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The Influence of Sustainability in Project Management Practices in the Building Sector

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RÉSUMÉ

La durabilité est un objectif adopté de manière croissante (et un concept globalement accepté) qui affecte - et réciproquement qui est affecté par - le processus de réalisation du projet de construction. Étant donné que le secteur du bâtiment se voit de plus en plus forcé d'adopter la durabilité dans les processus organisationnels, les chercheurs du domaine ont apporté des connaissances pour améliorer la performance de bâtiments dits « verts », en mettant l'accent souvent sur les technologies, les matériaux et les outils de gestion de l'environnement. Les praticiens se sont généralement concentrés sur l'augmentation de l'efficacité, de manière globale considérée comme une réduction de l'utilisation de l'eau, de l'énergie et d'autres ressources. Cependant, on constate que les connaissances demeurent encore insuffisantes existent encore sur les processus requis dans la mise en œuvre des principes de la durabilité elle-même. Ainsi, cette thèse vise à créer une compréhension détaillée de la manière dont les pratiques liées à la durabilité influencent la gestion du projet et les processus organisationnels dans les projets de construction.

La recherche repose sur cinq études de cas de projets de construction récents situés à Montréal qui ont adopté des principes de durabilité. Les données comprennent 14 entretiens avec des experts en durabilité, gestion de projet et construction, ainsi que 24 entretiens avec des professionnels impliqués dans les cinq projets sélectionnés. Plus de 200 documents liés aux projets, des communiqués de presse, et des documents des politiques organisationnelles du donneur d'ouvrage ont été étudiés, et comparés aux informations obtenues à partir des entrevues et des observations sur le terrain. Les données ont été analysées à l'aide d'une série de diagrammes et de techniques de cartographie visant à révéler l'évolution de la structure de la Multi-Organisation Temporaire (MOT) et des pratiques de durabilité dans les études de cas.

Les résultats révèlent que la durabilité facilite le processus d'alignement entre la gestion du projet et la stratégie de l'organisation. Ils montrent également que l'adoption des certifications « vertes » dans les projets de construction génère souvent une série de tensions qui influencent les processus et les pratiques de gestion de projet. De plus, l'étude révèle que les parties prenantes adoptent une multiplicité d'approches à la durabilité, et que ces approches changent au cours des différentes étapes du projet, générant alors des tensions supplémentaires entre les parties prenantes.

Cette recherche suggère que, pour adopter des pratiques de durabilité dans le secteur de la construction, il est urgent de passer des approches linéaires, normatives et axées sur les produits à une approche plus holistique, ouverte et centrée sur les processus. Contrairement à la conviction commune, les résultats montrent que la durabilité n'est pas une approche homogène appliquée aux projets de construction et que la diversité d'approches génère un impact significatif sur la performance du projet. Il est donc nécessaire de bien comprendre les différentes approches des parties prenantes ainsi que leurs évolutions dans les phases du projet. D'un point de vue pratique, les résultats de cette étude peuvent être mobilisés par les gestionnaires de projet pour éviter les conflits entre les parties prenantes, pour réduire les tensions entre les approches managériales, pour faciliter l'innovation et la collaboration, ainsi que pour transformer les tensions en opportunités d'amélioration de la qualité des projets.

Mots-clés: Gestion de projet, gestion stratégique, durabilité, bâtiments durables, pratiques de durabilité, projets de construction, gestion des parties prenantes, collaboration, innovation.

ABSTRACT

Sustainability is an increasingly adopted objective (and an overarching concept) that affects, and is affected by, every aspect of the construction project process. As the building sector is increasingly forced to adopt sustainability in organizational processes, researchers within the field have provided knowledge to improve "green" building performance, focusing on technologies, materials, and environmental management tools. Practitioners have usually focused on increasing efficiency, typically seen as reductions in the use of energy, water and other resources. However, insufficient knowledge still exists about the processes required in the effective implementation of sustainability principles. This dissertation seeks to create a comprehensive understanding of how sustainability principles influence project management and organizational processes in building projects.

The research is based on five case studies of recent Montreal located building projects that have implemented sustainability principles. First-hand data included 14 Interviews with experts in sustainability, project management, and construction, as well as 24 interviews with professionals involved in the five projects. More than 200 project documents, press releases, and policy documents from the client organizations were studied and compared with the information obtained from the interviews and observations. The data was analyzed through a series of diagrams and mapping techniques that aimed at revealing the evolution of both the structure of the temporary multi-organization (TMO) and the sustainability practices within the case studies.

Findings reveal that sustainability enables the alignment process between project management and business strategy. They also show that the implementation of "green" certifications in building projects often generates a series of tensions that influence project management processes and practices. Moreover, the study reveals that stakeholders adopt a multiplicity of sustainability approaches and that these approaches change during different stages of the project, generating additional tensions between stakeholders.

The investigation suggests that in order to adopt sustainability practices in the building sector there is an urgent need to shift from linear, regulatory, and product-centred approaches to a more holistic, open, and process-centred approach. Contrary to common belief, results show that sustainability is not a homogeneous approach applied to building projects and that the diversity of approaches has a significant impact on project performance. There is, therefore, a need to fully understand different stakeholder approaches as well as their evolution in the project phases. From a practical point of view, results from this study can be used by project managers to avoid conflicts between stakeholders, reduce tensions between managerial approaches, facilitate innovation and collaboration, and transform tensions into opportunities for project quality enhancement.

Keywords: Project Management, Strategic Management, Sustainability, Sustainable Buildings, Sustainability Practices, Construction Projects, Stakeholder Management, Collaboration, Innovation.

