarium made the jury deliberation problematic	For the Saint-Laurent Library, the building had to be visible from the main boulevard, yet this was in contradiction with the need to valorize the wooded area.	For the Montreal Planetarium competition, Croft Pelletier proposed an outdoor 'piazza' to encourage social revitalization instead of a green space. The jury deemed this to be problematic regarding the greenness of the site.	For the winning project of the MNBAQ, the wood used to address environmental sustainability was deemed too dominant by the jurors yet at the same time a good use of a local and a sustainable material.	Project by Chevalier Morales/FABG for the Saint-Laurent Library judged as riskiest in terms of LEED, yet had longest term vision of sustainability	The jury for the Saint-Laurent Library was split, and one reason was the risky nature of the second place winner's ability to obtain LEED Gold yet their more global sustainable vision was ignored
interpretive/ analytic comparability	The project by Chevalier Morales/FABG for the Saint-Laurent Library was deemed the riskiest so in terms of a political statement for the client, it was not an appropriate choice for the winning project.	The way in which the team of Chevalier Morales/FABG decided to integrate the building into the site was directly opposed to its visibility from the main boulevard. Even if its integration into the site was much more sensitive than the winning team, they had clearly defied a requirement.	The quality of interior space resulting from the leaf-like exterior grid that the team by Chevalier Morales/FABG proposed was questioned by the jurors, even if this was a symbolic way to connect to the site.	The clear set of LEED credits that the team of Cardinal Hardy proposed for the Saint-Laurent Library facilitated the comparison of the sustainability dimension even if the constructive choices were questioned by some jury members (monumentality of structure).	The winning project for the Montreal Planetarium was completely immersed underground, resulting in the need for a technical focus for most of the LEED credit requirements, and was visibly LEED because of the extensive green space proposed. However, the jurors deemed the symbolism of the telescopic cones to be weak.	The difference in symbolism between the two final projects for the Montreal Planetarium were based on a major difference in the symbolism both regarding LEED credits and the symbolism related to the planetarium as a cultural project.

What can we Learn from the Tensions Studied regarding Architectural Competitions and Sustainable Development

LEED remains a very significant analytical tool for helping address a series of ecological concerns for architectural projects, yet a strict application of LEED in architectural competitions may be at the detriment of addressing other important architectural concerns and may obscure the cultural and social motivations of architectural projects, specifically for public projects. The next sub-sections will present some of the lessons learnt from the three competitions. The way in which this will be discussed is based on the outcome of the jury deliberation. On the one hand we can learn from the problematic jury deliberations. Problematic jury deliberations are those where the winning project was selected through a vote as the jury was deadlocked. On the other hand we can learn from jury deliberations that selected the winning project unanimously, indicating a collective conceptual construction of the winning project by the jury.

Problematic Jury Deliberation: Split Jury Decision

Of the three competitions studied, two resulted in split decisions (Saint Laurent Library and the Montreal Planetarium). A split decision is a result of a deadlocked jury that cannot agree on the winning project. This is an indicator revealing the fact that jurors could not arrive at a common collective vision of the winning project during their deliberation process. In the next sections, some of the lessons learned regarding the problematic jury deliberations (jury deliberation with a split decision) will be elaborated.

LEED as a Brand for the City

For the Saint Laurent competition, there were several reasons for the tensions arising in the jury deliberation. First, for this competition, the imperative of LEED Gold was as an essential objective, emphasized by the preoccupations of the municipality of the competition, the city of Montreal. This introduced the tension between the use of LEED for communicating political objectives (i.e. to transmit a message that Montreal is a leader in sustainable development) and the potential repercussions on a project's other qualitative aspects, such as the way in which the project transforms the urban form and therefore the urban life.

Because the LEED rating system can provide clear numerical results regarding the environmental performance of a building, it can help demonstrate that some project in a competition has the most potential for environmental sustainability among the finalists[124]. Here LEED becomes the medium with which this message is conveyed and not the medium to help the competition move forward regarding the project of sustainability since the results must be considered in their true complexity given the level of details provided by competitors. When LEED is used in this way, then the focus is on communicating a message rather than on ensuring that the best architectural project was selected in a context of sustainable development. In addition, when the focus is on communication and therefore image branding, achieving LEED is a clear objective, however this may be at the detriment of constructing a collective understanding of the complexity of the sustainability dimension of the projects. In fact, when LEED is used in this manner, then it has become disconnected from its original vision as a tool towards sustainable development and reduced to a grid that must be filled in by the architects in order that a political message can be made and not that sustainable development becomes an encompassing concern in the architectural project. This is where sustainability is reduced to the methodology of the LEED (i.e. the checklist).

It is important here that the municipal representatives (i.e. the client, since for the three projects, the client was the city in which the project was built) are aware that judging a project based on LEED, or on the idea that sustainability is communicable through some visible building characteristic, is flawed. The broader social and cultural concerns that should ideally be identified in the brief within the sustainable development dimension would help clarify the intention of this dimension by the client. The following is a list of some examples of broader social concerns:

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124 The LEED rating system is a certification process and therefore a brand. It can be used for marketing purposes in order to communicate that sustainability has been considered in a systematic way as this is a universally accepted standard for green building design.

- How can we ensure social revitalization of place?
- How can we provide access to all members of community?
- Does the proposal contribute to urban life of the place?
- Does the project create or contribute to an identity for the community?
- Is collective transport encouraged?
- Does it consider the well-being of all members of the community, sense of equity?

The following is a list of some examples of broader cultural concerns:

- How can we ensure that the cultural diversity is enriched?
- How can we ensure that the contextual significance of place is enriched?
- Is the project a cultural impetus for the community?
- How does the symbolic dimension relate to the site, with the region?
- Does the project have a transformative value?
- Does the experiential quality provide an improved sense of well-being?

These are just a few examples, but they are the types of questions that may ease the lack of clarity that is at the source of many of the jury difficulties regarding sustainability.

The way in which this set of sustainability concerns is constructed for the brief could itself be a community project of the client. As Cornwall (1996) states, participatory processes where the community is invited to share and exchange ideas with experts, provides a co-learning opportunity between community members and experts. According to this author, this allows the emergence of a new form of knowledge, through the synergies of the different types of knowledge and experiences of all those participating. For the competition process, the client could invite members of the community to collect and share their concerns regarding the new project in terms of the social and cultural expectations and potential repercussions. This participative process would ideally be done before the brief is constructed so that some of the concerns raised by the community will be addressed in the brief and therefore in the final winning project. This collected information regarding the community's concerns could then be used both, when the design brief is constructed and when the jury is selecting the winning team. In many ways this process of participatory consultation and negotiation represents the methodology of fourth generation evaluation founded on criteria negotiation. In addition, this negotiation of criteria also is representative of the early planning phases of a design process, where design thinking base on reflection-in-action is fundamental for the problem-setting of the design situation for the given competition.

Regarding the sustainability criteria themselves, in a more general context, these can be conceptualized based on Table 56, where each of the empty squares would be filled in with a set of design inquiries defined by either, the organizing committee, the evaluation committee, the jury, and/or the community. In fact, Table 7 on page 161 presents a version of Table 56 with specific examples of design inquiries that may be used for each of the squares in a context of a competition with a sustainability dimension. This table may be different for each competition depending on the definition of sustainability adopted and the specific concerns the competition wants to address.

TABLE 56: TEMPLATE FOR IDENTIFYING THE SET OF DESIGN INQUIRIES FOR THE SUSTAINABILITY DIMENSION OF A COMPETITION BRIEF.

	Economic Pillar	**Environmental Pillar**	**Social Pillar**	**Cultural Pillar**
Preventive (efficiency and effectiveness)	The green building as a form of organizational growth.	The green building as a way to optimize performance while reducing impacts.*	The green building as a way to increase local business opportunity (socio-economic).	The green building seen as a way to increase local tourism (cultural-economic).
Precautionary (sufficiency and effectiveness)	The architectural project as a form of organizational and community development.	The architectural project as means for environmental regeneration.	The architectural project as a means of social cohesion and equity, enhancing community life.	The architectural project as a means for cultural impetus.

*LEED falls into this category, but does not cover the entire category. One reason , among others is because it does not have a life cycle perspective.

In addition, each of the dimensions of sustainability as shown in Table 56 can be further divided into a system as shown in Table 57. Table 57 is an expanded version of the social dimension. The criteria specified in the grid are only examples and may change for each competition. In this example, a library project was used to develop the criteria.

Table 56 is based on Nelson and Stolterman's (2003) systems perspective for design (as discussed in Chapter 2). In addition, the categories proposed for this social dimension are founded on the idea of sufficiency. As we have seen in Chapter 1, sufficiency is a significantly different strategy from efficiency. As Princen (2005) has defined, sufficiency is concerned with the idea of satisfying the most human needs for the least material artefacts. Human needs are however considered from Max-Neef's[125] perspective, since he provides a systems approach using an existential categorization of having, being, doing and interacting. The idea here is to identify concerns for each of these existential categories with regards to the general three criteria used for architectural projects.

TABLE 57: TEMPLATE FOR IDENTIFYING THE SYSTEM FOR THE SOCIAL DIMENSION OF SUSTAINABILITY. THE CRITERIA ARE ONLY ILLUSTRATUVE AND ARE FOR AN ARBITRARY LIBRARY PROJECT.

Social Pillar		**aesthetic**	**functional**	**structural**
Preventive (efficiency and effectiveness)	having	Visually interesting form	Ability to easily borrow books Increase in local business and community jobs	Safety of environment
Precautionary (sufficiency and effectiveness)	being	Imaginative and intuitive space	Quality of circulation and space	Adaptability of space
	doing	Zen like experience for reading	Comfortable lighting and air for reading Collective transport encouraged	Easy walking access to building
	interacting	Symbolically significant for community Creates identity of place	Welcoming quality of space Contributes to urban life of the place	Dedicated spaces for social interactions

125 Appendix 1 describes Max-Neef's (1991) approach to comprehending fundamental human needs.

Each of the empty squares would be filled in with a series of objectives or inquiries so as to guide the competitors in their proposals for social sustainability and also guide the jury in their judgment process.

Each of the other three pillars (culture, economic, and environment) in Table 56 can be equally developed as the social pillar was in Table 57, by adopting Nelson and Stotlerman's (2003) system design approach using the grid, as well as Max-Neef's (1991) existential definition of fundamental human needs. In addition, when all four grids representing the four dimensions of sustainability have been elaborated and constructed, it would be equally important to summarize the main criteria in one table by using Table 56 as a template. Where would the LEED criterion fall into this broader scope of sustainability? It would be represented in the square that intersects prevention and the environmental pillar of Table 56.

Conflicting Criteria in the Brief

Some of the tensions arising from the jury deliberation for the Saint-Laurent Library competition stemmed from the fact that the criteria in the brief were conflicting right from the start. For example, the fact that the building had to be visible from the main boulevard while the building itself would act like an entrance or door to the wooded area surrounding the project is contradictory. Visibility from the main boulevard requires a building form that is prominent, while acting as a door to the wooded area requires a sensitivity to the natural surroundings, implying a form that is both sensitive to and integrating with nature. These two requirements are contradictory and therefore resulted in difficulty during the jury deliberation. This resulted in a division of the jurors when the time came to resolve the criteria for selecting the winning project. The jury members had to prioritize one of the criteria since the two criteria did not co-exist for either of the two finalist projects (Chevalier Morales/FABG or Cardinal Hardy). In the end, this remained a point of contention and the jury had to vote for a winning project instead of collectively construct their vision of the best project. Although at first, the criteria in the brief did not seem to be contradictory, the interpretation of them by the finalists allowed this contradiction to manifest.

By identifying the fact that this criteria presents an opportunity for contradiction in some interpretations, during jury deliberation then the jurors move out of a judgment of the projects, and into the negotiation of the initial criteria for judgment. This represents a situation where fourth generation evaluation[126], as defined by Guba and Lincoln (1989) is necessary, since fourth generation evaluation moves beyond judgment and into negotiation of the initial conditions of the process. The main obstacle in the competition process when adopting fourth generation evaluation is that the time provided to jurors is typically a few days of deliberation, which may not be long enough to go through the methodology of fourth generation evaluation.

This is why, it was suggested that such negotiation processes of criteria, in this case the criteria related to the sustainability dimension, should ideally be done before the brief is constructed. In other words, it would be done during the preliminary planning phase of the competition process. This would then allow the criteria to be understood and constructed by not only the organizers and the client, but by those making the final judgment of the winning project. This represents a fourth generation evaluation process, since the criteria is negotiated by those requesting the project (organizers and client) and those constructing the winning project (jury members). In addition, this would contribute to the problem-setting of the design situation for sustainability and therefore avoid adopting the predominant quantitative approach for sustainability in competitions (i.e. LEED alone), which often reduces the sustainability dimension of the project to a problem-solving exercise of highest efficiency only.

AMBIGUOUS DEFINITION OF SUSTAINABLE DEVELOPMENT IN BRIEF

The specifications related to the dimension of sustainability were minimal for both competitions resulting in a split vote (Saint-Laurent Library and Montreal Planetarium)[127]. For the Montreal Planetarium, LEED platinum was the requirement, implying that the concerns for sustainable development were important for the organizers of this

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126 Fourth generation evaluation was described in Chapter 2.

127 The Montreal Planetarium specified LEED Platinum and an IDP. Saint-Laurent Library specified LEED Gold, an IDP, and health and work safety related issues (quality of air, etc). Refer to Table 53 on page 287.

competition, yet the brief provided the least information among all three competitions studied. Could it be that the organizers of this competition assumed that the definition of sustainable development is sufficiently clear and therefore besides the LEED certification requirement there was no need for further clarification? This was one of the sources of difficulty for the jury when selecting the best project since the approaches and scopes of the finalist proposals regarding sustainability were very different.

It is already difficult for a jury to judge social or cultural sustainability since there is no available formal methodology or at least unambiguous definition. Especially given that the repercussions of the cultural and social pillars of architectural projects cannot be quantified easily as these pillars reside in the social and human sciences. A Cartesian worldview would be too reductionist with regards to the complexity and uncertainty of these pillars for an architectural project. Tools exist to assess the social impacts of projects or the social impacts along the value chain of products, but they remain within a deterministic methodology[128], using a predominantly socio-economic perspective, where humans are regarded as employees and their well-being is calculated by the number of hours worked – a reductionist perspective of humans. This perspective of social concerns regarding the sustainability dimension for the competition process can then be elaborated within the preventive approach of the social pillar as shown in Table 57 on page 323. However, many other concerns regarding social sustainability are not elaborated in this reduced approach, as shown in this table.

If the jury is not given any set of guidelines from which to work from, the process of judging social sustainability becomes very difficult or nearly impossible. This is where a systemic vision of social aspects (see Table 57 on page 323) may be useful for the jury. By formalizing the social considerations for a competition from a systems perspective, through the identification of the main elements of concerns, their interrelationship with the project as a whole, and with the other elements, then the jury has a basis from which to base their judgments.

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128 An example of a social life cycle assessment tool developed by the research laboratory GaBi at the University of Stuttgart is www.gabi-software.com. This tool is based on 'hours worked' as a result of the project to assess the social repercussions of the project – a socio-economic predominant perspective. The software can be found at http://www.gabi-software.com/america/solutions/life-cycle-assessment

The two projects that experienced difficulties during jury deliberation were projects that both specified high LEED certification requirements. Both also included a minimal description for sustainable development in each of their briefs (refer to Table 53). Could this lead directly to contradictions of interpretations during judgments, since the concept of sustainable development was not clearly defined in the brief, yet sustainability is a very important criterion? In other words, could this be an indicator of difficulty of judgment? In other words, must a high LEED certification requirement also be accompanied by a clear definition of the client's intentions regarding the four pillars of sustainable development? At first glance, the answer would be yes, since the lack of information regarding the criterion of sustainable development in the brief presents a source of contention during the jury deliberation for these two competitions. This would require that the client would then have to define the sustainability criteria through an approach that is not based on its finality (i.e. LEED certification level), but one that is based on an approach of problem-setting where the intentions for the project's sustainability dimension are part of the whole project and not just the attainment of a credit rating. An example of this broader approach for elaborating the sustainability dimension for a competition was presented in Table 56 and Table 57.

Therefore the definition of sustainable development presented in the brief is of utmost importance for projects seeking sustainability. If the definition is not clear or only specifies the LEED certification requirements in the brief, as the Saint-Laurent project did, then the design teams are free to address the dimension of sustainability at their discretion but at the peril of not being judged for everything they may have considered in their vision of sustainability that falls outside the scope of the brief.

The project proposed by Big City/l'Oeuf experienced this kind of judgment regarding the way in which they addressed the sustainability criterion. As mentioned, this team adopted a systems perspective of the sustainability dimension. The jury recognized that this was the strongest team regarding LEED, as the jury report stated, *"l'équipe propose la meilleure expertise LEED"* (Ville de Montréal, 2009b, p.5). But had no way of judging that their vision of sustainable development was also the most global as was shown at the beginning of this chapter.

Symbolism Related to a Sustainable Architectural Project

A source of another tension for both the Saint Laurent Library and the Montreal Planetarium competitions, stemmed from the requirement that the winning project had to transmit a message of sustainable development, as much from its energy performance as from its choice of envelope. Yet, it was not clear in the brief what type of envelope or form would transmit such a message since the symbolism related to sustainable development is not universally understood.

The winning project for the Saint-Laurent competition may be seen by some jurors as transmitting a message of long-term durability because of its massive and omnipresent structure, while for other members of the jury, this same structure may transmit the opposite message of overconsumption of materials (see Figure 35).

FIGURE 35: WINNING PROJECT FOR THE SAINT-LAURENT LIBRARY COMPETITION BY CARDINAL HARDY.

On the other hand, the second place project for the Saint-Laurent competition by Chevalier Morales/FABG may also have been seen to transmit a message of eco-responsibility, with its grid-like light filter covering the building, emanating the language of nature through its sensitive contextual adherence to the site. (refer to Figure 36) It was a low-lying structure, contrary to the winning project which was massive and overpowering. This was the only finalist project for the Saint-Laurent Library competition that provided an innovative solution with respect to the choice of envelope, showing sensitivity to the nature surrounding the site. According to Guy and Farmer (2000), a project that adopts a language that is closer to nature would be considered to transmit a message of sustainability.

FIGURE 36: SECOND PLACE WINNING PROJECT FOR THE SAINT-LAURENT LIBRARY COMPETITION BY CHAVALIER MORALES/FABG.

However, the question remains as to what is meant by a language that is 'closer to nature'. Is the language adopted by Chevalier Morales/FABG or the one adopted by Cardinal Hardy closer to nature? Would a clarification in the brief regarding the language related to sustainability reduce the diverging views in the jury deliberation, or would this restrict the space of reflection by the competitors? This becomes a major future research question that would contribute to the knowledge of evaluation and judgment of architectural projects in a context of sustainability.

Constitution of the Jury

As mentioned previously, LEED certification is an essentially quantitative tool to rate the environmental performance of an architectural project. In a jury process for competitions endorsed by the Royal Architectural Institute of Canada (RAIC)[129], the technical committee is responsible to assess the feasibility of the finalists' LEED proposals before the jury begins deliberation. The technical committee reviews each of the finalists LEED proposals

129 The notion of endorsing a competition by the RAIC was discussed in Chapter 3.

in conjunction with the budget proposed, and evaluate whether the LEED proposal is feasible. For example, in the Saint-Laurent Library competition, this is the comment in the jury report regarding the way in which LEED was evaluated,

> *« Tous atteignent les points pour la certification LEED Or mais certains présentent plus de risques, dont ceux de Chevalier Morales/FABG, architectes, dont le budget est le plus serré et qui dispose de peu de crédits excédentaires. » (Saint-Laurent, 2010b, p.4)*

This evaluation process is similar to the technical committee that must evaluate the budget or the space requirements. Once this evaluation is done it is given to the jury and the jury uses the information in their reflection for selecting the winning project.

The question that emerges is: should a LEED expert be present in the jury or does the evaluation report from the technical committee provide enough information to the jury? Relating this question to design thinking, the expert evaluators reside in the realm of technical rationality, which is in tension with the architects in the jury, who adopt a reflective mode of thinking embedded within Schön's (1983) reflection-in-action. The tension between the two worldviews can only be resolved through co-learning and non-coercive speech from a Habermasian perspective. However, as the presence of an expert may implicitly present a coercive situation, where some members arguments are not considered as strong, not because they are not stronger (objective, subjective and normative elements), but because the speech situation is not conducive to knowledge sharing and co-learning from a Habermasian perspective. This co-learning is difficult to achieve since the speech situation is not ideal. In fact, this also relates to the dichotomy between prevention and precaution in general. The LEED experts reside in a preventive risk assessment worldview; the architects reside in a global reflective worldview, much like precaution. The gap between these two worldviews is the way in which they compare and interpret the projects. The tension between interpretive and analytical comparability is one of the main sources for this difficulty between LEED experts and architects.

It is important to mention that the LEED experts on the juries, within the framework of this research were also architects, and therefore they have an inherent reflective mode of thinking. However, it is not always the case that LEED accredited professionals are architects, as they may also be project managers, engineers, etc. Can it be that when architects are identified as LEED experts in a jury, their worldview shifts to one that is more technical rather than reflective because this becomes their main responsibility in the jury deliberation process?

REDUCING SUSTAINABLE ARCHITECTURAL DESIGN TO THE METHODOLOGY OF LEED

The way in which LEED was adopted by the jurors for assessing the sustainability criterion of the architectural projects represents their worldview towards sustainable development. One of the perceived advantages of LEED for competitions is that it is an objective approach to assessing the environmental performance of an architectural project and represents a systematic method for rating a building.

For both the Saint-Laurent Library and the Montreal Planetarium competitions, the jury essentially adopted a vision of sustainable development based on the LEED rating system, and therefore was reduced to a methodological question. In the brief for the Saint-Laurent competition, the definition of sustainable development included: (1) the requirement for LEED Gold; (2) the awareness that sustainability must go beyond LEED, without specifying how, what forms of inquiry, which other pillars of sustainability to consider; and (3) the need for an IDP, without specifying how it would be judged since it is not clear how it can. So both the jurors and the competitors had very little information regarding the dimension of sustainability besides the methodology of LEED. In this sense, then there is much latitude in terms of how this dimension of the project is interpreted by the jurors.

This lack of definition and specification becomes problematic not only for the finalists, but also for the jurors, since the conceptualization of an architectural project for sustainability in the global sense requires an understanding of the interdependence of the four pillars of sustainability and not only a LEED methodological perspective resulting in evidential data. If the finalists and jurors are not given enough guidance in terms of understanding the goals, the methods, the worldview and the essence of sustainability for the client, then the jurors and finalists will, on the most part, revert to the LEED methodology as the basis of sustainability.

If the definition of sustainable design is taken to be that defined in Table 1 on page 51 in Chapter 1, which is one example of a global and systemic conceptualization of a project by considering the repercussions on the environment, society, culture, and the economy, based on their integration, then sustainability cannot be reduced to the methodology of LEED. LEED is just one of the many tools and methods that the designers will adopt in the conceptualization process of their project.

The following quote is the definition for sustainable development from the Montreal Planetarium phase 2 brief:

> *« 4.4 Développement durable*
>
> *La certification LEED Platine exige un total de points entre 52-70. La Ville de Montréal a fait faire une analyse d'avant-projet sur la faisabilité de cet objectif et sur les coûts impliqués.*
>
> *Dans le cadre d'un concours d'architecture, il est fortement recommandé de cibler 58 points afin de tenir compte des imprévus de conception en cours d'évolution du dossier » (Ville de Montréal, 2009a, p.33)*

Therefore, for the Montreal Planetarium competition, sustainable development was reduced to the methodology of LEED specifically for attaining LEED Platinum certification. In addition, the finalists had to ensure that there was enough buffer in their credits so that future uncertainties of the design process could be absorbed by the proposal. However, for the Canada Green Building Council (CaGBC), LEED is defined as a system that:

> *"(…) promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health" (CaGBC, 2010, third paragraph on web page)*

The CaGBC therefore perceives the LEED system as a performance assessment system of the whole-building. However a whole-building performance assessment approach to sustainability is very different from a global approach to architectural design for sustainability. In the first, the focus is on efficiency and prevention of risks on the whole building, on the latter, the focus is on a design inquiry approach that addresses issues of sustainable development from the four pillars of society, culture, economy and environment within the architectural project[130]. These two are quite different and this difference is the source of many misunderstandings of the relationship between the use of LEED for an architectural project and architectural design for sustainability.

In this latter approach (architectural design for sustainability), addressing the sustainability of an architectural project is much more than a rating system based on a set of indicators. It requires that an ontological (definition of the main elements), a teleological (objectives or final purpose) and a methodological (operational considerations) and an epistemological (worldview) description of sustainability for the competition be specified in the brief so as to clearly identify the goals and visions of the sustainable development dimension to the competitors and jurors.

Here, the dimension of sustainable development is no longer reduced to the method of LEED, but is seen as a comprehensive vision where its ontology, its teleology and its methodology (one that goes beyond LEED categories of efficiency improvements) would be made explicit[131]. Table 58 describes sustainability design inquiry based on the complementary perspectives of prevention and precaution based on these four categories (ontology, epistemology, methodology and teleology).

130 Refer to Table 7 on page 161 for an example of concerns beyond LEED

131 As presented earlier and can be seen from Table 7, in a preventive approach, the green building can be seen as a form of organizational growth for the economic pillar. It can be seen as a way to optimize performance while reducing impacts from an environmental perspective (i.e. LEED). It can be seen as a way to increase local business opportunity from a socio-economic perspective. The green building can also be seen as a way to increase local tourism from a cultural-economic perspective. If a precautionary form of design inquiry for sustainability is adopted, then the architectural project can be seen as a form of organizational and community development. The architectural project can be seen as means for environmental regeneration. It can be seen as a means of social cohesion and equity, enhancing community life. Or the architectural project can be seen as a means for cultural impetus.

TABLE 58: COMPLEMENTING A PREVENTIVE AND A PRECAUTIONARY APPROACH FOR SUSTAINABLE DESIGN INQUIRY BASED ON AN ONTOLOGICAL, EPISTEMEOLOGICAL, METHODOLOGICAL, AND TELEOLOGICAL DESCRIPTION.

		Preventive Approach for Sustainable Design Inquiry	Precautionary Approach for Sustainable Design Inquiry
Ontological	Type of knowledge that will nourish process of inquiry	Known level of certainty of knowledge will be used to make decisions	Addressing uncertainty and contradictions nourish process
	Types of uncertainty that can be addressed	Technical, methodological (data unavailability, method inadequacies)	Epistemological (indeterminate, incommensurable)
	Type of innovation sought	Technical innovation (efficiency – doing it right)	Technical, social, cultural, educational, and organizational innovation (ethical – doing the right thing)
Epistemological	Worldview	Deterministic (causal effects) worldview	Complex (dynamic and interconnected) worldview
	Way the knowledge is constructed	Statistically	Socially (cooperatively)
	Type of thinking	Systematic thinking (using tools such as, LCA, SLCA, EIA, SIA, LEED, Ecological Footprint)	Systemic thinking and modeling (using approaches that are collective, exploratory, emancipatory, and therefore participatory decision processes
Methodological	Design strategy	Reduce energy, reduce social injustice, and reduce footprint, conservation of resources and environment and social structures	Express nature, contextual, living building/artefact, create identity, community and cultural revitalization, environmental regeneration
	Type of repercussions addressed	Predictable, repeatable outcomes considered	Prospective intents, so the uncertainties are of epistemic nature and may be of a non-linear, non-substitutional, recursive nature.
	Elements of concern (risks)	Resource and planet preservation, social-economic fairness, and cost-benefit analysis (normative and technical)	Ecological integrity, place identity and the individual, well-being, social cohesion, cultural and community life, transformative behaviour - (ethical, aesthetic and technical)
	Type of inquiry	Sequential inquiry	Recursive co-learning taking place within team
	Time frame/pace	Matches corporate pace	Matches nature's (civilization) pace
	Consideration of space	Functional and flexible	Organic, fluid, context specific, tactile, sensory, pluralistic
Teleological	Purpose of evaluation process	Optimization – regarding the improvement of designs - collecting evidence for optimization	Exploratory - regarding the transformation of practice and structures - generate diverging alternative solutions defying the status quo

These two competitions (Saint-Laurent Library and the New Montreal Planetarium) failed to consider the ontological and teleological basis of the sustainable development criterion and therefore could not position LEED in terms of the broader vision of sustainability. The information in Table 56, Table 57, and Table 58 present a global approach for sustainable design inquiry. Table 56 and Table 57 present specific examples of criteria for an architectural project when using this broader vision of sustainability. Table 58 presents a generic set of criteria when seeking a global vision for sustainable design inquiry.

For these two competitions, the fact that LEED was disconnected from the architectural project as a whole (in the brief and for most finalist projects) and was only used as a way to measure sustainability instead, was one reason that contradictions arose in the judgment process.

The next section will discuss the research findings for the competition that reached unanimity in their jury deliberation – the competition for the Musée National des Beaux-arts du Québec (MNBAQ).

CONSTRUCTIVE JURY DELIBERATION: UNANIMOUS JURY DECISION

The selection of the winning project for the MNBAQ competition was a unanimous decision. This implies that every member on the team chose the same winning project, and may indicate that the jurors constructed a collective common vision of the winning project. All finalist teams met the LEED Basic credits that were required in the brief. In fact, most finalist teams accumulated credits far beyond the credits required for LEED Basic certification. LEED Basic requires that teams attain between 26-32 credits. The five finalist teams all passed LEED Basic – their scores were: 34, 42, 45, 48, and 56 credits. The LEED criterion was evacuated from the judgment process early on because all teams had demonstrated their capacity to attain the LEED Basic certification.

As the MNBAQ was the only one of the three competitions that resulted in a unanimous decision, the research results for this competition will be present in the next sections in order to highlight some of the lessons learned.

LEED as a Technical Parameter Within a Broader Reflection for Architectural Judgment

In the final jury report, the jury did not mention the word LEED. Instead the jury report highlighted the qualitative architectural aspects (quality of space, experiential quality of museum, envelope choices, circulation flow, etc.) of each finalist and not the technical LEED solutions and their viability. Therefore, the cultural aspect remained the primary concern for this architectural competition throughout the deliberation, since it was not sidetracked to a discussion of the environmental performance optimization strategies. Since all teams could meet the LEED accreditation requirement, given that they could all potentially attain more than the required number of credits, this was a non-issue during deliberation and therefore the jury focused on the qualitative architectural dimensions of each finalist project.

LEED was treated here as was the budget, once it was clear that the teams were within the required parameters, then the discussion of the budget was finished and other concerns were brought to the forefront, as the following quote from the final jury report for the MNBAQ competition states:

> *« Le budget est évacué de l'évaluation, tous les projets respectant celui-ci sauf celui de David Chipperfield qui a réduit la surface. »(Ville de Québec, 2010c, p.3)*

In fact, the final list of criteria that the jury used to judge the finalist projects were explicitly stated in the final jury report, these were:

> *« Les membres du jury reviennent sur les critères d'évaluation.*
> *La gestion de l'enjeu du concours est soulevée; on recherche:*
> *• une impression exceptionnelle;*
> *• une absence de problème fonctionnel majeur et une adaptabilité;*
> *• une faisabilité technique dans le budget. »*
>
> *(Ville de Québec, 2010c, p.3)*

With reference to how the jurors considered and used LEED in their judgment process, by evacuating the LEED requirement early on, this shows that the evidence of LEED was treated like any other technical parameter. In terms of design thinking, this refers to technical rationality. However the final judgment of the projects rested on reflective thinking. In other words, the analysis of LEED results for each project, were used as one element of a final judgment; it represented the evidential data. This was complemented with the jurors' tacit knowledge and principles. Here the jury used LEED results as a source of evidential information nourishing their broader reflection of each project.

The reason why it was possible to treat LEED like an isolated technical parameter in this competition was first, because all teams could easily reach LEED Basic, since most finalist projects were well beyond the required credits. Second, as the requirement was for LEED Basic, this says something about the client's or organizers' concern regarding the sustainability dimension for this competition. It says that the sustainability dimension should be addressed by all finalists, but that it will not become a focal point in the selection of the winning project, as was evident from this latter quote from the MNBAQ's jury report. This approach may be more efficient in assessing the sustainability criteria, yet is many ways it also reduces the global vision of a project in a context of sustainability. It may have been beneficial to construct a global vision of sustainability (for example by using the templates of Table 56 and Table 58), where for this competition, the cultural pillar would comprise the majority of the concerns.

CLEAR DISTINCTION BETWEEN LEED AND SUSTAINABLE DEVELOPMENT

In the brief for the MNBAQ competition the dimension of sustainability was described as follows:

> *« La notion de musée du XXIe siècle ne vise pas uniquement la **flexibilité**, la **fonctionnalité** et la **technologie** de sa conception mais également un **engagement social** au niveau de sa **concrétisation écologique**.*
>
> *Le Musée veut faire preuve de leadership en matière de développement durable :*
>
> *• Le Musée adhère aux **principes de développement durable** (**architecture verte**) et souhaite que les concepteurs du projet empruntent la voie de la **conception intégrée**.*
>
> *• Le Musée souhaite appliquer les principes de développement durable qui lui permettront d'obtenir une **certification LEED minimum**.*
>
> *• En respect de l'approche en matière de développement durable, le Musée souhaite s'intégrer **harmonieusement à la vie de quartier**.*

*• Le MNBAQ veut promouvoir l'accès au musée par des **moyens autres que l'automobile**.*

*La direction du Musée vise donc la certification LEED Canada de base, en conformité avec ses limites budgétaires; **cet objectif représente un seuil minimum**. »*

(Ville de Québec, 2009b, p.35-36, researcher's highlighting)

This is the only competition among the three competitions studied that included a consideration of the social pillar as the second point in this quote suggests. This shows that for this competition, the LEED criteria was only one part of a broader vision of sustainability – where LEED would be used to help rate a series environmental considerations within their broader goal of sustainable development. However, it is also important to highlight that in their first point in this quote, where they state that the principles of sustainable development refer to green architecture, this represents a reduced perspective as the principles of sustainable development refer to the other pillars as well – social, cultural and economic – within the main considerations of an architectural project (function, utility and aesthetic).

Having said this, this definition still represents a systems conceptualization of the sustainable development of some sort, although incomplete. For example, the system is the architectural project in a context of sustainability. The main elements in the system are: flexibility, functionality, technology, the IDP as the recommended design process, minimum LEED certification, harmonious contribution to the urban life, and modes of mobility other than the car for access to the building. The interrelations are those between the social (urban life), the technical (LEED systems of performance), the environmental (LEED indicators), the usability (function and flexibility), and accessibility (mobility) through the use of a process of IDP.

Comparing this definition to the definition of sustainable development defined for the Montreal Planetarium, the difference is that for the Montreal Planetarium, LEED Platinum was the only requirement, as the following quote from their brief states:

> *« La certification LEED Platine exige un total de points entre 52-70. La Ville de Montréal a fait faire une analyse d'avant-projet sur la faisabilité de cet objectif et sur les coûts impliqués.*
>
> *Dans le cadre d'un concours d'architecture, il est fortement recommandé de cibler 58 points afin de tenir compte des imprévus de conception en cours d'évolution du dossier. » (Ville de Montréal, 2009a, p.33)*

Here there no attempt to consider any other qualitative architectural dimensions (perspective of the functionality, utility and aesthetic of the project) other than the environmental dimension within the tight confines of LEED categories. This represents a preventive approach to assessing the risk related to environmental sustainability since the only concern is the predictability of risks based on a LEED rating.

It is important to state that the definition of sustainability for the MNBAQ competition still represents a limited perspective, even if it is the most comprehensive among the three competitions. If we agree that the general definition of sustainability is that defined in Table 1 on page 51, then we can already see that the definition by the MNBAQ is limiting since, for example, the social is only considered through a perspective of a harmonious integration with the city life. In addition if we consider the template as presented in Table 56 and Table 57 as a way in which to guide a definition of sustainability for a competition, then again, we can see that their definition is limited since, for example, they do not consider the cultural as part of a sustainability definition. Furthermore, if we adopt the generic approach to guiding a definition of sustainability based on the complementary nature of prevention and precaution as presented in Table 58, then here again we can see that, on the most part, their definition resides in the preventive realm.

It is however important to state that even if their definition was minimal, it at least provided a demonstration to the jurors and competitors the distinction between environmental and social sustainability, and that attaining LEED certification is only one part of the broader context of sustainability.

INTERNATIONAL SCOPE OF PROJECT AND ITS DISTINCT FOCUS ON CULTURAL SIGNIFICANCE

The MNBAQ competition was the only one of the three competitions studied with an international call for proposals. All finalist groups were associated with teams from outside Canada: Berlin and New York, London, Rotterdam, Portland (USA) and Madrid (Ville de Québec, 2009a). In fact, from the 15 semi-finalist teams pre-selected after phase 1, there were 11 from outside Canada. The teams were from: Berlin/New York, Germany, Denmark, Brazil, Switzerland, London, Madrid, Tokyo/Paris, Holland, and the USA (Ville de Québec, 2009d).