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LIST OF ACRONYMS

AEC: Architecture, Engineering, and Construction Industry

APUC: Advanced Procurement for Universities and Colleges

BMO: Building Management Office

BREAM: Building Research Establishment Environmental Assessment Methodology

CASBEE: Comprehensive Assessment System for Built Environment Efficiency

CIB: The International Council for Building

DGNB: German Sustainable Building Council

DIKW: Data Information Knowledge Wisdom

EMS: Environmental Management Systems

GB: Green Building

GBCs: Green Building Certifications

HQE: Haute Qualité Environnementale

LEED: Leadership in Energy and Environmental Design

LEnSE: European Label for Environmental, Social and Economic Buildings

NGO: Non-Government Organizations

OCPM: Office de Consultation Publique de Montréal

PMBOOK: Project Management Body of Knowledge

PMI: Project Management Institute

SD: Sustainable Development

SME: Small and Medium Enterprises

TMO: Temporary Multi-Organization

UdeM: Université de Montréal

UNEP: United Nations Environment Programme

USGBC: United States Green Building Council

DEDICATION

A Yenny, mi amor y permanente inspiración

A Rafael y Pablo, mi motivación

A Dios, mi fuente

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1. INTRODUCTION

1.1. Research problem

The building sector has a significant impact on almost every aspect of the environment, economies, and societies. Effectively, the construction industry contributes to up 30% of the global annual greenhouse gas emissions, consumes up to 40% of all the energy (UNEP, 2009), and is responsible for approximately 40% of all human-produced waste (Hoornweg & Bhada-Tata, 2012). These cumulative short-range impacts result in more significant long-range impacts and their consequences will only become fully evident in the upcoming generations (P. Brandon & Lombardi, 2005). Thus, the adoption of innovations for improving the sustainability of building projects has become necessary (Darko & Chan, 2016). There is an increasing need to understand which dynamics and mechanisms are required to transform the built environment to make it more sustainable. However, several organizations, including the World Economic Forum (2016), have argued that the construction industry has been slower to adopt innovations and adapt to new technologies than other global sectors. Academics also argue that the building sector is particularly slow in moving towards sustainability (Berardi, 2013b) and have underlined the importance of identifying the barriers that delay the adoption of sustainability in this sector (Choi, 2009; Lam et al., 2009; Richardson & Lynes, 2007; K. Williams & Dair, 2007; Wilson & Rezgui, 2013).

This slow implementation of sustainability has been attributed to the specific structure of the construction industry and its managerial environment (Häkkinen & Belloni, 2011). Actually, building projects are developed in exposed contexts and executed by coalitions of heterogeneous organizations, grouped in temporary forms of cooperation and working constellations (Pauget & Wald, 2013) called "*Temporary Multi-Organizations, TMO*" by Cherns and Bryant (1984). However, additional challenges have also been identified.

Challenges to implementing sustainability

Darko and Chan (2016) identify and analyze 37 obstacles that hinder the adoption of sustainability in the building sector (see Annex II). Following a systematic review, their study focuses on five of the most important barriers: lack of information, cost, lack of incentives/support, lack of interest and demand, and lack of "green" building codes and regulations. Table 1 summarizes these barriers, their origins, implications and suggestions for overcoming the barriers. In general, the authors conclude that to overcome the barriers, a strong communicative and collaborative system between policy makers, industry, contractors, and developers is needed. The table is arranged according to the number of times (in parenthesis) that barriers are reported in the 36 articles analyzed in the study.

Table 1. Barriers affecting sustainability implementation, based on Darko and Chan (2016) with additional information by the author.

Barrier	Authors	Origins	Requirements	Suggestions
Lack of information (35)	(Potbhare et al., 2009) (Li et al., 2014)	Insufficient Green Building (GB) research and education	Better information on GB cost and benefits, management of green processes	Research and Development; dissemination on management implications
Cost (33)	(Shi et al., 2013) (Lam et al., 2009) (Kats et al., 2003)	Stakeholders are unaware of how to improve their market competitiveness and financial advantages	Research on lifecycle approach for assessing the cost and impact of GB	Change perception of extra costs by the analysis of the lifecycle performance and benefits; Increase the market competitiveness
Lack of incentives/ support (21)	(Olubunmi et al., 2016) (Choi, 2009)	Lack of effective and encouraging financial and non-financial incentive policies	Government policies. Stakeholder compensations	Government external financial and non-financial incentives. Stakeholders internal incentives
Lack of interest and demand (17)	(Hwang & Tan, 2012) (Geng et al., 2012)	Inexperience and lack of knowledge in GB certification	Research and Information	Educate the public and clients to create high market demand
Lack of clear codes regulations (14)	(Qian, 2010) (Luthra et al., 2015)	Unclear national public policies	Government policies	Government should create clear national public policy packages

Other scholars and practitioners have relied on the so-called Iron Triangle (cost, time, and quality) of project management (R. Atkinson, 1999) to classify these barriers. For example, based on a study of project stakeholders, Lam et al. (2009) identified that the three main barriers against "green" specifications are "additional cost," "additional delays," and "limited availability of reliable suppliers". For more than 20 years, Ofori (1992) has demanded the recognition of sustainability as the fourth objective of the iron triangle. Similarly, Choi (2009) finds significant barriers to implementing sustainability in the lack of reliable information about performance, cost, and benefits, but also in the misconceptions and uncertainty about sustainable development and the lack of expertise and resources for sustainable construction.

Although prior contributions indicate that the "triangle" factors can play an important role in identify these barriers (Ofori & Kien, 2004), other researchers have focused on understanding the organizational and managerial difficulties that entail the adoption of new practices. Support for this approach can be found in Wu and Low (2010), who state that project management in sustainable construction must focus more on processes such as stakeholder management, organizational structuring and commissioning and less on the implementation of new technologies.

Therefore, sustainability implementation in the building sector is not hindered by a lack of technologies and assessment methods, but it is instead affected by organizational and procedural difficulties entailed by the adoption of new methods (Häkkinen & Belloni, 2011). Innovative implementations are often meet resisted because they require process changes entailing risks and unforeseen costs. These limitations can be reduced by understanding the relationships between organizational levels (strategic and tactical), networking needs (collaboration and innovation processes), and the actor's roles in project phases (and their sustainability approaches).

Areas to improve sustainability implementation (theoretical perspective)

It is necessary to fully understand organizational processes to achieve sustainability implementation in the building sector. This dissertation will empirically demonstrate that three key factors permit to understand the effective adoption of sustainability in the building sector. Before analyzing the empirical evidence of this argument, let us to explore here its conceptual (theoretical) bases.

The first factor concerns the alignment between corporate strategies and the project management approach that characterizes the construction industry (Chinowsky & Meredith, 2000; P. W. G. Morris, 1994); second, collaboration and innovation processes in inter-firm relationships (Albino & Berardi, 2012); and third, the differences between stakeholders when sustainability approaches are applied (Hopwood et al., 2005). Table 2 summarizes these key factors and related concepts.

Table 2. Key factors to understand sustainability influence in the building sector

Key Factors	Organizational alignment	Collaboration and organizational processes	Stakeholder sustainability approaches
Main Authors	Chinowsky and Meredith (2000) Artto, Kujala, et al. (2008)	Albino and Berardi (2012) Darko and Chan (2016)	Hopwood et al. (2005) Pernilla Gluch (2009)
Main Related Concepts	Gaps between Project and Strategic Management	Collective Processes and Decision-Making	Tensions between sustainable implementation and project practice

The first key factor in understand the challenges related to sustainability implementation is organizational alignment. Project management is often quoted as an essential tool for organizational alignment, but there are still gaps in the literature on how this process happens (P. Morris & Jamieson, 2005). Project management is generally considered as a linear, rational, and analytical approach that, like other traditional planning methods, is focused on a goal-based framework (Cicmil et al., 2006; Kerzner, 2009). In spite of sustained evolution in project management research, the project failure rate remains unacceptably high (Ingason & Shepherd, 2014). It is often argued that practitioners still apply the Iron Triangle criteria to

projects, disregarding the new challenges imposed by their complex and uncertain environment (Curlee & Gordon, 2010; Winter et al., 2006). Unfortunately, due of the excessive focus on project management requirements organizations in the building sector give considerably little attention to strategic management requirements (Chinowsky & Meredith, 2000), including long-term sustainability implementation. Therefore, project management methods requirements are rarely aligned with corporate strategies (Artto, Kujala, et al., 2008). At the strategic level, projects are required to deliver additional corporate, economic, and societal value; but this is only possible through the alignment between project objectives and tools and the organization's strategy (Dietrich & Lehtonen, 2005). In response, Bagheri and Hjorth (2007) have theoretically established that shifting from a '*what*' to a '*how*' framework is essential in that the most important product in planning is the process itself and that a process-based, multi-scale, approach guided by long-term vision is required. Few empirical research projects, however, have investigated how sustainability affects organizational alignment and project performance.

The second factor to be analyzed is the collaboration and organizational processes. It is widely accepted that in order to overcome the complexity and fragmented nature of the building sector, construction organizations need to work collaboratively (Loosemore et al., 2003). In fact, understanding how people work together plays an important role in complex projects with high levels of uncertainty. Most of the literature, however, has focused on the use of tools and techniques (Smyth & Pryke, 2008), along with technological solutions and knowledge management systems. Shelbourn et al. (2007), on the other hand, recognize that effective collaboration requires a balance between organizational and people needs and opportunities and the use of information technology systems adopted within strategically managed approaches. Based on the analysis of collaboration in organization coalitions, Stokols et al. (2008) find five characteristics that can facilitate or constrain the effectiveness of collaboration processes: i) Identification of common goals and outcomes, ii) Distribution of power and control, iii) History of collaboration, iv) Leadership and member characteristics, and v) Organizational support. Similarly, in the field of management, some authors suggest that sustainability has increased

collaboration between and within internal and external stakeholders (Kiron et al., 2012; Wu & Low, 2010). More specifically in the construction industry, where the implementation of sustainability has encouraged the use of certification systems (Albino & Berardi, 2012), collaboration practices have (at least in theory) an important influence on organizational processes and need to be recognized and reinforced (Bagheri & Hjorth, 2007). Following this approach, Ofori-Boadu et al. (2012) have argued that early collaboration is essential for the success of green certified building projects. Nevertheless, few studies have empirically analyzed and demonstrated with hard evidence how sustainability influences collaboration processes (Darko & Chan, 2016).

The third factor concerns the differences between stakeholder sustainability approaches and their influence on how stakeholders interact. Admittedly, the concept of stakeholder management (Freeman, 1984; Mitchell et al., 1997) is central to project sustainability. In fact, recent stakeholder theory increasingly considers a sustainable development perspective (Eskerod & Huemann, 2013). However, in terms of collaboration, not everyone agrees on what sustainable actually means (C. C. Williams & Millington, 2004). For example, most stakeholders accept that environmentally responsible collaboration includes reducing negative, and generating positive, environmental impacts (Wassmer et al., 2012), but whose, who or when impacts will be reduced is not clear and differs significantly. In response, Hopwood et al. (2005) have already proposed a mapping technique to identify and examine different approaches to sustainability. Arguably, different world-views, communication approaches as well as perceptions about the environment potentially create tensions between sustainable implementation and project practice (Pernilla Gluch, 2009). In fact, projects frequently fail due to "*unarticulated – and thus unresolved – tensions and/or trade-offs among the project stakeholders*" (Loch & Kavadias, 2011, p. 225). Despite these theoretically established differences, very few empirically grounded studies have paid attention to sustainability stakeholder approaches in the building sector.

In sum, a primary theoretical perspective based on three key factors can be established to closely examine the relationships between the concept of sustainability and its influence over organizations that develop building projects. However, this theoretical proposition needs to be empirically tested and validated with real-life evidence. This dissertation aims at achieving this objective.