The importance of this project was therefore evident, not only for Quebec City, but also for the competitors, as submissions came from all over the world. The cultural significance of this competition was therefore unmistakable. So the winning project could not be selected by questions of LEED alone. In this competition, the ability to obtain LEED certification was not a focal point, but the architectural project in its entirety. In other words, the jury adopted an overall interpretive approach for comparing the projects rather than an predominant analytical approach based on evidential facts alone.

There can be no generalities made here, but the focus on the exceptional overall character of the winning project (judgment of the whole project) instead of technical parameters based on LEED (fragmented view of the project) resulted in a unanimous decision implying that the winning project was collectively judged as the best. It can be said that in this competition, the focus during jury deliberation shifted away from the evaluation of individual technical parameters and shifted towards a global view of the project.

ARCHITECTURAL DESIGN FOR SUSTAINABILITY AS A PROJECT OF INTENTIONS

This jury (MNBAQ) did not encounter deadlocking tensions in the deliberation process as the vote was unanimous. Here, LEED was used as a tool within a broader context of the architectural project in a context of sustainable development. The way the winning project was judged for the MNBAQ competition was the following according to the jury report:

> *« Les accès et la circulation proposent une expérience riche en découvertes, grâce à des percées visuelles sur l'extérieur et l'intérieur.*
>
> *Les salles d'expositions offrent une certaine flexibilité et fonctionnent bien; leur neutralité facilite leur aménagement, de même que la trame structurale.*
>
> *Le grand hall, conçu comme un **lieu urbain dynamique**, est des plus **spectaculaires** de jour comme de nuit.*
>
> *Le concept présente une **solution flexible** et **adaptable** aux attentes du musée, sans altérer sa **force évocatrice**.*
>
> *Le jury se questionne sur la transparence et la translucidité de l'enveloppe et sa performance énergétique.*
>
> *Le jury fait mention de **l'évolution positive du projet** depuis l'étape 1, ce qui démontre une **capacité d'écoute**.*
>
> *Le **tunnel** devient un **point fort** du projet, il est **générateur** du concept.*
>
> *La **structure de bois**, quoiqu'intéressante, semble **trop dominante**, principalement pour les salles d'expositions. » (Ville de Québec, 2010c, p.4, researcher's highlighting)*

The highlighted text refers to the main elements in the project. This project was considered in its entirety with regards to the general architectural characteristics of quality of space, constructive choices, aesthetic, functionality, and structure. The idea of the architectural project as an activity for projection and intention of ideas remained the focus for the jury. The use of LEED in this context was therefore a detail that had to be contended with by all competitors and the jurors, just like the budget. It was not mentioned in this statement. LEED fell out of the equation early on in the deliberation process as all finalists met this criteria and therefore the jury could focus on selecting a project with an 'exceptional impression' (sic).

In other words, LEED was considered in its entire form of knowledge. This implies that LEED was considered from a methodological, ontological, epistemological and teleological perspective. Methodologically the client as well as the jurors adopted it like a rating system, a way to obtain an objective rating of the 'greenness' of a building. Ontologically, they considered it as only one part of a larger sustainable architecture context, as is evident from the above quote that judges the winning project. Epistemologically, the jurors were aware of its limitations regarding the objectivity and certainty of essentially quantitative results. This became evident through the fact that the results were not given the predominance as in other architectural competitions studied in this research. And from teleological perspective, the client and the jury adopted LEED as one tool to help move projects towards sustainability.

In the next section, the last section of this chapter, the significance of the precautionary principle as the basis for reflection of this study will be explained with regards to design thinking, design practice in general and for the vision of sustainable development.

Relationship between Tensions Studied, the Precautionary Principle and Design Thinking for Sustainability

The results of these three competitions provide some evidence of an emerging problematic with the use of standard (essentially) quantitative environmental evaluation methods (i.e. LEED) for the judgment process of competitions. In the next few sections, the results of this research will be discussed from the perspective of the theoretical framework adopted in order that its pertinence can be demonstrated for design for sustainability.

The Precautionary Principle and a Complex Worldview

In this section, the significance of a complex worldview for a precautionary approach for design thinking in a context of sustainability will be elaborated based on a reflection of the analysis.

Global and Systemic Vision for Design

Design cannot be reduced to an approach where conceptualizing architectural projects in a context of sustainability relies on readymade universal solutions that have been proven to be energy efficient. What cognitive processes are available for designers to help them adopt a more global yet contextual perspective of the design situation? A global and systemic approach for design for sustainability is intended to complement the often myopic view of efficiency as the main strategy for design which is founded on a fragmented view of the design situation and where, within each of the fragments, there are in many cases a series of predefined solutions. In addition, such a vision may help articulate dimensions of a design project such that the interrelationships between these can be better comprehended. One example of a systemic vision for design would be the grids proposed by Nelson and Stolterman (2003) as was described in Chapter 2. Figure 37 is a specific example of a grid that may help in the conceptualization and judgment process based on a systems perspective. The interrelationships between the inquiry and the system considered can be explicated using such a grid. This explication of the interrelationships is a recursive process, where the exploration and articulation leads to the construction of the project. Through this process, antagonisms, contradictions and complementarities will emerge. This is its most significant strength.

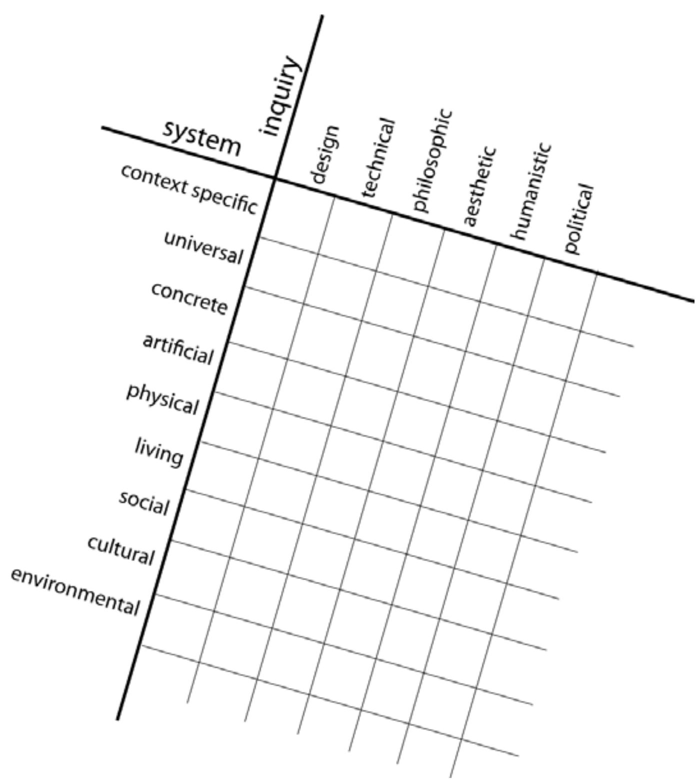

FIGURE 37: AN EXAMPLE OF A SYSTEMS DESIGN PALETTE BASED ON NELSON AND STOLTERMAN (2003).

For example, the Chevalier Morales/FABG project proposed for the Saint-Laurent Library adopted a global vision of sustainability. They sought to address the various dimensions and their inter-relationships. They did not present the interrelationships of their sustainability philosophy in this manner. However, the following quote from the descriptive text of this team's proposal helps understand the implicit systems approach for the sustainability dimension:

> *« Une seconde peau composée de panneaux de bois perforés suspendus à l'horizontale au plafond et à la verticale derrière le vitrage agit comme le feuillage de la forêt qui diffracte la lumière trop vive du jour et contribue à étouffer le bruit ambiant ; elle constitue un filtre lumineux et acoustique contribuant à produire l'atmosphère de calme et de recueillement propice à la lecture. Les panneaux de bois blond verni sont montés sur pivots pour faciliter l'entretien des surfaces à l'arrière et sont localisés principalement dans les aires publiques et les espaces de lecture.» (Chevalier Morales Architectes et al., 2009a, p.1)*

The second skin proposed by this team, a skin of perforated wood that was intended to benefit many dimensions of the project; from providing a filter for light, to a noise filter, to an element that would imbue calmness because of the way the light would be deflected, to the way in which it would be easily maintained. In this paragraph, they addressed noise quality, light quality, social setting, symbolic quality, and technical requirements all through one characteristic of envelope choice. In coming to this conception of a second skin, this team adopted a systems perspective by seeking to relate the one characteristic to a series of benefits of which not all were related to efficiency. This example of the conceptualization of one constructive choice inevitably resulted from a recursive learning and co-learning process that considered the antagonistic and complementary relations of the many choices.

If the content of this descriptive paragraph above by Chevalier Morales/FABG is deconstructed in order to be reconstructed again within a systemic approach (see Figure 38), it would help visualize the interrelationships of the sustainability solutions and the general qualitative architectural elements.

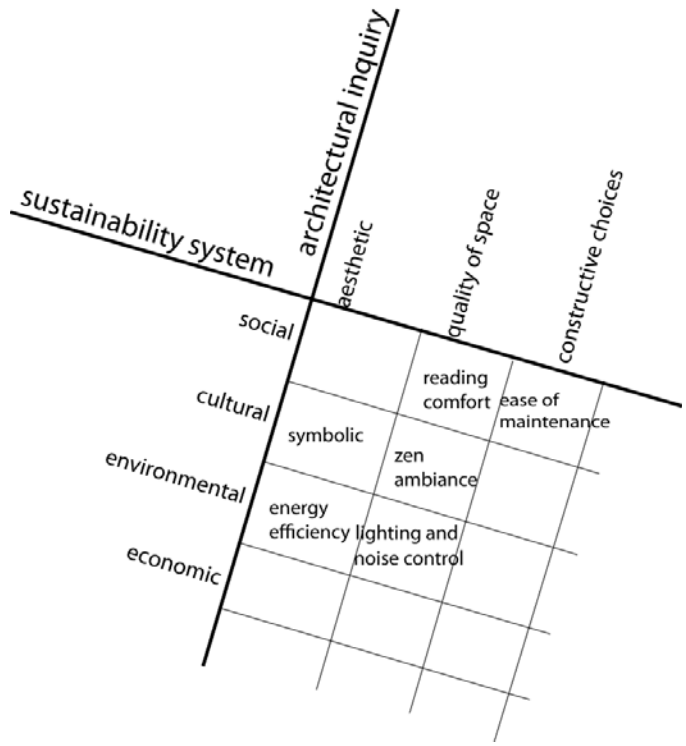

FIGURE 38 : EXAMPLE OF A SYSTEMS GRID SHOWING THE INTERRELATIONSHIPS BETWEEN THE SUSTAINABILITY SOLUTIONS AND OTHER QUALITATIVE ELEMENTS OF THE CHEVALIER MORALES/FABG ARCHITECTURAL PROJECT, BASED ON THE GRID APPROACH BY NELSON AND STOLTERMAN (2003)

Figure 38 is an example of a set of criteria that can serve as an analysis grid in a context of a competition that would allow concretizing a global vision for a project. In turn, this would allow the jurors to evaluate the project from a global and systemic approach.

It is very important to highlight that this is only an attempt at filling out this systems design grid based on the descriptive text provided. The interrelationships between the sustainability criteria and the architectural criteria can only be done comprehensively through the design of the project itself. Therefore the information needed to articulate the interrelationships between these two dimensions resides in the minds of the design team or in the minds of the jurors (during their interpretation process). However, we can see that the interrelationships present a complex system where the sustainability pillars have begun to be addressed based on the qualitative architectural dimensions.

Theory of Counter-Productivity

Energy efficiency is one of the main focuses of LEED. In addition, the 2030 Challenge, which requires that all public buildings are carbon neutral by the year 2030, imposes additional responsibilities to architects, not prescribed by LEED (RAIC, 2007). There are many ways in which energy efficiency of a building can be dealt with. According to Frampton (1985) architecture can only be sustained today as a critical practice if it neither adopts a purely universal technological approach nor seeks to return to nostalgic tendencies of the preindustrial past. In most architectural projects studied in this research, the way in which energy efficiency was addressed was through technical solutions juxtaposed onto the building. These were, on the most part, universal technical solutions. In other words, the teams did not exploit the passive energy freely available on site.

The problem with adopting only technical solutions is that, first, technology changes quickly and therefore future costs will have to be incurred to upgrade the technical systems. Costs here would then be related not only to budget, but future environmental and social impacts as well, since renovation incurs impacts on both these dimensions. Second, the cost of technology is greater than the cost of capturing free energy on site, not only for the construction phase, but in the long-term as well, since active energy itself requires energy to operate and therefore is less energy efficient. So focusing on technology alone for achieving the energy efficiency level required by a tool like LEED, in the end, defeats the goal itself.

This example is representative of what Illich (1978) refers to as the theory of counter-productivity. As a reminder, the theory of counter-productivity states that the more the production of a technical intervention (and its use) increases, the more it becomes an obstacle in the realization of the objectives it itself tries to accomplish. In the case of LEED, if designers focus on technical intervention only for addressing energy efficiency of an architectural project, then the goal of energy efficiency is circumvented by the technology itself, since, in the long-term, it is much less efficient (both budget and energy-wise) when compared to the use of passive energy. It can be said that this phenomena constitutes an example of this theory.

The strategy of using only active energy in a project can be thought of as adopting an approach of efficiency, whereas the exploitation of passive energy can be thought of an approach of 'effectiveness'[132]. Here the idea of 'waste=food', the basis of an approach based on 'effectiveness' is essential. Since passive energy takes from the site to provide energy to the building, it can be seen that what is considered 'waste' to architects that advocate only active energy solutions, is considered 'food' for architects that advocate passive energy for energy efficiency. This is why the ideas of efficiency, effectiveness and sufficiency presented in Chapter 1 are important when considering the architectural design project. Efficiency alone, as LEED prescribes to, is not enough for sustainability.

From a more global perspective, and moving beyond the idea of efficiency and effectiveness, an architectural design inquiry approach founded on the precautionary principle is suggested in this research, since ideas such as: (1) the architectural project as a means of social cohesion and equity, enhancing community life; or (2) the architectural project as a means for cultural impetus and diversity, become equally important to questions of energy efficiency. These types of questions do not fall within a paradigm of efficiency (or prevention), but within one in which we are trying to address as many human needs as possible through the building's design. This may be referred to as an approach of sufficiency. Figure 39 presents a systems design palette for sustainability based on precaution, prevention and foresight as defined in Chapter 2, specifically in Table 4 on page 95 and in Figure 12 on page 97. This grid is also based on an systemic design approach as defined by Nelson and Stolterman (2003) presented in Chapter 2. This template can be used to construct the vision of sustainability for an architectural competition or for any design project. The indicators in this grid are only an example of criteria that may be used for a project for sustainability. The construction of this grid would be the result of a recursive co-learning process since the elements within it are based on the concerns, claims and issues of the various stakeholders of a design project.

132 This idea was introduced in Chapter 1.

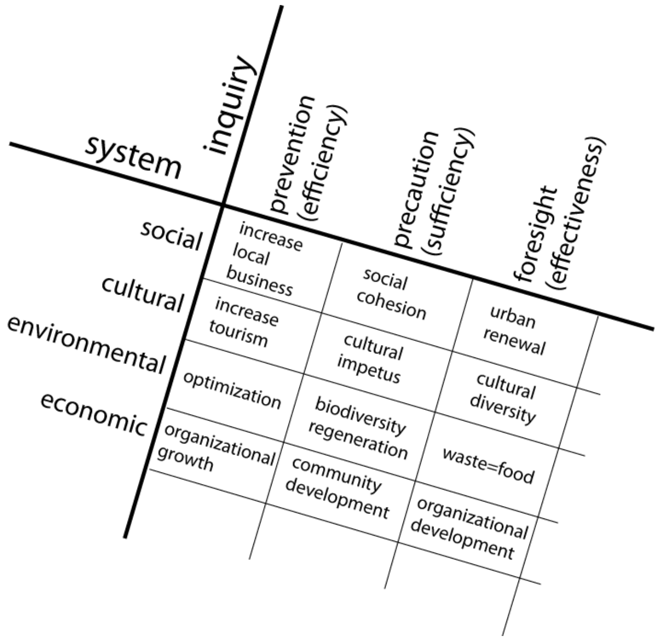

FIGURE 39: AN EXAMPLE OF A SYSTEMS DESIGN PALLETTE BASED ON THE PREVENTION, PRECAUTION AND FORESIGHT

When adopting an approach of LEED for addressing the environmental sustainability of an architectural project, it is important not to neglect other areas and consider other strategies of design in a context of sustainability. By focusing solely on efficiency, blind spots may emerge, since the instrumental and purposive goals of attaining credits shift the focus away from a more global perspective of the project. In order to help identify blind spots, designers can adopt a systems design approach, where a grid like the one shown in Figure 39 can help designers articulate and become aware of such blind spots.

Consequently, this is where the tension between analytical and interpretive comparability is substantiated. Analytical comparability is adopted when comparison is based on measurable and quantified results. Comparing environmental solutions for obtaining LEED certification is one example of analytical comparability. However, when the comparison is not on the LEED points, but instead on the solutions proposed by the designers, and where the solutions are incomparable, analytical comparability fails. This is where an interpretive form of comparability helps in making a judgment.

An interpretation of the projects entails a critique and deeper understanding of the qualitative aspects. This critique from a judgment perspective is embedded in what

Dewey (1933) terms as worldviews and tacit knowledge, in complement to any evidential data available. This critique, from a Habermasian (1984) communicative speech model perspective, could be made by adopting normative and subjective type of arguments, in complement to objective arguments. From a Habermasian cultural perspective (1985), this critique could be made by adopting the moral-practical and aesthetic-expressive dimensions, in complement to the cognitive-instrumental dimension. So here, the question of ethics becomes important not only for the design teams in their conceptualization process, but also for the competition organizers in the construction of the brief. This is an important consideration in the long-term sustainable vision of the project.

Precaution as an Integral Principle for Participatory Judgment in a Context of Sustainability

In this section, the pertinence of a reflection of the precautionary principle for design thinking in a context of sustainability for participatory judgment will be elaborated based on the analyzed data.