It is crutial here to clarify the differences between the terms "sustainability" and "sustainable development". Jeronen (2013) considers sustainability as a long-term goal and sustainable development as the process to achieve it. Robinson (2004) focuses instead on stakeholder differences to draw this distinction. He argues that NGOs and academics often consider "development" as synonymous with "growth," and, therefore, sustainable development implies some form of economic growth. Similarly, Waas et al. (2011), observe that whereas sustainable development focuses on development/economic growth, sustainability focuses on environmental protection. This research concurs with Jeronen (2013) and uses the term "sustainability" which stands for the "goal" of achieving environmental, social, and economic objectives, considering their relationships in the short-, medium-, and long-terms, whereas sustainable development refers to a specific "process" meant to achieve them. The term "green" (green buildings or processes, for instance) will be used to differentiate widespread marketing terminology applied to buildings, certifications teams or projects, from other sustainability-related processes that include additional social and cultural dimensions. Therefore, the main differences between "sustainable" and "green" buildings are the economic and social requirements that typically only apply to sustainable buildings (Berardi, 2013a). It is worth mentioning, that in this research "sustainability principles" in general correspond to high level ideas and include a high moral ground and are stated with a high level of abstraction (Shrivastava & Berger, 2010). They are designed to apply broadly to many different organizational situations.

A more detailed explanation will be found in section 4.3.2.

It should be noted that Publication I does not take into account the differences considered here because it was developed before the discussion was raised.

1.2. Research objective and questions

The main objective of this dissertation is to increase the understanding of the influence of sustainability principles in the organizational and project management processes in building projects. The purpose is to provide new theoretical and empirical insight into building sector organizations and project processes through the study of the implementation of sustainability and its influence on project management. In order to do so, bodies of knowledge in management, the built environment, and sustainable development are adopted. The study examines and explains how organizational processes adopt different mechanisms, tools, and techniques of sustainability in building projects.

The object of this analysis is approached from three central perspectives. The first perspective focuses on the convergence of the field of management and the built environment, particularly project and strategic management. The objective here is the understanding of how sustainability principles contribute to the alignment of projects and corporate strategy. The findings of this inquiry are developed in section 4.1 (Publication I). The second perspective concentrates in the interaction between the built environment and the field of sustainable development field. More specifically, this approach pays attention to the effects of "green" certifications in project stakeholder collaboration and innovation processes. The results of this analysis are presented in section 4.2 (Publication II). The third perspective challenges the overlap of the management field and the paradigm of sustainable development. In fact, having revealed the complexity of project stakeholders, the research permits to appreciate the main differences that exist in the understanding of sustainability. Based on the stakeholder management approach, the findings identify a series of tensions that emerge within sustainable construction projects. Findings of this perspective are presented in section 4.3 (Publication III). Finally, a cross-analysis of these three perspectives is developed in the discussion and conclusions presented in Chapter 4.4. Figure 1 illustrates interactions in the research scope of the three separate publications and perspectives, which become the analytical framework of the study.
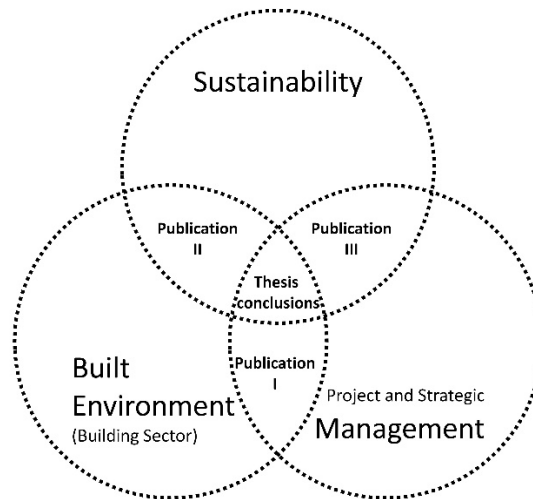
Figure 1. Individual publications and their relations with the analytical framework

The main research question (RQ) is: How does the adoption of sustainability principles influence the project management processes in construction projects? The expected research outcome is the creation of new knowledge that can be used to effectively implement sustainability principles in construction projects, eventually reducing their negative impacts on the environment and increasing their positive effects on society. Underlying the overall research question is the search for a better understanding of the existing and potential linkages between approaches to sustainability principles, and tools and management practices and organizational processes. The premise is that these linkages can (and should be) 'translated' into organisatioonal approaches and corporate practices.

To respond to the main research question (RQ), this research seeks answers regarding: (RQ-1) The role of sustainability principles and practices in the relationship between project management and strategic management (Publication I); (RQ-2) How common challenges and gaps in sustainability can be overcome through improved stakeholder management, collaboration and innovation (Publication II); and (RQ-3) How divergences among stakeholders' approach to sustainability influence construction projects (Publication III). The three research questions are interconnected in the sense that their respective contents, investigations and expected outcomes build upon each other. Figure 2 provides an overview of the specific research questions 1, 2, and 3 and their location in the analytical framework.
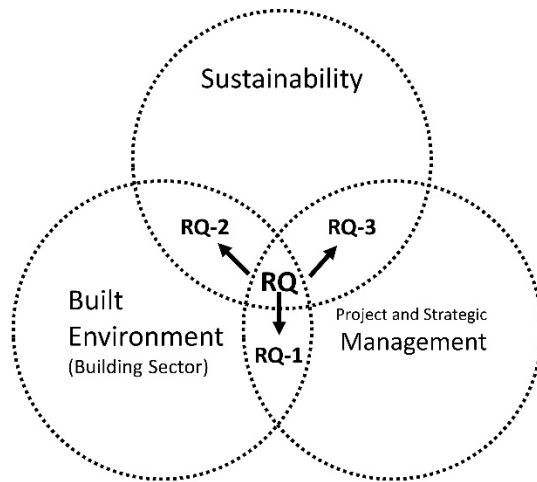
Figure 2. Overview of specific research questions

RQ-1. How does sustainability principles contribute to aligning the longer-term strategic management of clients in the building sector with their short-term needs for construction project management? Publication I offers a new perspective of sustainability principles, illustrating it as an approach that can fill the frequent gaps between strategic planning and tactical management in construction client organizations. Additionally, the article reveals that the pressure for achieving performance in the project management triangle (time, cost, and quality) hinders strong links with the organization's strategy - all at the expense of the performance of the project itself. Sustainability instead helps to reduce four major challenges in the construction sector: the fragmentation of the sector, the project complexity, the environment complexity and the size of the diverse companies involved.

RQ-2. How do "green" building certifications influence building project processes, particularly collaboration and innovation? Publication II reveals that innovation and collaboration processes are positively influenced by the integration of sustainability practices in construction projects. This influence is due, among others, to the link between the strategic and tactical levels. Research results are useful for project stakeholders because they show the importance of reinforcing these processes, in particular, knowledge management.

RQ-3. How do differences between stakeholders' approaches to sustainability affect building projects? Publication III examines the project stakeholders' approaches to sustainability, and their differences, and analyzes both their theoretical and practical implications. The study dwells and builds on stakeholder analysis and the mapping of the evolution of sustainability approaches. Results include a method for mapping the dynamic character of sustainability approaches that can help clients, project managers, and design professionals anticipate possible tensions and make informed choices.

1.3. Scope of the study

The dissertation is explorative, in the sense that it focuses on describing and explaining both organizational processes and project stakeholder characteristics and activities, describing what is actually happening. This research shows trends, and does not generate guides or tools. It focuses more on people than on plans, policies, or regulations. Figure 3 provides a schematic view of project processes and their context.
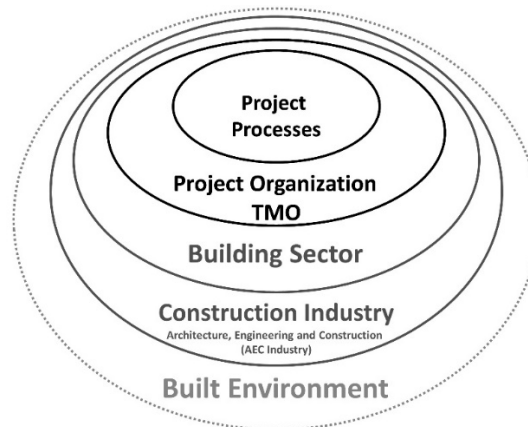
Figure 3. Building projects and their context

The broader concept presented here is the Built Environment. For analytical and practical reasons, this dissertation limits the term "built environment" to all buildings and living spaces that are created, or modified, by people, including the infrastructure systems put in place to serve it (Sarkis et al., 2012). The Construction Industry includes buildings, infrastructure, and industrial projects. According to Halpin (2006),

the building sector includes facilities built for housing, institutional, educational, light industrial, commercial, social, and recreational purposes. Additionally, there are categories drawn in terms of service firms: Architecture, Engineering, and Construction AEC (Pernilla Gluch & Bosch-Sijtsema, 2016). At another level, the client determines the roles and responsibilities of all participants. The result of this team in the project organization is called by Cherns and Bryant (1984) the Temporary Multi Organization (TMO). A more detail explanation of TMO can be found in section 2.1.1.

1.4. Structure of the dissertation

The dissertation is organized into six chapters plus three included papers. The first chapter introduces the research problem and presents the objectives, questions, and structure of the dissertation. The second chapter explores the connections that are required in various areas of research in management, sustainability, and the building sector. The chapter starts with a reflection on the interrelated research fields and identifies the gaps within those fields of research that are not covered in the publications. The chapter includes the theoretical perspectives that have been used as exploratory and explanatory tools for understanding the management of sustainability principles in the built environment. Chapter three describes the research process and establishes the philosophical foundations and methodological choice, including the research design, methods, and tools, the analytical approach, unit of analysis, and the sampling strategy and data collection. The chapter ends with the ethical considerations that have been applied in this research. The fourth chapter presents the results in three individual publications having their own sub-objectives and specific findings. At the end of this section, two narratives are included to illustrates two specific processes that were analyzed in the Publication I and III. The fifth chapter summarizes the discussion, provides general conclusions including theoretical contributions, managerial implications, the validity and reliability of the empirical research, the limitations, and raises questions about the direction that future research could take. Finally, the last part presents the references used in this doctoral research.

2. LITERATURE REVIEW

This chapter summarises the most significant academic literature that links the general question with the three research questions developed in the publications. The purpose of this chapter is not to repeat the literature review of each publication, but to put the emphasis on the concepts and tools that help to connect the publications and fill the knowledge gaps that were not covered. Figure 4 illustrates the link between the analytical framework (interactions of three fields of knowledge) and the research results (three separate publications and conclusions).

Figure 4. Literature conceptual map and publication outputs

The relationship between sustainability, management, and built environment has been partially examined. For example, there are several articles that examine the adoption of Management in the Built Environment (Alexander, 2006; P. Brandon & Lombardi, 2005; Chynoweth, 2009). Scholars have also been interested in the relationship between Sustainable Development and management, an area of research that has been called Sustainable Management (P. S. Brandon, 1999; Petrini & Pozzebon, 2009; Porter & van der Linde, 1995). Moreover, academics have

examined how processes in the Built Environment can be developed in a more sustainable way (Bourdeau, 1999; Kibert, 1996; Myers, 2005; Ofori, 1998), focusing on different approaches such us Sustainable Design (Berardi, 2013a; Cole, 2012b; Du Plessis & Cole, 2011), and Sustainable Construction (Berardi, 2012a; Cole, 2011; Richard Fellows, 2006). However, only a few studies have simultaneously analyzed these research areas in the context of building projects.

2.1. Managing the built environment: More than a project management approach

According to Vischer (2008, p. 232) "*Since the built environment became a legitimate subject of research, theories of the built environment have tended to be oriented to process – how it is created and supplied*". Processes include planning, designing, building, managing, and occupying buildings. Among these approaches, project management in the built environment has often been considered obsolete (Koskela & Howell, 2002). According to Egan (1998), and more recently to Bryde (2008), this poor performance in management processes can be linked to: inadequate procurement methods, organizational fragmentation, lack of project team experience, poor project communication, and dysfunctional stakeholder relationships.

In response, academics like Koskela and Ballard (2006) propose to shift from an economics-based theory of project management to the theory of production (better known as "lean construction"). However, the lean construction theory has its own limitations and requires further development, particularly in areas such us processes and organizations, risk and uncertainty, and its unitary concept of value (Winch, 2006). Thus, managerial challenges have an inevitably increased in the field of built environment (Chynoweth, 2009).