Fourth Generation Evaluation

Let us emphasise that fourth generation evaluation is based on negotiation of claims, concerns and issues regarding that which is to be evaluated (see Chapter 2). In this sense, fourth generation evaluation is not evaluation of only evidential data, which adopts an adaptive and hermeneutic method of knowledge construction in order to assess the merit of a project. Negotiation is the underlying orientation of fourth generation evaluation. It is not measurement or objective oriented. Therefore, fourth generation evaluation is similar to judgment as defined by Dewey (1933), which is comprised of empirical data, tacit knowledge and basic principles. The benefit of adopting this theoretical component is that fourth generation evaluation offers a method of arriving at a final judgment through a hermeneutic and constructivist approach.

In the jury deliberation of a competition process, the jury members constitute a team that must select a winning project. In the process of selecting a winning project, the jury deliberates on the various components, criteria and objectives of each project submitted. In this deliberation, the jury members share their knowledge, their expertise and their preferences. From a Habermasian perspective (1984), this implies that the jury members in constructing their arguments regarding the projects provide not only objective claims, but also normative claims based on a general acceptance of various characteristics, as well as subjective claims regarding their own personnel preferences and tacit knowledge. This, according to Habermasian communicative action, constitutes a strong argument.

The participative nature of a jury deliberation for an architectural competition, given that the jury is comprised of client representatives, architects and various experts, among others, can result in a rich deliberation because of its inherent interpretive and emerging quality. A rich deliberation can be defined from a Habermasian perspective, by adopting this author's definition of the ideal speech situation (Habermas, 1984), as discussed in Chapter 2. As a reminder, an ideal speech situation is one where the participants are free to speak, there is a lack of coercion in the speech situation, and that the arguments are comprised of objective, normative and subjective elements to be deemed as strong arguments. Such a rich deliberation may help the participants of a jury reach some form of consensus since the arguments are used to build the collective knowledge. This categorization regarding the structure of arguments is therefore important within the context of a jury deliberation, specifically when LEED is adopted, since the discussion may quickly become one where the arguments are solely based on objective empirical data.

As an example, the jury process of the MNBAQ resulted in a unanimous decision. A unanimous decision may be the result of the reconstruction of plural views according to Guba and Lincoln (1989) which requires an adaptive and hermeneutic process. If the winning project is not only selected collectively, but becomes a collective construction by the jury, then this would represent a part of a fourth generation evaluation process. In addition, if the evaluation grids for defining sustainability presented earlier were collectively constructed by the jury members and the competition organizers, this would then represent a fourth generation evaluation process. This is also then related to Schön's problem-setting since through the action of constructing the system grid for describing sustainability, the idea of sustainability is collectively better understood.

This co-learning process may have also been adopted by the other two competitions, the Saint-Laurent Library and the Montreal Planetarium, both of which selected the winning project through a split decision. However, as each of these two competitions failed to reach a consensus, they failed to collectively construct the winning project. As the jury process for an architectural competition in Canada, is bound by a time limit, often a one or two day process, the entire method of a fourth generation evaluation may be too long and arduous. However, a combined approach of fourth generation evaluation, with an analysis of the arguments based on Habermasian characteristics of strong arguments may help the jury better understand the weaknesses of their deliberation process.

IDP and Systems Design for Transformational Sustainable Benefits

The IDP, a participative process for design that was a requirement for two of the three competitions studied with regards to the sustainability dimension. The IDP is an interesting process for design for sustainability since the participative approach can help capture the synergy of ideas among the member of the design team.

As LEED was never designed to be a tool that can provide transformational sustainable change, as it focused only on the technical, it can, at best, guide designers to propose incremental changes to existing unsustainable situations. The IDP may be a process that can enable a tool like LEED to be used to conceptualize transformational changes. This is because, through an integrated perspective of the design problem, synergies of the various professions and experts can then be exploited to move beyond the technical as the IDP requires a whole project perspective and not a fragmented technical approach. For example, LEED can actually certify a Platinum project that ignores free passive energy. This was the case for the New Montreal Planetarium's winning project, whose energy efficiency solutions were primarily from active means (mechanical systems). Here the costs of using only active energy imply that there is less money to spend on other architectural components. In addition, active energy requires a continual expenditure of energy and costs for the lifetime of the building.

The main difficulty with the IDP – and this is a problem that may also arise in a jury process – is that a minimum understanding of the vocabulary of the others is necessary so that the synergies can emerge. Without this minimum understanding of vocabulary, how can anyone talk with any profoundness of the reflection in the deliberation? A systems conceptualization of the project may be a way through which this difficulty of minimum understanding of vocabulary may be addressed. And therefore a systems conceptualization of the project may also help in conceptualizing transformational changes in contrast to incremental improvements.

It can be seen that design methods based on communication or emergent processes[133] are best suited for design for sustainability.

Precaution as an Integral Principle for the Project in a Context of Sustainability

In this section, the pertinence of a precautionary approach for the project will be elaborated. As discussed in Chapter 3, precaution represents a mode of anticipation for the project that is both adaptive and cognitive – an appropriate mode of anticipation for a design project in a context of sustainability. Prevention, on the other hand, represents the ability to predict, in Boutinet's modes of anticipation. This can only represent one part of design thinking when compared to a precautionary mode of anticipation.

Project Perspective of Design

As was seen from the three competitions, the difficulty of adopting LEED in competitions is not in its use, but in the relationship between its use and the wider scope of the project, as defined by Boutinet (2005). An architectural project cannot be reduced to a set of credits prescribed by a rating system such as LEED, since the entire notion of projection and designer's intentions is then reduced to a universal list of indicators that was created

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133 Design methods based on (1) emergent phenomenon of auto-organization and (2) communication were described in Chapter 1.

at a national level. In some of the competitions studied in this research, particularly the two competitions that resulted in a split vote, the requirement of obtaining LEED credits overwhelmed the requirements of the project as a whole.

In addition, by focusing strictly on LEED credits and the visibility of LEED solutions to the public, important architectural dimensions were overlooked and therefore a shift from one dimension to another may have resulted. For example, in the Montreal Planetarium competition, the winning project, although a visibly green project overlooked symbolic, aesthetic and quality of space issues. The jury report stated that some of the weaknesses of the winning project were the following:

> *« Le plan génère un manque de fluidité, surtout entre les niveaux. (...) Le jury questionne le traitement du revêtement et le gabarit des cônes. » (Ville de Montréal, 2009b, p.7)*

From this quote, the jury identified a lack of fluidity and questioned the treatment and size of the cones. The fluidity refers to a weakness in the quality of space. The treatment and size of the cones refers to a problem regarding the symbolic or aesthetic quality of the project. This shift is problematic for projects that are based in the cultural or social fabric of the community, such as public projects studied in this research, i.e. museums, libraries, and cultural centers.

In this sense, the architectural competition can be seen as a project rather than a process as it is typically seen. In other words, it represents a space where alternatives to a design situation are conceptualized and presented. These alternatives are provided from a public that has appropriated the design brief in their own vision. These alternatives are potential projects which are then judged by a jury that was selected such that the cross-fertilization of their backgrounds, knowledge and expertise provides a rich collectivity. The objective of the jury is to select the best project. The deliberation for selecting the winning project can be done in a variety of ways, but in its ideal form, the winning project is not only selected unanimous, but is also collectively constructed by the jury. Although there are rules to follow in order that the competition is fair, open and transparent, the jury's responsibility is therefore the collective construction of a design project, where design thinking represents the recursive mode of conceptualization and judgment.

Tensions, Dialectical Thinking and Axiology

The study of tensions observed in the competition process revealed some of the challenges for design inquiry based on a preventive approach, since most of the finalist projects adopted the underlying principle of prevention for sustainability. As described in Chapter 2, strategies of optimization and efficiency are at the core of the principle of prevention. In particular, the LEED method adopted for architectural competitions is a prescriptive tool in the form of a checklist. In light of this, the preventive way of thinking about a design project when adopting LEED is not conducive to a systemic vision of the sustainability dimension of the project, and how this dimension fits into the whole, since designers are requested to accumulate points (a juxtaposition of solutions), and not provide a global perspective of their project (integration and emergence) regarding sustainability. In the case of juxtaposing solutions, the approach is mechanist, in the case of integration and emergence, the approach is systemic. Here, there is a lack of cohesion between the global definition of sustainability and the architectural project. This lack of a systemic vision of the project, where the qualitative dimensions of the architectural projects are separated from the technical solutions or from the social-cultural implications, implied a lack of cohesion between a global vision of sustainability and the architectural project. This was the case for most of the projects from the three competitions studied. As an example, the Cardinal Hardy winning proposal for the Saint-Laurent library competition adopted an approach for LEED that was disconnected from the rest of the project, as was shown in their descriptive text for their project related to sustainable development.

Also, a strict adherence to norms, like LEED, excludes the ability to transcend the status quo. This adherence, in some ways represents a deontological approach[134], as it may disregard important consequences for the project as a whole. For example, the Chevalier Morales/FABG proposal for the Saint-Laurent project defied the criteria regarding its position on the site and its visibility from the main road. According to their descriptive

134 A general description of ethics, morals and ethical action, which includes a deontological form of ethics, was discussed in Chapter 2.

text, this was done in order that the site disturbance was kept to a minimum and in order that the building would be better integrated with its natural surroundings, both decisions made to fit their overall objective of sustainability. However, both these decisions were questioned by the jurors, since they defied the objectives in the brief. Therefore, axiological approaches, or approaches that are founded on a set of principles that help understand the nature of values (as seen in Chapter 2), may also be encouraged when designing in a context of sustainable development. The design team of Chevalier Morales/FABG for the Saint-Laurent competition was penalized for this approach. However, an axiological approach may often lead to a critical reflection of the given problematic and where some of the objectives in the brief are then challenged. It is not obvious how the jury can handle this, given that the fairness of a competition rests on the judgment of projects based on the same criteria. This was the problem that this jury deliberation faced.

Consequently, in a sustainable architectural project, defying the status quo shows to some degree that a critical reflection of the situation took place and the proposal presented is a result of such critical reflection. Although a critical reflection does not necessarily imply an approach for sustainability in and of itself, it does represent a mode of thinking that encourages change. This type of reflection is where the incremental changes afforded by tools like LEED appear minimal and negligible compared to the far-reaching changes that a more global perspective of the sustainability dimension of a project engenders. This is where given boundaries can be questioned and represents an important element for societal change, where societal change is necessary for a long-term vision of sustainability.

In defying the status quo, controversies and contradictions to original intents or criteria may emerge. This is where the diverging views can be used as a catalyst for revealing new objectives or criteria important for the project. In this research these diverging views are represented by the tensions studied in the three competitions. Through this study, new objectives or formulations of criteria for sustainability may be conceptualized.

As a reminder of Hans Jonas (1985), irresponsibility is a key word with regards to a blind faith in technology, where the use of tools like LEED for addressing sustainability must be considered in a critical perspective since there is a preponderance of the use of leading edge technologies when adopting such tools. Even if LEED credits are obtained to achieve LEED certification, the project may not be sustainable at all with regards to other important criteria regarding sustainability. The above analysis helped bring to light some of the tensions regarding the judgment process.

PREVENTION AND PRECAUTION: PRINCIPLES PERTINENT FOR THE DESIGN PROJECT FOR SUSTAINABILITY

The tensions analysed in each of the three architectural competitions in this research adopted a global perspective of sustainability[135], a perspective that seeks to move beyond efficiency and performance optimization for design for sustainability. From a teleological perspective, the main purpose of design for sustainability, as defined in Chapter 1, is the project of the possibility that humans and other life will flourish on Earth forever (Ehrenfeld, 2009), where flourishing is based on quality of life as defined by Max-Neef (1991)[136]. Given this purpose of design for sustainability then, from an epistemological perspective, sustainability requires a global worldview, where a systems approach to conceptualization may help understand the interrelationships of the elements within this global worldview (see Table 56 on page 322 and Table 57 on page 323).

Therefore, the theoretical lens used in data analysis was based on a reflection of the precautionary principle for sustainable design inquiry. The analysis of the projects and jury reports were done from an approach to design for sustainability that included the four pillars of culture, society, economy and environment, and the awareness that these are interrelated with the basic irreducible criteria for architectural design, that of aesthetic, structure and utility[137].

The tensions identified were on the most part a result of an epistemological barrier that tools like LEED may engender on design thinking for the project. This research helped

135 The definition of sustainability that this research adopts was defined in Chapter 1.

136 Refer to Appendix 1 for a definition of Max-Neef's fundamental human needs for an understanding of the improvement of quality of life.

137 Table 7 on page 160 presents an example of a series of architectural design questions that may be adopted in this worldview.

identify that a part of this epistemological barrier is comprised of dialectical tensions whose poles are at once opposing, complementary and antagonistic, such as the tensions identified in Chapter 4. In order that these tensions can be addressed and dealt with, the complementary and antagonistic natures must be better understood. This is where the idea of auto-eco-re-organization as defined by Morin (2005) and Le Moigne (1999a) is important. Let us emphasise that the tensions identified reflect a part of a larger system – the project. For example, the practical tension between the environmental performance and the quality of space reflects a relationship that helps in the understanding of the project on a broader scope. In other words, by being aware that there is a relationship between the environmental performance proposal adopted for a LEED credit and the quality of space that may result because of choices made for addressing the LEED credit, a broader vision of the project can be attained. This is because the two dimensions must coexist in a project at once, and that an understanding of their relationships can help the designer or the juror realize how. This is the same for the practical tension between environmental performance and constructive choices, or any of the other practical tensions identified in Chapter 4.

The idea of auto-organization is characterized by an understanding of how parts of a system are organized and reorganized. In other words, each understanding of the system, which is itself a recursive and dialogic process as defined by Morin (2005), impacts any future understanding of the system since the system is constantly being reorganized through this process. This is the essence of complexity and of a systemic conceptualization process. Figure 40 presents a model depicting the duality between preventive and precautionary design inquiry approaches. Complexity implies the co-existence of both, even if these two approaches may be opposing, complementary and antagonistic.

In this sense, the results of tools like LEED for design for sustainability would then be reflected upon through the dialectical tensions that they engender in a design or judgment process. An understanding of the characteristics and organizations of these tensions may help in their reconciliation. A strict reliance on the results of such tools, without a critical and integrated conceptual approach, may drive the architectural design project into a problem-solving mode instead of a problem-setting mode, where these norms are taken within the larger context of the project.

This represents one of the tensions studied; the tension between the environmental performance and some other qualitative characteristics of the architectural project. An attempt to understand the essence of this tension helps adopt a critical reflection of the results of LEED with respect to the architectural project as a whole. In this sense, this research is therefore stating that the criterion of sustainability could be seen as a lever of creativity, opening the exploratory space through an integrated understanding of the implications of the technical solutions necessary for environmental sustainability to the whole project.

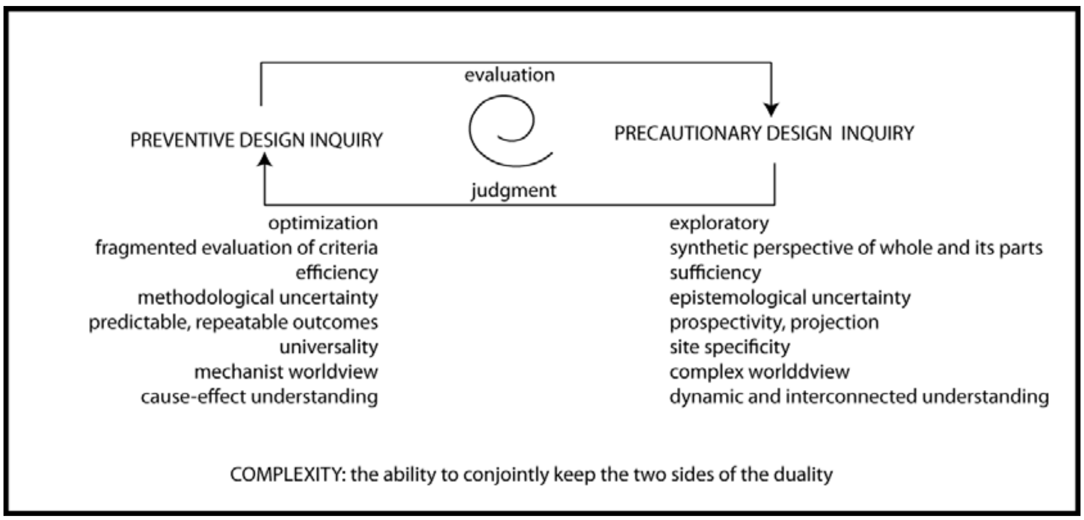

FIGURE 40: THE DUALITY BETWEEN PREVENTIVE AND PRECAUTIONARY DESIGN INQUIRY

As a reminder, Table 7 on page 161 shows some examples of inquiries for both a preventive and a precautionary approach to design. For example, in a preventive design inquiry approach, the social pillar would consider the green building as a way to increase local business opportunity (socio-economic). In a precautionary design inquiry, the social pillar would consider the architectural project as a means of social cohesion and equity, enhancing community life, accessibility to all. Therefore, for design thinking, a precautionary approach opens up the exploration of alternatives through an attempt of identifying the interrelationships (at best) and the uncertainties (at worst) of the potential repercussions of a project (Cucuzzella, 2007).

So a preventive approach, as mentioned previously, is an approach to design that focuses on the technical performance optimization since the objective is to prevent known environmental risks and where uncertainty is evaluated statistically and not reflectively. Evidence that a preventive approach was adopted for some of the architectural projects was apparent from the way in which the discourse unfolded in their descriptive text. One possible indicator of this is when there is little attempt in the descriptive text to discuss the way in which the technical solutions may impact the social, cultural or economic pillars, or how the technical solutions may impact the constructive choices, the aesthetic or the quality of space of their project. This may suggest that the technical solutions regarding LEED were added onto the project and not integrated with it.

For example, in the case of the winning project by Cardinal Hardy for the Saint-Laurent competition, where the concerns of the architects regarding sustainability were isolated to a one paragraph section that described their LEED proposal. The approach to sustainability adopted by this team was preventive, as efficiency and performance optimization were the main strategies described. Prevention is not an undesired approach to sustainability, as it seeks to reduce potential known risks. However, on its own, it restricts the vision of other important dimensions for an architectural project in a context of sustainability, as was shown through the distinction of preventive and precautionary forms of design inquiry in Figure 40 on page 358.

Finally, one cannot ignore the level of uncertainty of LEED results in a competition process either. Let us emphasise that the projects submitted to competitions have not yet reached the detailed design phase, so the uncertainty related to the LEED proposals may be significant. On this point, as the LEED rating system is based on prevention, the environmental risks are assessed depending on the rating of the project. This is why a critical awareness of the results of such tools or methods is necessary for design. The example of the Cardinal Hardy project for the Saint-Laurent Library competition is a good example of this lack of critical perspective of the LEED results. On the other hand, the project by Chevalier Morales/FABG is a good example of a critical perspective of LEED results.

Precaution as an Integral Principle for Design Thinking in a Context of Sustainability

The core of this thesis is an understanding of how the precautionary principle can contribute to design thinking in a context of sustainability in an effort to characterise the epistemological barrier that exists between design thinking and the use of preventive approaches for sustainability. This will be the focus of the next sections.

Designer as Glass Box/Black Box/Self-Organizing System

The designer as glass box/black box/self-organizing system as defined by Jones (1970) is another way to understand the tensions that were studied in this research. As the model represented by the 'designer as a self-organizing system'[138] addresses the limitations of the other two models of a designer, it best represents the need to oscillate between the endless generations of alternatives and the need to evaluate and select the most appropriate design.

Relating this to the jury deliberation process and the expert evaluations they must consider in their thinking process, the jury members can be seen to be 'designer as a self-organizing system', since they are using their background knowledge and the external criteria, in the reflection of each of the architectural projects in order to select the winning project, essentially a process that is at once one of discrimination and one of unification.

If the jury members were considered to be 'designers as a glass box'[139], then they would essentially be studying each of the architectural projects from a set of well defined information, and would not be able to come to a final judgment as there is no way for them to discriminate based on this model. This is similar to when the juror is embedded within a logical conceptualization approach, without any analogical thinking mode to help them decide what is interesting and creative – it would be difficult to interpret the projects and therefore to select a winning project.

138 This is a term coined by John Christopher Jones in 1970, as presented in Chapter 1.

139 This is a term coined by John Christopher Jones in 1970, as presented in Chapter 1.

If they were adopting the model of 'designer as a black box'[140], again they would not be able to select a winning project as the unbounded unconstrained space would lead them nowhere. This model is similar to when a conceptualization process is embedded only within an analogical process of thinking, without shifting into a logical form to help reach some bounded rationality, as Simon (1996b) defines. Here we can see that a dialogical dimension exists between the 'designer as a glass box' and the 'designer as a black box'.

The model of 'design as a self-organizing system' is the closest model to how the jury thinks, when compared to the other two models proposed by Jones (1970). Design thinking oscillates between poles of an understanding of the criteria and the ability to generate alternative interpretations so as to reach at some kind of most appropriate design. In fact, the 'design as a self-organizing system' model by Jones (1970) can be related to the new model developed in this thesis depicted in Figure 43 and Figure 45. The dialogic tension inherent in Jones' model between the need to find a satisfactory design and the need to consider external objectives and criteria can be paralleled to the dialogical tensions in these models.

For example, for the MNBAQ project, the jury report stated for one of the finalist projects that, *"En résumé, le projet répond à tous les critères sans recherche ni surprise."* (Ville de Québec, 2010c, p.4). This statement shows the jurors oscillated continuously between an understanding of the set of criteria, their own interpretation of the project and their ability to reach at a final judgment – that this project was not acceptable.

REFLECTION-IN-ACTION AND TECHNICAL RATIONALITY (PROBLEM-SETTING AND PROBLEM-SOLVING)

When technical solutions are isolated from the rest of the project in order to maintain a level of objectivity in the proposal, and do not consider the broader impacts of these technical solutions with respect to the whole project, this represents a divergence in the design thinking paradigm as defined by Schön (1983). An example among the three

140 This is a term coined by John Christopher Jones in 1970, as presented in Chapter 1.

competitions that illustrates this is the proposal by Cardinal Hardy for the Saint-Laurent competition. The list of universal technical solutions proposed for addressing the LEED credits in order to obtain LEED Gold were disconnected from the rest of the considerations of the project. In addition, there was no attempt to indicate how the technical solutions would be manifest. Not only did the technical rationality dominate their discourse regarding the sustainability dimension, the uncertainty relative to the realization of their LEED proposal was significant. The dialectical tensions between the LEED technical solutions, which were on the most part universal solutions proposed through an selection of pre-existing technical solutions seemed a logical approach for this team, instead of complementing this thinking with an interpretation of the available universal solutions based on the site specific subtleties and irregularities. This is a good example where reflection-in-action and technical rationality of design thinking are no longer integrated as one, where their antagonist yet complementary form of thinking is in harmony, but instead are disconnected as two separate and isolated activities that cannot be resolved.

Figure 41 presents a model where the activities of problem-setting and problem-solving, both typical of a design thinking process are disconnected because of tensions that exist between technical rationality and reflection-in-action. In fact, in this model, the problem-solving approach to design is overwhelming the problem-setting in this model, as was the case of the Cardinal Hardy proposal regarding LEED certification and the rest of the project.

The approach that this team adopted for proposing solutions for LEED credits was based on the technical solutions almost completely isolated from the other qualitative aspects of the architectural project. So the solutions proposed by this team were universal technical solutions, where their focus was on optimization and efficiency, and where the worldview was mechanist with regards to how LEED was used. The choices made for attaining LEED credits were not integrated with other elements in the project, so the solution was completely juxtaposed. There was a disjunction between the proposals regarding the sustainability of the project because of the use of LEED, and the way the rest of the project was conceptualized. Their inability to integrate the sustainability dimension into the rest of the project represents an example of the tensions between problem-solving approaches and problem-setting approaches for design thinking. These tensions are indicative of an epistemological barrier between these two modes of thinking for design.

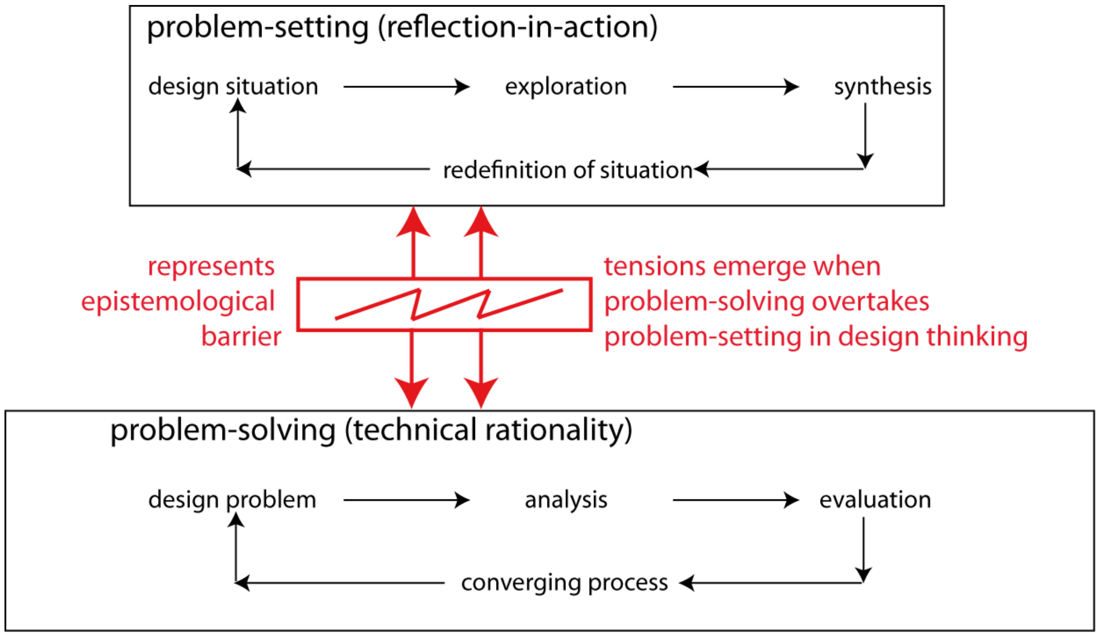

FIGURE 41: MODEL DEPICTING DESIGN THINKING WHERE PROBLEM-SOLVING IS THE DOMINANT APPROACH OVER PROBLEM-SETTING. THIS IS REPRESENTATIVE OF A PREVENTIVE FORM OF DESIGN INQUIRY.

One of the reasons for such dominance in the technical rationality mode of thinking for design is that technical solutions are often perceived as the most reliable approach to performance optimization, since the solutions are universal and proven to work in a universal context. However, this is not necessarily true in all cases. But what of the site specific irregularities? From a Schönian perspective of design inquiry, a preventive approach to sustainable design inquiry represents a technical rationality, as was previously explained. Schön states that from a

> *"(...) perspective of Technical Rationality, professional practice is a process of problem-solving. Problems of choice or decision are solved through the selection, from available means of the one best suited to established ends" (Schön, 1983, p.40-41).*

A preventive approach to jury deliberation can therefore be described in a similar manner. This would comprise an approach whereby the juror seeks to make a choice based on an established end (i.e. LEED certification level) and will ensure that the winning project satisfies this measurable criterion. In fact, Schön (1983) goes on to say that uncertainty and value conflict are troublesome for evaluation processes (such as LEED expert knowledge). Let us emphasise that according to this author, the action of judgment is based on reflective thinking which embeds within its process of problem-setting notions of uncertainty and value conflict. The relationship therefore between judgment and evaluation may represent the difficulty between the normalization effect of adopting such standard modes of evaluation for sustainability (as LEED represents) and creativity. Such normative evaluation methods or tools may exclude artistic ways of coping with such situations, since this does not qualify as universal, predictable, repeatable and purposeful modes of design inquiry. Figure 42 presents a model where one of the tensions between problem-solving and problem-setting are made explicit; that related to the comparability of alternatives. This model also shows that in order that the dialogic inherent in design thinking between problem-solving and problem-setting is maintained, the two sides should ideally co-exist.

An example of the dialogical tension between interpretative and analytic comparability was from the Saint-Laurent Library competition. In the jury report the way in which the projects were compared was indicative of the presence of this dialogical tension as was explained at the beginning of this chapter in the section entitled, *Analysis of the Tension Between Interpretive/Analytic Comparability.* In the jury report, the projects were compared with respect to the LEED credits (an analytic approach for comparing the projects), and with respect to their architectural signature (an interpretive approach for comparing the projects). The main difficulty in this jury deliberation process was that these two poles could not be reconciled and as a result, the jury deliberation concluded with a split vote where no consensus could be reached.

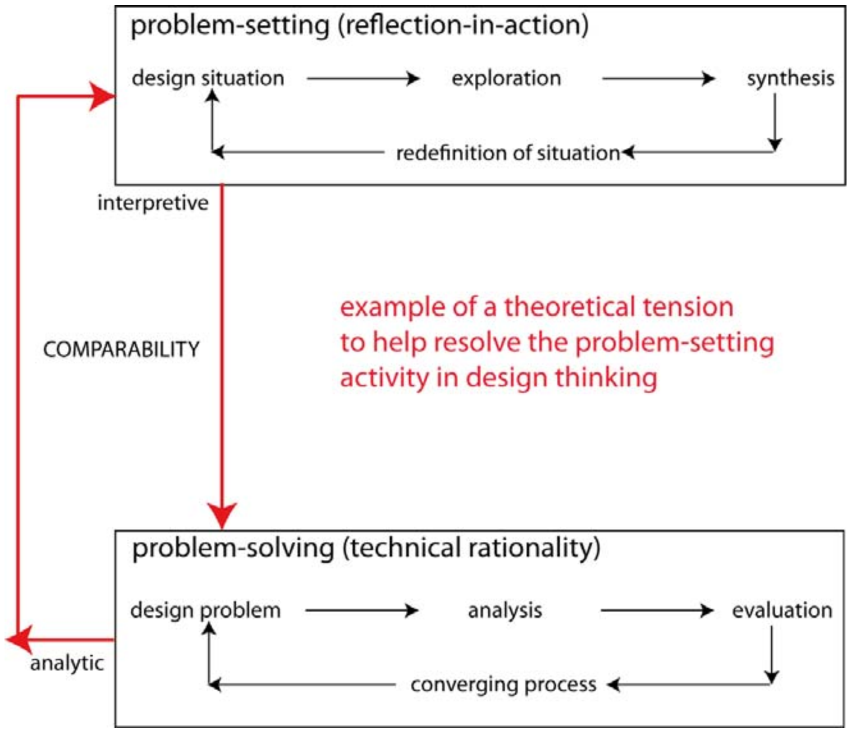

FIGURE 42: MODEL DEPICTING THE RECURSIVE AND DIALOGIC RELATIONSHIP BETWEEN PROBLEM-SOLVING AND PROBLEM-SETTING ACTIVITIES FOR DESIGN THINKING INTERCONNECTED BY TENSIONS CATEGORIZED BY UNCERTAINTY AND COMPARABILITY

Had the jury members sought to understand the limits of the LEED analytic results for addressing sustainability, and had the jury questioned the need for such a strong signature given the need to valorize the wooded area, and had the jury sought to understand the relationship between these in a context of sustainability, then they may have been able to reconcile this tension with regards to this point of contention. This would have required a recursive process of comprehension, since first they had to question each of the different elements of comparability (LEED credits on the one hand and signature of building on the other), and then they had to understand how these two are linked. An understanding of the second (the relationships) must necessarily follow an understanding of the first (the elements), representing a recursive process.

Figure 43 presents the interconnectedness of problem-solving and problem-setting through the four theoretical tensions studied. It is important to emphasize that Figure 43 is an extension of Figure 42 since it characterises all four tensions. Figure 42 is a necessary illustration since it helps understand the way in which each one of the four tensions in

Figure 43 operates within design thinking. As with the tension of comparability, each of these tensions in Figure 43 represents a spiral relationship between the two poles where each cycle that oscillates between problem-setting and problem-solving produces a new definition of the design situation. It is in this way that the process is recursive. The two opposing yet complementary poles of each of the tensions represent a dialogical perspective. The inherent complexity of resolving the two poles of each of the theoretical tensions identified in Figure 43 contributes to the construction of the new design situation until a satisfying solution is reached. The tensions highlighted in this study were a result of an inability to find the complementary nature of these opposing poles.

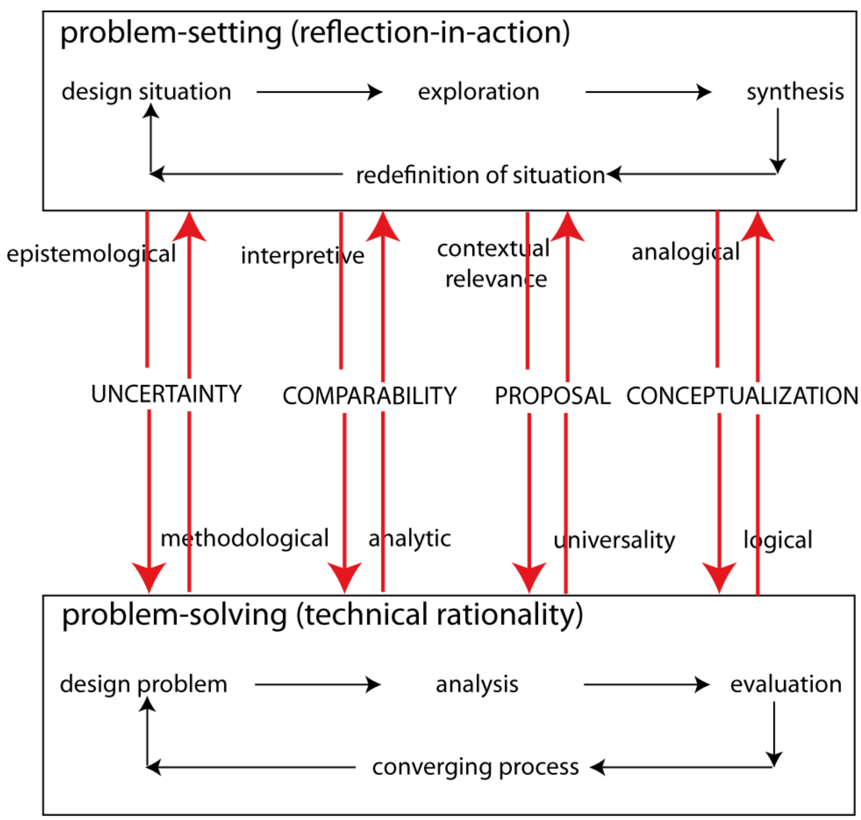

FIGURE 43: MODEL DEPICTING PROBLEM-SOLVING AND PROBLEM-SETTING ACTIVITIES OF DESIGN THINKING INTERCONNECTED BY TENSIONS CATEGORIZED BY UNCERTAINTY, COMPARABILITY CONCEPTUALIZATION, AND RELEVANCE OF PROPOSAL

These tensions are the characterization of the epistemological barrier that was identified at the end of Chapter 3. These four tensions characterize the difficulties encountered when adopting tools like LEED in design thinking. When technical rationality and reflection-in-action are disconnected from each other in design thinking, then an understanding of the presence of these tensions helps address the difficulties. These tensions may occur in the planning phase, in the conceptualization phase, in jury deliberation phase, in general throughout the competition project, which as mentioned earlier is characterized by it similarity to the design project.

This characterization of these tensions helps better understand how the encompassing design thinking activity of reflection-in-action can integrate the results of technical rationality rather than be in opposition to them. In this way, the understanding of these tensions helps understand that their opposition and their complementarity must coexist for design thinking.

The examples of the competitions adopting LEED studied in this research presented good examples of the problems that may arise when these tensions are not resolved in design thinking. A strict adherence to LEED requires an analytic process of comparability that depends on the reassurance of universal type solutions and where the uncertainty related to obtaining LEED credits becomes a serious consideration in the jury deliberation. This represents a limited perspective regarding the vision of sustainability for a project since the vision is restricted to a preventive approach for design inquiry.

As an example, the Saint-Laurent Library competition, where the second place-winning project was considered too risky in terms of LEED, yet where their project adopted the most global perspective of sustainability presented an example where the jury was caught within a technical rationality for assessing the sustainability dimension of the project. However, if only universal technical solutions are valorized because of their ease of predictability rather than considering the contextual relevance of proposals, then this is where, solutions that seek among others (1) passive energy solutions (that are dependent on site specificities); or (2) to interrelate their general qualitative architectural choices to the sustainability dimension, may not be properly considered or understood.

In addition, if the design thinking is restricted to logical rationalizations only, then it is trapped within technical rationality, as it relies solely on evidential data. Yet analogical conceptualization is necessary for a project, as it provides the cognitive leaps necessary for moving the project forward. The 'Living Machine' analogy used by the second place winner for the New Planetarium competition was a good example of analogical thinking that allowed the design team to conceptualize a solution regarding environmental sustainability that considered a waste=food or effectiveness strategy regarding the water treatment proposal for their project.