Three situations are necessary to better understand the main managerial challenges in the built environment: i) the organizational fragmentation, more specifically the fragmentation nature of the temporary multi-organization of TMO, ii) the relationship between strategic management and project performance, and iii) the role of

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stakeholder management in the built environment. Figure 5 shows these interactions and the most relevant publications in each field. These alignments are covered in more detail in the following paragraphs.

Strategic Management
Chandler (1970)
Mintzberg (1978)
Porter (1996)
Nag et. al (2007)

Stakeholders

Project Management
Freeman (1984)
Mitchell (1997)
Newcombe, R. (2003)
Olander (2005)

PMBOK(1996)
Atkinson (1999)
Cleland (2002)
Winter et al. (2006)

Publication I

Betts & Ofori (1992)
Chinowsky & Byrd (2001)
Langford & Male (2001)
Price & Newson (2003)

Stringer (1967)
Cherns & Bryant (1984)
Lundin (1995)
Lizarralde (2011)

Strategy

TMO

Eagan (1998)
Walker (2002)
Pryke & Smyth (2006)
Chynoweth (2009)

Built environment

Figure 5. Relevant articles focusing on the relationship between strategic and project management in the built environment

2.1.1. The Temporary Multi-Organization (TMO)

Construction projects are a multi-organization (Cherns & Bryant, 1984), that is highly fragmented with the cultural diversity of organizations coordinated through a combination of markets, contracts, networks, and pressures (Wild, 2002). According to Stringer (1967), a multi-organization is the combination of parts of several organizations that represent their own interest around the project. De Blois and Lizarralde (2010) identify four main characteristics in multi-organizations. First, effective communication is essential for TMO to perform its task adequately. Second, relations in a TMO are conditioned by specific tasks. Third, TMO participants have other concerns different from the project and once it is completed, collaboration disappears and fourth, TMO complexity is more than the formal representation of legal frames and procurement strategies.

Based on the relationships between the four main groups of project stakeholders (users, client organization, operators, and participants), Lizarralde *et al.* (2011) classified the Temporary Multi-Organizations in six main possible configurations: classical, cooperative, user-driven, integrated, developer, and institutional (including four subcategories: user initiated, external operator-influenced, strategy-initiated, and owner occupant).

Therefore, complex temporary organizations, such as the ones that create construction projects, are different from permanent organizations, and require particular forms and mechanisms of management. Construction organizations compensate the consequences of temporality and the lack of organizational routines and organizational memory with effective and efficient networks that require developing solid collaborative relationships (Pauget & Wald, 2013). However, configurations and stakeholders' roles change through the project phases (Wild, 2002) and generate other types of Temporary Multi-Organizations that need to be reconfigured again. Figure 6 illustrates the three decision-making levels at the organizational structure (see grey rows) and how organizations (first column) assign actors to the project TMO (second column). This configuration changes along project phases.
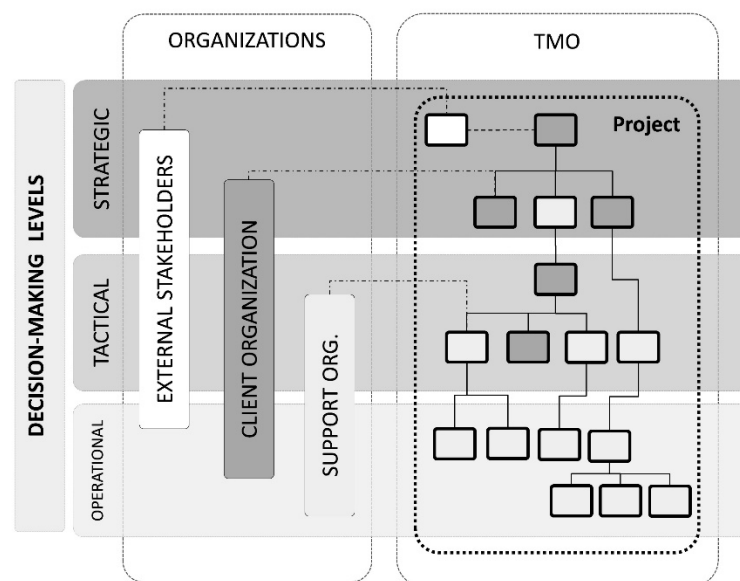
Figure 6. Integration of decision-making levels in the TMO

2.1.2. Strategic management and project performance

The construction industry works in a project-based manner (Winch, 1989). This means that it focuses on planning and within controlling resources, the framework, the budget, and the timeline of the project (Chinowsky & Meredith, 2000). Consequently, less attention is often paid to the influence of the external organizational environment and long-term planning. This practice has led the construction industry to be considered as a sector that focuses on short-term goals (Dansoh, 2005), which typically expose the construction organization to waste resources, fail financially and lose competitive advantages (Porter, 2008). Therefore, strategic management in construction organizations is a vital tool to keep these competitive (Price & Newson, 2003).

According to Johnson et al. (2008, p. 3): *"Strategy is the direction and scope of an organization over the long term, which achieves advantage in a changing environment through its configuration of resources and competences with the aim of fulfilling stakeholder expectations"*. Chinowsky and Meredith (2000) argue that understanding the strategic level of construction organizations requires the identification of seven key elements that can help top managers take the organization in a sustainable direction: i) vision, mission, and goals, ii) core competencies, iii) knowledge resources, iv) organizational learning processes, v) long-term financial goals, vi) market, and vii) competition. Moreover, for strategic management it is important that the vision is consciously generated in the project group (Naaranoja et al., 2007).

Construction organizations typically formalize strategic management in response to changes in the business environment and the increased complex project environment (Price et al., 2003). There are significant differences on how organizations adopt strategic processes, particularly between small, medium, and large constructions firms. Dansoh (2005) claims that strategic planning in small organizations is often characterized by the absence of formal plans and a management structure to support them. The formalization process, he argues, increases with the size and experience of the firm, but a top-down approach is often

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adopted in all types of organizations, regardless of their size or age. However, for Langford and Male (2001) and Bakar (2011), the ideal strategic management process is a combination of both 'bottom-up' and 'top-down' procedures.

Strategic plans in small and young construction firms often involve simple extrapolation by top management of information from recent experiences (Dansoh, 2005). In larger and more experienced construction firms, the strategic management process often involves three phases: i) the formulation phase, which seeks to include most of the variables within a plan, ii) an implementation phase, where all planned activities are realized, and iii) the evaluation and control phase, when a systematic comparison between the plan and the final result is required (Bakar, 2011).

Studies by Chinowsky and Byrd (2001) demonstrate that strategic management in construction has a positive effect in two areas. First, in the knowledge resources area, including the integration of technology to support knowledge transfer between members. Second, in the market awareness area, facilitating market opportunity identification. The same study shows, however, that two areas often need greater emphasis in strategic management processes: organizational learning or "lifelong learning", which needs to be incorporated in formal structures and mechanisms and strategic finance to focus on a strong financial plan.

To achieve a balance between a long-sighted innovation process (exploration) and a more short-sighted efficiency perspective (exploitation), there is a need for a change of attitude among both construction clients and contractors (Eriksson et al., 2013). Therefore, it is crucial to better understand the stakeholders' attitudes in a wider context than the project itself.

2.1.3. Stakeholder management

According to Newcombe (2003, p. 842), project stakeholders are "*groups or individuals who have a stake in, or expectation of, the project's performance*"; they typically include clients, project managers, designers, subcontractors, suppliers, funding bodies, users, and the community at large. Identifying stakeholders and their

interests and expectations during the different lifecycle project phases help project managers to forecast their effects on project outcomes (Manowong & Ogunlana, 2010). In the building sector, stakeholders are often classified as external and internal (Manowong & Ogunlana, 2010). Table 3 shows the frequent members of each group. Each group has different interests and objectives in the project as well as different influences on project success. As such, it is important to know their different expectations and level of attention and determine to what extent they could and would exert influence (Manowong & Ogunlana, 2010).

Table 3. Stakeholder groups according to Manowong and Ogunlana (2010)

Primary/Internal Stakeholders	Secondary/External Stakeholders
Project owner	Local and national authorities
Clients	Public, community groups
Project leader	Financier, media
Core team members	End users
Designers and contractors	Other independent concerned groups
Suppliers and subcontractors	with special interests

Stakeholders in a construction project include the owners and users of facilities, project managers, facilities managers, designers, shareholders, legal authorities, employees, subcontractors, suppliers, process and service providers, competitors, banks, insurance companies, media and press, community representatives, neighbours, the general public, government, visitors, customers, regional development agencies, pressure groups, civil society institutions, etc. (Newcombe, 2003; Smith & Love, 2004).

According to Pryke and Smyth (2006), conceptual approaches used in project management can be classified as: i) the traditional project management approach; ii) the functional management approach; iii) the information processing approach; and iv) the relationship approach. Despite the fact that these approaches include key human dimensions, Pryke and Smyth (2006) note that the relationship dynamics (from conception to project completion) are the most recent step in the evolution of the project management discipline. The authors also have found that the most recent

generation of construction project management literature emphasizes the relationship approach, which carefully considers the interactions between project stakeholders. Practice stakeholder analysis is also currently considered crucial for organizations that participate in the field of construction (Yang et al., 2011). The traditional approach assumed that stakeholders played a single role in architecture and urban planning projects. In response, multiple approaches have been developed to identify and classify them (Bourne & Walker, 2005; Mitchell et al., 1997; Pryke, 2004). It has been recently found, however, that project stakeholders not only have different levels and types of engagement but also diverse and dynamic interests and roles (Newcombe, 2003).

The construction client is an important stakeholder who starts and commissions the project. According to the International Council for Building (CIB), a construction client is a "*person or organization, who at a particular point in time has the power to initiate and commission design and construction activity with the intention of improving the performance of an organization's social or business objectives*" (CIB, 2005). This concept underpins Newcombe's (2003) argument that in most projects the client is a group of stakeholders and not just one.

Numerous authors have proposed different categories of construction clients (Blismas et al., 2004; Boyd & Chinyio, 2006; Cherns & Bryant, 1984; Chinyio et al., 1998; Newcombe, 2003; Thomson, 2011). De Blois *et al.* (2011) argue, for instance, that construction project clients can be classified: i) by sector, ii) by previous experience, iii) by size parameters, and iv) by type of project. Strategic management is not adopted in the same manner by all of them. Table 4 summarizes the types of construction project clients who are more likely to adopt a formal strategic management process.

Table 4. Construction project clients more likely to apply formal strategic management processes, adapted from de Blois et al. (2011)

Factors	Categories	Category that is most likely to adopt formal strategic management
Previous experience	Sophisticated or naïve Primary or secondary Continuing or one-off Private or public	Sophisticated Secondary Continuing Both
Sector	Private or public Individuals or corporations	Public Corporations
Size parameters	Size: small or large; Sector: public or private; Project interest: developer or owner-occupier	Large Both Owner occupier
Type of project	Experienced or inexperienced	Experienced

Important relationships have been found between stakeholder management in construction projects and: i) their impact on organization performance (Chinyio & Olomolaiye, 2010); ii) the types of strategies used to influence project performance (Frooman, 1999); iii) the methods for engaging construction stakeholders more effectively (Manowong & Ogunlana, 2010); iv) the creation of project coalitions as networks of relationships (Pryke, 2005). In fact, the issue of roles in construction is generally presented as a matter of task and responsibilities or division of labor (Georg & Tryggestad, 2009). Consequently, the literature about multi-role stakeholders in construction projects is scarce and fragmented. Despite the fact that multiple studies have been conducted recently on stakeholder management, only a few of them analyze the multiple roles that a stakeholder plays in the different phases of the building project. Wilkinson (2006) is one the few authors who examine the relationship between the role of stakeholders and the phases of a project. In her work, a model (see Table 5) is proposed for improving the processes of a construction project (middle column) by focusing on the relationships at different stages (first column) and the representative's changing role (right column). Table 5 shows that the client's representative has to be multi-skilled over the project life cycle. This can be achieved in two ways: having a single client representative during project-life, or having multiple representatives at different stages with particular skills pertaining to the stage requirements (Wilkinson, 2006).