So, if a strict adherence to universal technical solutions for attaining LEED credits is critically reflected upon by considering the two ends of the dialectical tension (Figure 43), this would entail a return to a more global vision of design thinking as defined by Schön (1983). It is important to highlight that the model depicted in Figure 43 represents a global vision of design thinking for sustainability because it not only adopts the more traditional preventive approach to design inquiry but also one based on a precautionary approach to design inquiry. This is done by not only adopting approaches of (1) analytical comparability; (2) universality of solutions; (3) need to address methodological uncertainty; and (4) conceptualization based on logical rationalization using only empirical data, but through a recursive cycle of problem-setting and problem-solving it also adopts a mode of thinking based on the other poles of these tensions.

Therefore, an oscillation between the two ends of these dialogical tensions is necessary for a global vision as it will also (1) adopt an interpretive mode of comparability, (2) seek to understand the contextual relevance of proposals, (3) become aware that epistemological uncertainty is a necessary condition for the projection of intentions for a project, and (4) adopts analogical thinking to move beyond a mode of conceptualization based on empirical data alone[141].

Figure 44 presents the characterization of the epistemological barrier between problem-setting and problem solving in the context of sustainability. This also represents a global vision for design inquiry, since the thinking moves from a mode dominated by technical

141 A logical mode of conceptualization based on empirical data alone is the typical design inquiry approach in eco-design, discussed in Chapter 1.

rationality to a mode that oscillates between technical rationality to refection-in-action through the identified dialectical tensions. Here, we can make the parallel to preventive and precautionary modes of design inquiry as depicted in Figure 40 since on the left side of this figure, design thinking is disjointed, whereas on the right side of the figure, design thinking is integrated into a recursive cycle though the dialectical tensions.

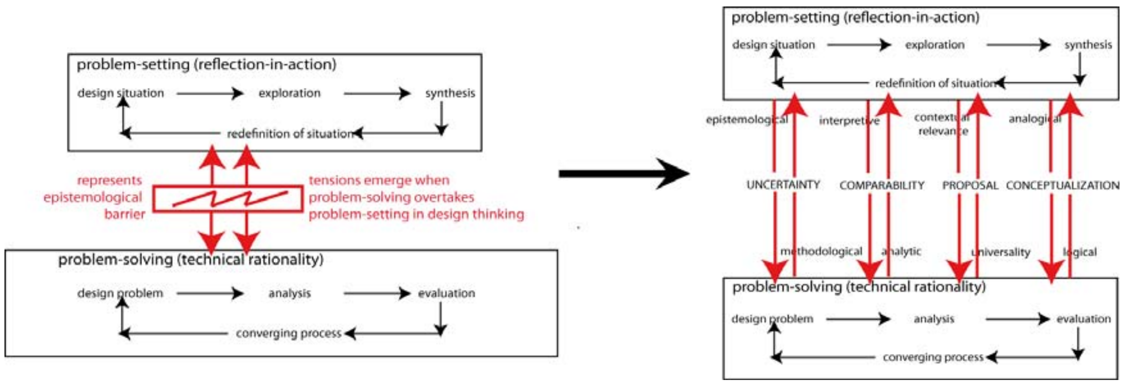

FIGURE 44: MOVING TOWARDS A GLOBAL VISION OF DESIGN FOR SUSTAINABILITY

This is where the benefit of a jury deliberation process emerges when selecting a winning project for a municipal architectural project. Since the jury composition must be at least half architects[142], who have an inherent reflective capacity based on their professional practice, as Schön (1983) has demonstrated, then the jury deliberation may also likely be a reflective process. Since the jury must also consider LEED expert evaluations (among others), then the deliberation may need to shift focus from the qualitative dimensions to the quantitative results and back. Here, there is an oscillation between problem-setting and problem-solving, which can be paralleled to a shift between the precautionary and the preventive forms of design inquiry (Figure 40).

This can be done not only through a broadened design inquiry approach based on precaution, but it can also be done through an awareness of the tensions that manifest in

142 In order that a competition can be endorsed by the Ordre des architects du Québec, a minimum of half the jury must be comprised of architects (Ordre des architectes du Québec, 2007).

design thinking. This means that if the deliberation remains fixed within a preventive design inquiry approach, and therefore focusing on LEED parameters or indicators, as depicted in Figure 41, this is where the more general qualitative dimensions of the architectural project may become compromised or overlooked, or where the synergies between the technical solutions for LEED and the rest of the architectural project are lost. This loss of synergies between the technical solutions and the rest of the project was seen in the Cardinal Hardy winning proposal for the Saint-Laurent Library competition. This project as a reminder proposed only a list of technical solutions without any details of how they would be manifest or how they would integrate to any other part of the architectural project.

In fact, a precautionary approach for sustainable design is very much in line with the vision of ecology described by Gregory Bateson in his book *Steps Towards an Ecology of Mind* (1972). This worldview encourages an exploration that moves beyond one that is purposive, in other words, moves beyond one where the areas of opportunity are predetermined.

In other words, because of the dominant use of the strategy of efficiency and universal type solutions, the areas of opportunity for a project are essentially predetermined, and therefore considerably reduced. This would indicate a preventive approach for design thinking for sustainability. A precautionary form of design inquiry would represent an exploratory space of reflection (Figure 40). Figure 45 presents a model depicting design thinking as defined by Schön (1983), and where the tension of “comparability’ is used as an example to show how each of the fours tensions fit into design thinking.

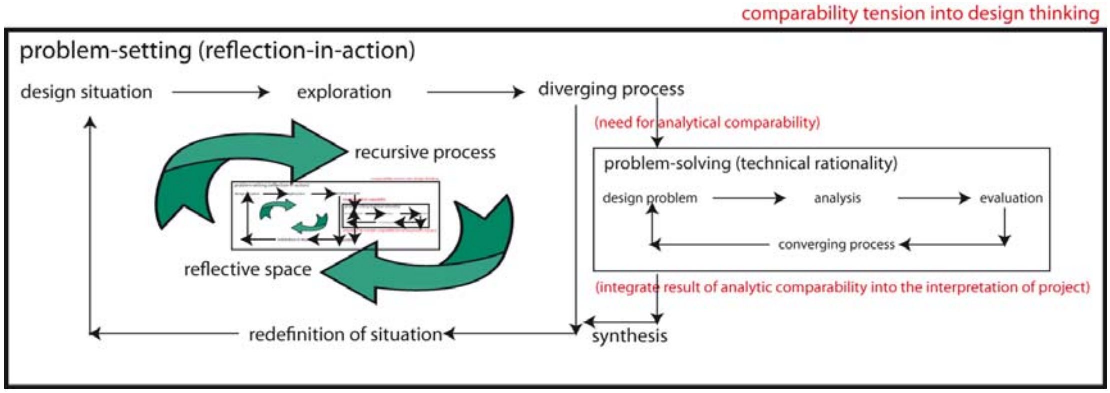

FIGURE 45: MODEL DEPICTING A DESIGN THINKING PROCESS BASED ON EMERGENCE, COMMUNICATION AND CONVERSATION (WITH SELF AND OTHERS) AS DEFINED BY SCHÖN (1983).

This model of thinking is representative of a precautionary approach to design inquiry, since it is founded on a reflective process, where analytic comparability is necessary, yet is itself part of the more encompassing interpretation of the project. Here, the mode of thinking based on technical rationality is embedded within the broader mode of thinking referred to as reflection-in-action. The evidential data from the process of problem-solving for a particular design problem is assimilated within the wider context of the design situation in order to further project the intentions of the designer, through a redefinition of the design situation, and therefore moving forward in the problem-setting of the design situation.

If we consider judgment as the recursive cycle of exploration and synthesis through the continual redefinition of the design situation, then judgment is at the core of design thinking as depicted in Figure 45. In turn, if we consider Dewey's (1933) model of judgment, which, as a reminder comprises the analysis of empirical data, a set of principles and tacit knowledge, then in this perspective, empirical data analysis is embedded within the problem-solving cycle, whereas the set of principles and tacit knowledge is embedded within the recursive, reflective space.

We can therefore say that problem-setting (or reflection-in-action) comprises problem-solving. This is what Figure 45 depicts: problem-setting includes the process of problem-solving. In this case, these two are not in tension, but are rather complementary, antagonistic and opposing. This is where the theoretical tensions enter the model. These tensions connect these two modes of thinking, as indicated in Figure 45 with the example of the *comparability* tension.

Each of the four tensions studied can be used in the same manner as the example of the comparability tension that is included in Figure 45.

In essence then, Figure 46 presents a combined model that shows the shift from first generation systems thinking (mechanist paradigm), to second generation systems thinking (complex paradigm). In this figure, the model at the top represents first generation thinking, where a preventive mode of design inquiry is embedded. The model at the bottom represents a second generation systems thinking, where a precautionary mode of design inquiry is embedded. A preventive approach is therefore representative of a mode of design thinking where technical rationality is dominant, whereas a precautionary approach is representative of a mode of design thinking where reflection-in-action is the encompassing mode of thinking.

In this sense, a precautionary approach for design inquiry for sustainability can help move beyond the epistemological barrier that is present when technical efficiency strategies are the main purpose and dominant use of tools like LEED. Therefore, a precautionary approach to design inquiry for sustainability is more in line with the way in which designers think, as defined by Schön (1983), when compared to a preventive form of design inquiry. As mentioned in Chapter 2, a preventive approach is simplifying as it reduces the designer's vision of the design situation into a design problem.

Another main contribution of a precautionary approach for design inquiry in a context of sustainability is that the four pillars of sustainability (culture, social, environmental and economic) can be considered in an integrated manner, particularly when the design criteria and objectives of the project are constructed. This can be done by adopting the system design grids as proposed by Nelson and Stolterman (2003). The construction of these grids will require that those involved in the construction of the set of criteria and objectives for the project, be it the design team, the competition organizers, the client, the jury, or any combination of these, would adopt a second generation systems thinking approach, as depicted on the bottom part of Figure 46.

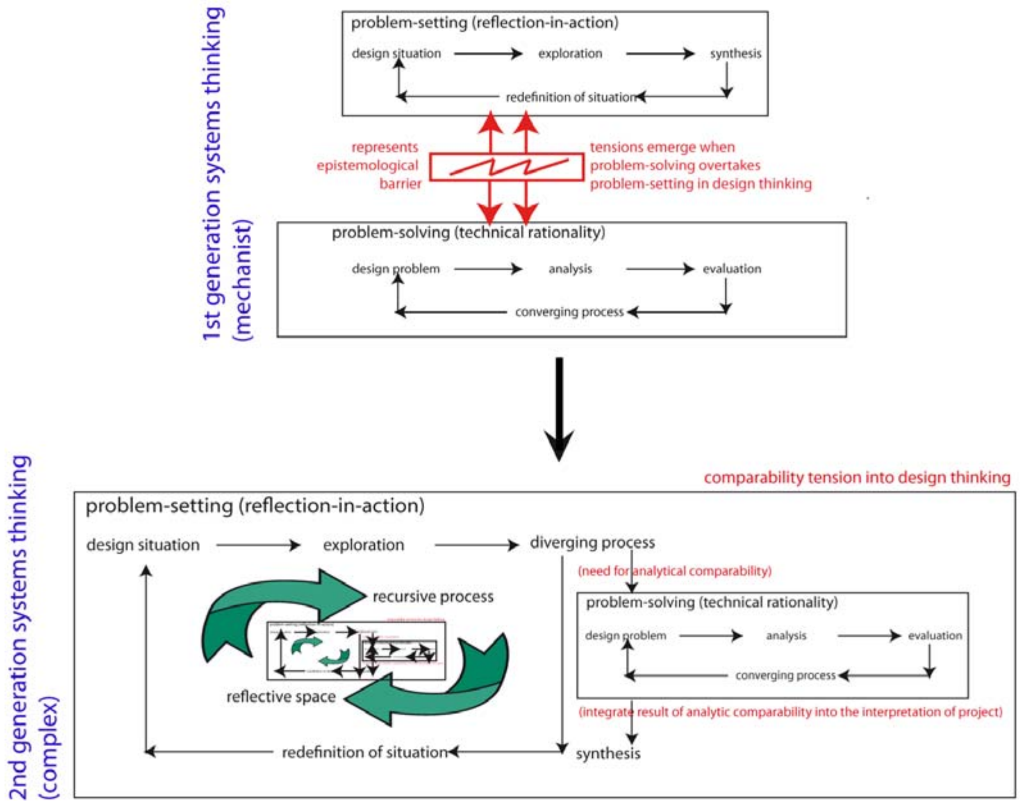

FIGURE 46: SHIFT FROM 1ST GENERATION SYSTEMS THINKING (MECHANIST) TO 2ND GENERATION SYSTEMS THINKING (COMPLEX)

Such grids would be difficult if not impossible to construct using the model on the top of Figure 46 since the interrelationships would not be possible to comprehend and therefore articulate in this approach. The benefit of adopting a problem-setting approach as depicted in the bottom model of Figure 46 is that it allows for a recursive learning process, where the antagonist and complementary points of view can be articulated through the reflection-in-action learning cycle. In the top model of Figure 46, there is no such allowance for this recursive process between the two modes of thinking, so in this model, the methodological and epistemological limits.

This is why a global and systemic vision is a necessary epistemological and methodological enhancement to design thinking as proposed by Schön (1983) as is what this research is proposing by combining design thinking with the precautionary principle. This theoretical model resulting from a combination of the precautionary principle and design thinking provides a way to better understand how the complex interrelationships of a design problem may be better articulated. So although prevention and precaution may seem similar at first, they are fundamentally different in the ways in which risks are addressed and the ways in which they may influence the planning, design and judgment processes.

Precaution as a Dimension of Prudence for Design Thinking in a Context of Sustainability

The tensions that characterize the epistemological barrier in design thinking can also be related back to the model proposed in Chapter 2, specifically, Figure 12 on page 97. This model identified various strategies, goals and dimensions for sustainable development through a perspective of prudence (precaution, prevention and foresight) for the four pillars of sustainability. As explained previously, each of the dimensions of prudence represents a different worldview with their own concerns, issues, goals, methods and purposes.

The four conceptual tensions[143] identified in design thinking for the context of sustainability can be equally applied to this model, where the tensions can help integrate rather than oppose the three dimensions of prudence. Figure 47 presents the tensions between the different strategies and goals between each of the dimensions. In this perspective, each of these dimensions may be integrated through a global and systemic vision of design in a context of sustainability.

By mapping the tensions within the framework of prudence, then these different worldviews can be seen to be at once, antagonistic and complementary. In addition, the recursive nature of these conceptual tensions can equally be adopted such that the different worldviews represented by each of the dimensions of prudence can be reconciled. In this sense, starting from initial problematic of the limited and constraining vision of efficiency for design for sustainability, the precautionary principle allowed the construction of a theoretical model that integrates the various visions and strategies

143 As presented earlier, these four conceptual tensions are: (1) analogical/logical conceptualization; (2) epistemological/methodological uncertainty; (3) interpretive/analytic comparability; and (4) universal/contextual relevance of proposal.

through the set of four tensions shifting from a mechanist (opposition) to a systemic (recursive and integrative) mode of design thinking for the specific context of sustainability.

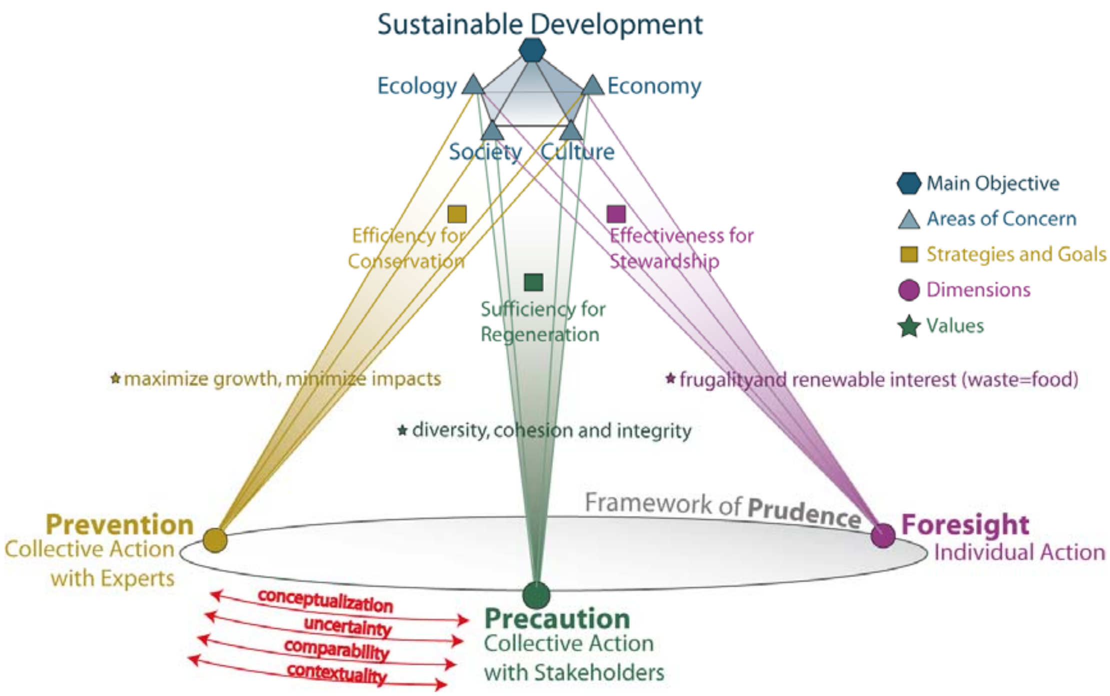

FIGURE 47: TENSIONS BETWEEN THE DIFFERENT STRATEGIES, GOALS AND VALUES FOR THE DIMENSIONS OF PREVENTION AND PRECAUTION OF THE FRAMEWORK OF PRUDENCE.

The three different strategies of efficiency, effectiveness, and sufficiency depicted in this model therefore represent strategies that adopt different worldviews. For example, for prevention, the thinking is embedded within the value system of maximizing economic growth while reducing impacts. This represents purposive and instrumental vision. In the dimension of precaution, the thinking is embedded within the value system of diversity, cohesion and integrity of the systems in question. As mentioned, this represents a global vision for sustainability as the essence rests on exploration of alternatives rather than the optimization of identified problem areas (as in prevention). In the dimension of foresight, it is the value system of frugality and cyclical renewability (waste-food) that is foremost. These implicit value systems are rendered explicit when the four tensions are adopted in design thinking, and their opposing yet complementary poles are sought to be resolved.

LEED WITHIN THE SUSTAINABLE DEVELOPMENT PARADIGM BUT NOT ALWAYS WITHIN THE DESIGN THINKING PARADIGM

As a conclusion to this discussion chapter, this thesis is stating that LEED can be a rating system that imposes an anti-design thinking approach for architectural design practice when seeking to develop a project in a context of sustainability. In this sense, when LEED is adopted in such a way, it may be counter-productive since it defeats the purpose of its intention. This is because it can reduce the design situation into a problem-solving exercise since the reflective part has been overwhelmed by the technical rationality that the system of LEED in itself engenders. The precautionary principle as a theoretical and reflective basis for design thinking in a context of sustainable development can help open up design thinking back to a design epistemology of problem-setting, as defined by Schön (1983). Figure 48 presents an example of a precautionary perspective of design thinking for sustainability, and its relation to the project and design practice.

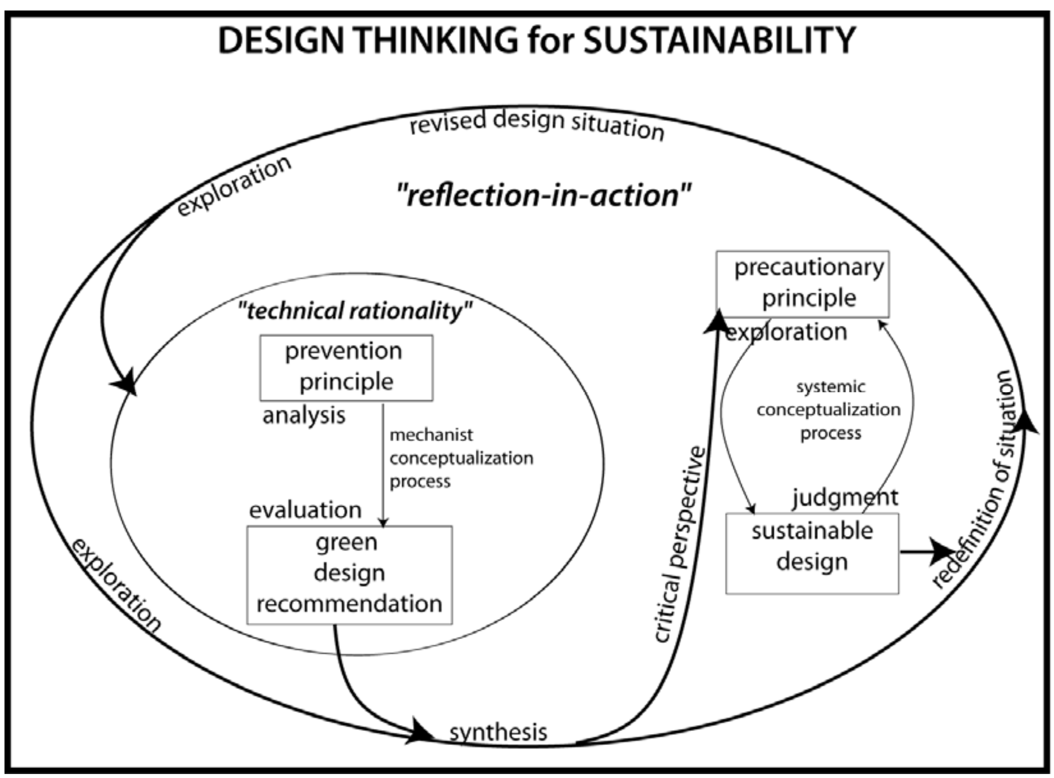

FIGURE 48: DESIGN THINKING FOR SUSTAINABILITY

The model depicted in Figure 48 is a design thinking model specific for the context of sustainability. It can be applied to the design project, to judgment as well as to design practice. It illustrates that the principle of prevention is embedded within technical rationality and that the precautionary principle is embedded within reflection-in-action. Each one is necessary for the other (complementary nature), yet they are also antagonistic and opposing perspectives. The recommendations of the preventive principle would be considered through the precautionary principle by adopting a critical perspective of the results. The exploration process when adopting the precautionary principle would then enable the design team, the jury members, the competition organizers, the client, or any combination of these stakeholders of a competition, to adopt a more global vision of the design project and then redefine the design situation through this critical perspective. This reformulation of Schön's design thinking model for the context of sustainability is here referred to as "reflective prudence", as design thinking is intersected with the precautionary principle.

Consequently, as LEED is based on a preventive, prescriptive and predictable epistemology, the design thinking process does not have to be. In fact, according to Schön (1983) design thinking is reflection-in-action and in this sense, is anything but prescriptive and predictable (refer to Figure 48). A design project that adopts LEED then should remain a reflective recursive approach, where LEED is just another source of information specific to environmental sustainability. When the other pillars of sustainability are also considered in this reflective approach, then this represents a precautionary design inquiry approach. For example, in the case of the New Montreal Planetarium competition, the project by Big City/l'Oeuf proposed an approach that sought to integrate the LEED solutions to a variety of other architectural dimensions in an extensive manner. The conceptualization process of this team did not therefore adopt the methodology of LEED but instead, adopted a design thinking process that considered the design project in it's entirely and not from the perspective of the list of LEED indicators.

CONCLUSION: DEVELOPMENT OF A THEORETICAL MODEL FOR JUDGMENT AND DESIGN THINKING IN A CONTEXT OF SUSTAINABILITY

This final chapter of the thesis restates the research problem and reviews the main methods adopted in the study. A summary of the contribution to the current knowledge of design thinking and judgment that this present thesis contributes, its results and a discussion of their implications will be presented. This concluding chapter will close with a reflection on potential future research opportunities.

CONTEXT OF PROBLEMATIC

As presented in Chapter 1, design has become an increasingly important medium for understanding and addressing the current environmental and social crisis. As a vehicle for change, with the intent of improving a given situation into a better one, design can therefore contribute to the changes necessary such that society can move towards a type of development that is sustainable.

In order to move towards such a goal, it is important to understand the main objectives of this new type of development. However, to do this, it is necessary to be able to identify and understand some of the main root causes of the un-sustainability of current developmental practices. The difficulty is that it is not evident to go from an understanding of the root causes directly to the main objectives as both of these engender large and complex problems. This is why international norms and conventions have been developed for guiding action. These standard norms or conventions seek to simplify the complex task by breaking down the problematic into a set of indicators or checklists. They are meant to render the immense problematic of sustainable development manageable. These conditions on their own cannot be addressed unless a set of principles, strategies or methods are available to help meet the conditions that have been set.

As design is one of the professions that can contribute to such change, then design requires its own set of principles, strategies or methods to guide judgment of design projects, products, buildings, etc. Many already exist of which designers make extensive use of in their design practice. LCA, LEED, Ecological Footprint are examples of methods or systems of evaluation available to designers to help them assess or understand the potential environmental risks of their projects. There are also methods to help designers assess social impacts of their projects such as Social Life Cycle Assessment. All these tools or methods are primarily based on the principle of prevention.

Sustainability tools that are based on the principle of prevention help designers identify weaknesses in the products, projects, or buildings so that they can focus on these areas for improvement. This represents an instrumental and purposeful approach to design, implying that the designer focuses on those weaknesses, but this may be done at the detriment of a deeper exploration of the design situation at hand.

Relating this approach to Schön's design thinking (1983), we can see that a preventive approach to design for sustainability refers to, what this author refers to as, technical rationality. An approach to design based only on technical rationality represents a problem-solving approach to design. This is reductive for design, since design problems are not given, but instead, design situations are constructed, and therefore cannot be solved in the same way as problems in the hard sciences. The paradox is that current approaches to design for sustainability adopt, on the most part, a preventive approach. This is done even when it is known that the problems related to sustainability are far-reaching and complex where such problem-solving approaches are limiting for the exploration of new alternatives.

This is why the precautionary principle was explored for design thinking, as a way to both complement and oppose the principle of prevention of which many current tools and methods are founded. This requires a recursive process rather than a linear process for design thinking. A reflection of the precautionary principle for design revealed that its underlying theoretical and possible operational framework may help shift the importance that is placed on such tools and the tensions that they may engender, to a more reflective thinking of the design project. This exploration contributed to the development of a theoretical model that was further enriched through the empirical study.

The intent of the exploration of the precautionary principle for design was to try to reposition, what Schön (1983) refers to as reflection-in-action, back as the main activity of design thinking, of which technical rationality is only a part of. The tensions between these two modes of thinking represent an epistemological barrier. The identification of such tensions helped characterize the essence of this epistemological barrier.

The pertinence of this research is that it contextualizes the place of standard evaluation sustainability tools within design thinking. And in doing this, it characterizes some of the difficulties encountered when adopting tools like LEED in the design process. These difficulties constitute the epistemological barrier between preventive and precautionary design inquiry approaches for sustainability, or more specifically, the epistemological barrier between technical rationality and reflection-in-action for design for sustainability.

Review of Methodology

The main hypothesis for this research was that a precautionary approach to design inquiry in a context of sustainability may help bridge the gap between the exploratory, reflective nature of design thinking and the use of quantitative environmental evaluation tools increasingly imposed on the architectural competitions – an important concern as these tools have had an increased importance at the international level for addressing issues of sustainability. In order to understand the essence of this gap, an exploration of tensions regarding the use of standard evaluation tools for sustainability and design thinking was the focus of the research.

For this research, the architectural competition was the empirical field in which this hypothesis was tested and the theoretical model enriched. The competition represents a significant window for all design projects (industrial, urban, architecture, landscape). Since this research situates itself within the conceptualization phase of design, the competition represents a pertinent choice for the study of design thinking and the judgment process. In addition, the competition represents a public process that is fertile for generating alternatives. Judgment is made within a participatory environment, thereby enabling a fair, open and transparent process of deliberation, in an ideal situation. Consequently, the competition documents are publicly available. More importantly, exploration in this field is important for the domain of design since competitions represent a format for commissioning public projects that seeks to find the best project for a design situation.

The corpus of archived competitions in the Canadian Competitions Catalogue (CCC) was the basis of the selected competitions of study. The main criterion for selecting a competition was that a sustainable development dimension was identified in the brief, of which LEED was one of the criteria within this dimension. In addition, as there are four levels of LEED certification, the intent was to select four competitions, each with a different LEED certification requirement (i.e. Basic, Silver, Gold, and Platinum). However, as there is no architectural competition yet archived with a LEED Silver certification requirement in the CCC, only three competitions were selected – Basic, Gold and Platinum.

In addition, the proposals submitted during a competition are not final detailed designs. In other words, the designs are not yet finalized and therefore there is still much room for improvements. This also implies that there is both, much uncertainty in the intentions and various solutions of the designs as well as much potential for development. All these points are important for this thesis, since a precautionary approach to design inquiry represents on the most part, an anticipatory collective judgment process for finding alternatives to a design situation.

Various text documents related to the competitions represented the main data to analyse – specifically, the descriptive texts of each finalist proposal, the panels related to LEED, and the jury reports for each competition. Observations in jury deliberations were not conducted, as the permission to participate was either denied or the jury process had already taken place. Individual interviews with jury members were also not conducted since the organizer of the competitions did not grant the permission. This is a known limitation of this research, since jury observations or interviews with jury members might have confirmed many assumptions.

There were two types of tensions identified in the methodology. There were practical and theoretical tensions. Practical tensions related directly to design project criteria and were directly observable from the competition documents. Whereas the theoretical tensions were representative of modes of design thinking that are at once, opposing and complementary for the design thinking process. The tensions observed from the competition data were identified, categorized within the practical tensions and finally related to their theoretical counterparts. The reason for this double set of tensions (practical and theoretical) is because theoretical tensions are not easily observed in text, whereas practical tensions as defined in this thesis can be.

This analysis was then correlated back to the theoretical model in order that the epistemological barrier could be characterized and the design thinking model adopting a precautionary approach for sustainability inquiry was further elaborated.

SUMMARY OF RESULTS

The focus of this doctoral thesis is to identify and categorize the tensions between design exploration and the adoption of standardized evaluation sustainability tools or methods. The precautionary principle was explored as the critical basis of the theoretical model (Ewald, Gollier & Sadeleer, 2001; Ewald, 1996) regarding the gap between instrumental and intuitive thinking in a design project scenario. The development of this theoretical model based on an exploration of this principle through a reflection and understanding of its main epistemological, ontological, methodological and teleological perspectives thereby contributes to the domain of knowledge of evaluation and judgment for design thinking in a context of sustainability. Standardized environmental evaluation approaches are used to help decision makers or designers focus on areas for optimization or improvement through the identification of environmental impacts or through the form of a prescriptive checklist, such as LEED. The design exploration process is based on the approach of design thinking (Broadbent, 1988; Rowe, 1987; Jones, 1984; Schön, 1983) and the project perspective (Boutinet, 2005).

The architectural competition serves as an empirical situation offering a basis for comparisons. Besides the quantitative technical, budgetary, or sustainability data, the architectural projects are judged on the basis of their intrinsic qualities as a whole. This is a complex process, in particular in what concerns the various judgment criteria and the qualitative evaluation of the projects. The review of these architectural competitions through the lens of this theoretical model contributes to its further enrichment in that it contributes to the identification and categorization of the gaps or even contradictions arising from the adoption of such normative evaluation sustainability tools or methods in design practice.

When studying the architectural competitions through the lens of this theoretical model, it was seen that on the most part, LEED strategies are juxtaposed onto the project, where the LEED solutions are only seen with respect to other LEED solutions, without a reflection of how they interrelate to other architectural qualities. However, the theoretical model can help articulate how the technical solutions adopted for LEED are interrelated with other important architectural qualities, which may be far-reaching or shallow, but nonetheless related to other architectural qualities. In fact, because of the form of design inquiry when adopting a precautionary approach to design thinking for sustainability, it may also help position the use of LEED, which adopts a predominant form of technical rationality, back within the larger recursive hermeneutic cycle of reflection-in-action, instead of opposed to it. In other words, integrating the two forms of rationality rather than opposing them.

Finally, by reducing LEED to a methodological question, which was the case in two of the three competitions studied, the jury may have failed to recognize the underlying vision of LEED and more generally sustainable development – which is the need for a global and systemic vision regarding the design situation. One reason for this may be that in the earnestness of seeking to be the most sustainable, where the only tool available is essentially a quantitative prescriptive checklist, the question of the underlying vision of the methodology and the long-term vision it seeks is lost in the need for rigor in the analysis. In fact, a precautionary approach to design can be seen as a way to innovate in a context of sustainability instead of a way to hinder and constrain innovation. The main reason for this is that it relies on the opening up of a systems perspective in which the project is embedded, and therefore helps position the constraints that tools like LEED engender within a broader scope of reflection on the project. Finally, it helps articulate the relationships between the technical solutions regarding LEED with the other qualitative aspects of the project. This is complementary to a preventive form of design for sustainability.

Discussion of Results

In this research, a theoretical model based on the precautionary principle and design thinking was developed as a way to complement the limits of current methods of design for sustainability founded on the principle of prevention. This model identified the presence of an epistemological barrier. The constitution of this epistemological barrier was the focus of the empirical study since the tensions between the use of standard environmental tools and design thinking were investigated. In essence, this is representative of the tensions between a preventive and a precautionary form of design inquiry. These tensions helped characterize this epistemological barrier. Therefore, the empirical study is intended to help move towards an integrated preventive and precautionary form of design inquiry (referred to in this thesis, as a prudent form of design inquiry), rather than remain within a preventive form as is currently done in many design projects focused on sustainability.

This research is therefore intended, first and foremost, to help better understand and describe, both, the utility of and the nature of the difficulty from the use of assessment tools such as LEED for design thinking. However, through the theoretical model, and its potential for application to design thinking for sustainability, some recommendations are presented as a way to help move towards a future potential of a prudent (integrated precautionary and preventive) form of design inquiry for design practice.

In the following sections, the interpretation of the findings will be presented and will situate these findings with respect to the larger community of knowledge regarding design and sustainability.

Interpretation of Findings

Design thinking as defined by Schön (1983) remains after more than 25 years an excellent model from which to understand the way designers conceptualize, evaluate and judge. As judgment refers to critique and critique is reflective thinking, as Dewey (1933) has stated, the designer is then in a constant state of reflection. This model has been useful and remains useful in understanding and describing how designers conceptualize.

However with the prominence of the environmental crisis and more recently the crisis of sustainability, the need for data in order to be able to make decisions has been an insurmountable challenge. However, it is not only the immense need for data that hinders a more global, exploratory form of design for sustainability, there is also the challenge of the acceptance of fundamental uncertainties and doubt in decisions made, and therefore the need for a complex worldview. Particularly for sustainability, where it is not only one dimension, but the four pillars of social, culture, economic and environment, and their interrelationships that must be considered. This has in turn reflected in the new responsibilities of the designer, and therefore has imposed an enormous burden on the activity of design for sustainability.

The complexity of this crisis has been addressed for the most part through a mechanist view. This worldview of cause-effect, predictability, repeatability of risks, etc., has resulted in the need to collect as much data as possible in order for designers to understand the design situation precisely. Therefore, complexity is not only inherent in the crisis, but there is also the crisis of the need for complexity. This immense requirement for data and its integration in the design process has become non-negligible and in some cases problematic to the outcomes of the design or judgment process.

The main reason why the outcomes of design or judgment have become problematic, is that design thinking has shifted from the original model proposed by Schön (1983). What this implies is that the relationship that Schön (1983) has identified between reflection-in-action and technical rationality, where technical rationality is a necessary yet embedded activity within reflection-in-action has shifted with the need to address the large amounts of data needed to understand design situations for sustainability. This shift, in turn, has resulted in the disjunction between technical rationality and refection-in-action, where they are now in opposition rather than complementary forms of thinking within design. This is because the immense amount of quantitative data must be dealt with in design thinking for sustainability. In this sense, technical rationality then becomes the more prominent form of thinking in design compared to the activity of reflection-in-action. This represents an anomaly for design thinking as defined by Schön (1983).

This displacement of the relationship between reflection-in-action and technical rationality as Schön (1983) has defined cannot be ignored as it removes the essence of design. This shift has revealed difficulties regarding some important elements of design thinking: conceptualization, comparability, addressing uncertainty and doubt, and contextual relevance of proposals.

A first difficulty regards the idea of project or intention is no longer relevant in this perspective of technical rationality as the thinking is driven by the quantitative data. The idea of reflective judgment and qualitative critique is therefore circumvented by the more technical mode of rationalization. Second, the concept of risk and uncertainty has also shifted from the more epistemological form of uncertainty, which is necessary in the activity of projection as defined by Boutinet (2005), to the more methodological form of uncertainty, driven by the need for more data. Third, intuition is therefore also evacuated from the designer’s way of thinking as the quantitative data becomes more relevant in design thinking than intuition and interpretation. Intuition is based on experience and tacit knowledge. Dewey (1933) stated that a good judgment requires all three forms of knowledge, evidential data, worldview (or principles) and tacit knowledge. So here again, design thinking is impacted negatively by the immense need for data in a context of sustainability. Fourth, because of this dependence on data, the way in which decisions are made then rests on analytical modes of thinking instead of the more interpretive mode of thinking, a thinking that is based on “reflective prudence” and critique.

The theoretical model developed from a reflection of the precautionary principle helped reveal these tensions by revealing the epistemological limitations of the more traditional tools for design for sustainability and the need to adopt a different vision. This theoretical model is founded first and foremost on a systemic and global vision (as these are the basis of the precautionary principle) of the design situation by adopting a complex worldview. This in turn has repercussions on the design project and on design thinking for sustainability.

Systemic thinking based on a complex worldview is therefore the key to help designers deal with the extra burden of considerations in a context of sustainability. Systemic thinking helps designers organize the design situation, especially when the interrelationships between elements are as important as the elements in the design situation. This process of systemic thinking may help them reflect on the design situation and make judgments in a recursive manner, therefore changing the situation as the reflection occurs. This is what Le Moigne (1999a) refers to as auto-eco-re-organization of the design situation and is essentially 'problem-setting' as defined by Schön (1983) . However, as the immense amount of data has to be contended with, collective forms of design thinking has become increasingly important. This is why the IDP has become such a prominent process in a context of sustainability. It is one way of dealing with the complexity of the situation where the various stakeholders of the design team meet early in the conceptualization process in order to be able to capture the synergies of their ideas regarding the design project. The competition process is another form of collective judgment, which typically involves 8-12 jurors, often with representatives of the client (i.e. the municipality) or the community. A competition process is therefore in line with this global approach to design because of the potential of the projects proposed and by the ideas drawn from the various proposals. In addition, in an ideal jury deliberation process, the jury then collectively reconstructs the winning project. In a collective approach for selecting and constructing the winning project, which is the way it is done in a competition judgment process, the interrelationships between the various domains and professions may become clearer through the process of deliberation. The main reason is that the various jury members, each with their own tacit knowledge and principles, contribute to the collective reflection as well as assimilate the collective discourse within their own inner reflection, a recursive hermeneutic co-learning process. This is why the way in which evaluation and judgment is done, is important, as it must be a fair and open process as defined by Habermas (1984). In addition, the hermeneutic and co-learning process that is inherent in collective judgment processes is a reflection of a type of evaluation that is based on a fourth generation evaluation as defined by Guba and Lincoln (1989). Fourth generation evaluation is founded on the idea that the claims, concerns and issues of each stakeholder are shared, assimilated and addressed by all others in a negotiation process that seeks to arrive at a common goal, where consensus is the ideal result.

This is in essence the theoretical model of a precautionary approach for design thinking in a context of sustainability. This research allowed a better understanding of this proposed model through a review of the dialectical tensions in the context of architectural competitions adopting LEED. In two of the competitions studied, the tensions were much more prevalent, particularly when the LEED requirement was high (Gold and Platinum). In the competition where the LEED requirement was LEED Basic, these tensions were not as prevalent.

In this sense, this research is therefore stating that the criterion of sustainability could be seen as a lever of creativity, opening the exploratory space through an integrated, global understanding of the implications of the technical solutions necessary for environmental sustainability to the whole project, rather than simply juxtaposing the technical solutions onto the projects.

The study of the competitions regarding these tensions helped confirm the characterization of the tensions in order to better understand how the shift in modes of design thinking as defined by Schön (1983) occur. In other words, how technical rationality has become disjointed from reflection-in-action in some cases where the need for an immense amount of data for sustainability overwhelms the design thinking process. The precautionary principle as a way to guide thinking in a context of sustainability by considering the more global perspective of a situation and the interrelationships of the pillars combined with design thinking is therefore suggested as a way to address this new phenomena.

In summary, this research reinterpreted Schön's (1983) model of design thinking. Schön's model, when adapted to the context of sustainability has been reduced to the opposition of problem-solving and problem-setting resulting in outcomes of design projects that are not more sustainable when considering the four pillars. This thesis proposes a systemic vision of Schön's (1983) model; where problem-solving and problem-setting are not only in opposition, but are also complementary and antagonistic, and where their coexistence is fundamental. This coexistence is possible through the understanding of the four tensions studied since it allows to better understand the phenomena of the domain of judgment and design thinking. The four tensions studied were: (1) analogical/logical conceptualization; (2) epistemological/methodological uncertainty; (3) interpretive/analytic comparability; and (4) universal/contextual relevance of proposal. These four tensions comprise a system for judgment as they each address an important element for design thinking. This system becomes the characterization of the epistemological barrier between problem-solving and problem-setting for design thinking in a context of sustainability.

RELATIONSHIP OF CURRENT STUDY TO PREVIOUS RESEARCH

There has been very little research on the very specific area that this research has focused on – the critical study of the impact of the use of LEED on the design thinking process. Some reasons for this is, as previously mentioned, the use of LEED in the architectural competition process is a fairly new occurrence. So this phenomenon may become more pronounced as the use of LEED for addressing environmental sustainability becomes even more prevalent.

There are already authors, such as Fox (2000b), Guy and Farmer (2000) or Guy and Moore (2005a), who have adopted a critical thinking perspective of instrumental tools for environmental sustainability in a context of architectural design from a variety of perspectives. Some of these authors have begun to develop analytical frameworks to accommodate the varying logics inherent in architectural design practice specifically in a context of sustainable architectural design practice.

There is also ongoing research work conducted at *Laboratoire d'études d'architecture potentielle* (L.E.A.P) in the School of Architecture of the Faculty of Environmental Design at the Université de Montréal, on architectural judgment and competitions from a theoretical, critical and philosophical perspective. This thesis work is directly related to the work conducted at the L.E.A.P on architectural judgment since the difficulties and observations highlighted in this thesis can benefit the research on architectural judgment, similarly, as the work in this lab has enriched the reflection for this thesis. In addition, the corpus of architectural competitions is common.

Future Research Opportunities

In this section, the opportunities for future research based on this thesis will be presented. However, it is important to begin with identifying the limits of this thesis, as the limits become a fertile ground for future research.

Limits of Current Research

The most important research limit for this thesis was the fact that only competition documents (descriptive text and panels of proposals and jury reports) were studied. In this research, there were no participatory observations conducted within the jury deliberation process or interviews conducted with any of the finalist teams or jury members. As mentioned in Chapter 4, the competition organizer, who was the same for the three studied competitions, did not grant permission to participate in the jury deliberations or conduct interviews with any member of the jury for the three competitions. Her justification was that the projects are important and sensitive for the cities and that the information exchanged during the jury deliberation is reflected in the jury report and therefore there is enough information necessary to explain the way in which the judgment took place. Although, she said this, it is known that the text (jury report or descriptive design texts) cannot say everything. Participation in the jury deliberation or interviews with the jurors or designers could have enlightened some assumptions that came out of the reading and re-reading of the text documents.

This limitation in the methodology resulted in the fact that, as the text does not say everything; some information was missing in order to obtain a clear understanding of the jury deliberation process or the conceptualization process. For example, it is well known that the jury report is only a summary of the main points that came up during jury deliberation. The subtleties, the interactions between jurors, the form of argumentation, etc., are not known and of which are important data to help further enrich the theoretical model.

A second limitation of the methodology was that there were only three competitions studied. It is for this reason that no generalizations can be made. However, instead of generalizations, the observations made can be used to develop future hypotheses for future research opportunities.

FUTURE OPPORTUNITIES

The results of this research, is revelatory of the emerging problematic regarding design thinking and the use of standard environmental sustainability tools. It can be further enriched through several venues.

From a methodological perspective, by conducting interviews with architects and jury members, as well as participating in the jury deliberation process, a clearer understanding of the way in which tools like LEED were considered is possible. This would imply that the text analysis of the documents available in a competition process (jury reports, descriptive texts, etc.) would be confronted with data collected from interviews and observations of jury deliberations, allowing a reconstruction of the historical events of the competition process. This would also help clarify any assumptions. In addition to this opportunity, the argumentative logic constituting the justifying text and discourses of each of the actors can also be enriched by analysing the socio-cultural-political environment of the competition. The dialogue would be studied in terms of a Habermasian vision of the ideal speech situation. Here the dialogue may reveal with greater depth the oscillations that are manifest in the discourse regarding technical rationality and reflection-in-action.

In addition, during the course of this research, several areas were revealed as significant future opportunities. First, regarding the dimension of sustainability in the brief, the question that arises is: Could a more global and systemic description of sustainability in the brief reduce the ambiguity and contention (tensions) in jury deliberations regarding the sustainability dimension as well as the divergences in the definition of sustainability adopted by each of the finalist teams? If yes, in which ways? Another area of research would be to understand whether the constitution of the jury regarding LEED experts would have any impact on the deliberation jury process. Specifically, how the constitution of a jury may help to reduce tensions further, if at all. This is an important future research question since for both competitions that had a split vote – Saint-Laurent Library and the Montreal Planetarium – leading LEED experts were members of the jury. Did their presence add to the richness of the deliberation or did it move the focus to the technical parameters of LEED? Since this research only studied the text documents resulting from the competition and did not conduct any participatory observations of jury deliberations, this question could not be answered. However, it remains an important inquiry regarding jury constitution.

Another research opportunity that is suggested is the study of not only the tensions, as were studied in this research, but the controversies that arise in the jury deliberation process. In addition, controversies can be studied in a context of architectural competitions, where controversies are defined not as conflicts within discourse, but more specifically the negotiation of the urban space of the architectural project among the actors of the architectural competitions. Here, the actors are not only stakeholders of the competition, but actors in a more general context of the competition, both human and non-human. This would allow a much more global understanding of this emerging problematic. This research would be based on Bruno Latour's definition of the social (Latour, 2005).

Finally, the tensions studied in this research could be further elaborated by studying them not only for the judgment process, but also for the whole competition process. Consequently, in this enlarged focus, these tensions would be therefore studied not only from the perspective of their argumentative logic, but from the perspective of the socio-political and cultural climate of the competition. Therefore, the socio-political and cultural underlying canvas of the application of these norms within the practice of competitions could be a future focus of study.

There is already ongoing research at the laboratory called the *Socio-Spatial Complexity Research Axe* of the *Human Geography Research Group* at the Geosciences Department of the Faculty of Sciences at the University of Fribourg, where they conduct research on architectural competitions from a human-geography perspective. Their approach to studying architectural competitions is from a larger socio-political perspective. This new perspective would allow a further analysis of the interrelationships of the diverse phenomena (client criteria, community involvement, social and political dynamics, facilitation process, jury interpretation, etc) of a competition process (Van Wezemael, forthcoming 2011; Van Wezemael *et al.*, forthcoming 2011; Van Wezemael, 2010). This would therefore allow testing a higher level of complexity with regards to the theoretical model developed in this thesis.

In each of these future areas of research, the empirical situation remains the architectural competition, as it presents a fertile area of exploration regarding the design thinking process, both from the process of conceptualization as well as judgment. In this way, the impact of tools such as LEED on the design thinking process may be understood in a more comprehensive manner and the theoretical model based on the precautionary principle can be further enriched, thereby allowing for the possibility of more generalized recommendations.

There are also future research opportunities that move beyond the study of architectural competitions, as the theoretical model developed in this research can be confronted with other fields of design and for other design situations adopting collective forms of judgment for design projects for sustainability. In this broader perspective the intent would be to further enrich the model by seeking to elaborate other tensions that contribute to the epistemological gap between problem-solving and problem-setting in a context of design for sustainability.

Closing Remarks

The most serious problem with preventive approaches to risk assessment for design for sustainability is that prevention is based on a technical rationality, whereas design thinking, in its essence is based in reflection-in-action. The challenge in this research was to bridge the gap between these two worldviews so that design is not reduced to an aggregation of indicators of sustainability but instead, by adopting a critical approach to such evaluative methods, these types of risk assessment methods can then nourish, but not define the judgment process of architectural competitions. In this same thought, design thinking in a context of sustainability is therefore not driven by a linear, predetermined sequential process, but rather by a recursive process in function of a vision (set of intentions) and a project.

What is being proposed in this research is that precaution complements prevention for design for sustainability since prevention on its own evacuates critical and reflective thinking from design thinking. In this duality, there exists on the one end, an optimization approach for design based on a paradigm of optimization and efficiency, and on the other end, the search for a satisfactory solution using reflective and critical thinking. As was presented in Chapter 4, reflective thinking comprises, among others, but in particular for this study, four elements: interpretive comparability, the awareness of epistemological uncertainty in projects, the need for contextual relevance of projects, and the use of analogical conceptualization. This reflective mode of thinking is in tension with respectively, analytical comparability, the importance of methodological[144] uncertainty of knowledge, universal approaches to projects, and logical conceptualization. These tensions identified in Chapter 4 and discussed in Chapter 5 are one part of what comprises the epistemological barrier for design thinking for sustainability.

The reason why the precautionary principle came to the fore during the surfacing of the environmental crisis is the awareness that optimization approaches are not only limiting but may push projects on the wrong road if the recommendations of tools do not undergo a critical thinking process. This is what precaution offers. In design, this is referred to as reflection-in-action as defined by Schön (1983).

Precaution requires a global and systemic vision, where optimization approaches but one part of a larger view of the project, and where this project can be seen as a system. The main reason for adopting a systems vision is so the impacts or risks are not shifted from one dimension of the project to another, but instead the interrelationships of the many

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144 Methodological uncertainty refers to either data or method inadequacy and therefore the uncertainty is calculated statistically (Mayumi & Giampietro, 2006; Dupuy & Grinbaum, 2005; Tallacchini, 2005; Funtowicz & Ravetz, 1994).

dimensions of a project are explored and articulated through systemic conceptualization and through a reflective approach regarding the integration of technical parameters. Since this integration of the many dimensions of a project may require a variety of professions or experts, this articulation and exploration is ideally done through a fair and un-coercive dialogue.

This is why the competition format is a fertile form for a precautionary approach for design thinking for sustainability, because of the potential of ideas for projects through the submitted proposals, because of the collective nature of the judgment process and critique and because of the requirement of an open and transparent process.

So, one of the most important aspects of using this principle is its catalytic capacity for generating alternative views, visions, and ultimately solutions. The focus is on the 'what can be' and not only on the 'what is' (Simon, 1996b; Schön, 1983), as is done using traditional methods of evaluation. What this implies is that a constraining approach must go hand in hand with a constructive one, where precaution becomes a catalyst for innovation. Therefore, this research contributes to the knowledge for design thinking for sustainability, as it proposes a theoretical model that can help better understand the difficulties revealed when adopting preventive tools for design for sustainability based on a reflection of the precautionary principle.

Appendix 1 - Wellbeing According to Max-Neef

According to Max-Neef (1991, p.18), human needs are "few, finite, and classifiable", as distinct from the conventional notion of wants that are infinite and insatiable. He also claims that human needs are common across all human cultures and span historical time periods. The only dimension that changes across different cultures and times is the way in which these needs are satisfied (Max-Neef, 1991). This will vary across cultures and is the main reason why there is such diversity among cultures. Table 59 presents his classification of fundamental human needs.

Max-Neef classified nine fundamental human needs based on axiology (values) where their satisfiers are specified according to existential categories (being, doing, having and interacting). He organizes the basic human needs as: (1) subsistence; (2) protection; (3) affection; (4) understanding; (5) participation; (6) recreation (in the sense of leisure, time to reflect, or idleness); (7) creation; (8) identity; and (9) freedom (1991). He claims that the nine categories must be satisfied in order to achieve human well-being. When one of the needs is not met, then this indicates a sense of 'poverty' for an individual.

Individual needs satisfied by individual consumption acts are of little importance; it is the system of needs affected by a minimum amount of satisfiers that is of relevance to this characterization of human needs. He claims these needs are interrelated and behave as a system; each of the values and their existential categorizations represent a complex web defining human well-being (Max-Neef, 1991). This means that when one need is affected one or more other needs may likely be affected. Max-Neef (1991) refers to these as trans-disciplinary since the needs, which are based on values, require existential categorizations to help define the satisfiers, and in turn the satisfiers refer to various disciplines for their identification.

TABLE 59: CLASSIFICATION OF FUNDAMENTAL HUMAN NEEDS WITH EXAMPLES OF THEIR SATISFIERS (MAX-NEEF, 1991).

Existential Categories / Axiological Categories	Being (qualities)	Having (things)	Doing (actions)	Interacting (settings)
subsistence	physical and mental health	food, shelter work	feed, clothe, rest, work	living environment, social setting
protection	care, adaptability autonomy	social security, health systems, work	co-operate, plan, take care of, help	social environment, dwelling
affection	respect, sense of humour, generosity, sensuality	friendships, family, relationships with nature	share, take care of, make love, express emotions	privacy, intimate spaces of togetherness
understanding	critical capacity, curiosity, intuition	literature, teachers, policies educational	analyse, study,meditate investigate,	schools, families universities, communities,
participation	receptiveness, dedication, sense of humour	responsibilities, duties, work, rights	cooperate, dissent, express opinion	associations, parties, churches, neighbourhoods
leisure	imagination, tranquillity spontaneity	games, parties, peace of mind	day-dream, remember, relax, have fun	landscapes, intimate spaces, places to be alone
creation	imagination, boldness, inventiveness, curiosity	abilities, skills, work, techniques	invent, build, design, work, compose, interpret	spaces for expression, workshops, audiences
identity	sense of belonging, self-esteem, consistency	language, religions, work, customs, values, norms	get to know oneself, grow, commit oneself	places one belongs to, everyday settings
freedom	autonomy, passion, self-esteem, open-mindedness	equal rights	dissent, choose, run risks, develop awareness	anywhere

For example, food and shelter are not considered as needs according to Max-Neef, but as satisfiers for the basic need of subsistence. Some satisfiers may satisfy several needs. For example, bottled milk may satisfy the need of subsistence for a baby, whereas breast-milk will simultaneously satisfy the needs of subsistence, protection, affection, understanding, participation, recreation, identity and freedom. This model is radically different from the model used by traditional economics. In traditional economics, needs are dealt with individually, without being conscious of the fact some types of satisfiers can actually be violators of other needs; for example, formal democracy, which is supposed to meet the need for participation often dis-empowers and alienates; the arms race, while satisfying the need for protection, in fact destroys the basic needs of subsistence, participation, affection and freedom (Max-Neef, 1991).

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