Table 5. Relationship roles and success factors at project stages. Source:
(Wilkinson, 2006, p. 161)

Stage	Critical relationship success factors	Development roles
Inception	Appointment of client representative.	Initiating adviser
	Accurate needs analysis	Information gatherer
	Establishing client–client representative relationships	Relationship builder
Feasibility	Continuity of representative	Adviser
	Identification of users and project philosophy	Analyst
	Professional guidance and advice to client	Programmer
	Knowledge and research of project	Information gatherer
Design	Definition of requirements	Team builder
	Clear authority for representative	Listener
	Clarification of roles	Coordinator
	Compatibility of teams	
Tender	Liaison and good technical assistance	Analyst
Construction	Delegation	Organizer
	Clarification of team network	Mediator
	Independent assessment and control	Manager
Commissioning	Early confirmation that project is operational	Quality manager
	Project evaluation organization	Assessor

2.2. Sustainability in the built environment: enabling collaboration and innovation

As stated earlier, the term built environment refers to all buildings and living spaces that are created, or modified, by people, including the infrastructure systems put in place to serve it (Sarkis et al., 2012). But it is also a cultural product that reflects how people understand the nature of meanings related to the environment (Rapoport, 1990). The main producer and custodian of this built environment is the Architecture, Engineering, and Construction (AEC) industry, that plays a critical role in determining its quality, integrity, and longevity (Vanegas, 2003). Its processes include the use of resources, materials, and energy, which generates cumulative environmental impacts with long-range impact consequences for future generations (P. Brandon & Lombardi, 2005; Du Plessis, 2012). Current challenges, thus, demand a series of inter-linked systems through genuine interdisciplinary collaboration and dialogue (Yao, 2013). Nonetheless, there are at least three key barriers to the development of such an integrated approach. First, the fragmentation of built-environment professions in the AEC industry (Richard Fellows & Liu, 2012); second, the often poor management of communication and information (Chinowsky & Carrillo, 2007); and finally, the differing priorities of project stakeholders (Kemp & Martens, 2007). It

is important for built environment practitioners to overcome these challenges by promoting collaborative working between project teams (D. Walker & Lloyd-Walker, 2015), by increasing the mechanisms of communication and information (Dainty et al., 2006) and by validating tools, including environmental certifications (Cole, 2012b). Therefore, there is a need to understand which tools ("green" certifications, for instance), mechanisms (i.e. communication and information by "green champions"), and dynamics ("green" project teams) are required to integrate sustainability principles into conventional AEC practices within the built environment. Figure 7 presents these interactions and identifies relevant articles in each field, will be developed in more detail in the next sections.

Figure 7. Relevant articles about the relationships between sustainability, and collaboration and innovation, and the built environment literature

2.2.1. Sustainable construction and "green" certifications

Even if (and given that) sustainable development has been accepted across the world as an effective way of addressing current social, economic, and environmental concerns, the real challenge is increasingly to find ways to effectively implement it in everyday and operational terms (Matar et al., 2008). However, actual sustainability

implementation depends on consensus about on what and how to sustain, what to develop, and for how long and in which circumstances (Wikström, 2010). In different sectors, various sustainability approaches have been developed though (P. Brandon, 2012). For example, in many cases, businesses "use" sustainability for branding purposes (Ramus & Montiel, 2005), by adopting measurement systems that incorporate financial, ecological, and social outcomes, known as the triple bottom line approach (Ruparathna & Hewage, 2015). Triple bottom line is thus an extended baseline that adds social and environmental dimensions to the traditional monetary benchmarks (Wikström, 2010).

To handle increasing societal environmental demands many construction companies have adopted environmental management systems (EMS) that were originally developed for permanent organizational structures (Pernilla Gluch, 2005). However, it has been found that, in the case of built environment and sustainable construction, tools and measurement methods tend to focus only on one or two dimensions of sustainable development (Cole, 2012a). In fact, the social aspects of sustainability are rarely considered during project management, environmental factors are generally reduced to the mere procurement of environmental certifications while economic aspects are efficiently addressed (Labuschagne et al., 2005).

In fact, it is well known that the dominant measure for all aspects of sustainable construction is reduction in energy consumption, and particularly energy associated with climate change impact (Kibert, 2007). "Green" certifications are presented as "sustainable" but in reality most of them only focus on energy consumption (Pérez-Lombard et al., 2009), this despite the fact that some researchers even question the type of energy being saved by green certifications (Scofield, 2009). Moreover, "green" certifications are increasingly used as part of a greenwashing market. Greenwashing means that "*significantly more money or time is spent advertising being green, (i.e., operating in consideration for the environment), rather than spending resources on environmentally sound practices*" (Heine, 2014, p. 396). Therefore, practitioners need to pay attention to the use of ratings and certification tools in order not to fall in "symbolic accreditations" or "corporate greenwashing"

(Bowen & Aragon-Correa, 2014).In response, Sev (2009), emphasizes the need for an integrated approach and a more rigorous implementation of the different components of the sustainable "system". Similarly, Reed (2007) suggests shifting from today's (reductive) green design to sustainable design, or to more ambitious restorative design, or regenerative approaches, that is, to include additional dimensions of emerging approaches and expanding the time scale of the impact considered.

The logical impossibility of fostering unlimited growth in a world of limited resources questions the long-term viability of the current economic model (Gladwin et al., 1995; Pinelli & Maiolini, 2016). In response to the effects on performance and profitability, companies have strategic reasons for considering sustainability and social dimensions as an opportunity for creating business value (Wheeler et al., 2003). Thus, the construction industry increasingly understands that implementing sustainability practices is a source of competitive advantage (Tan et al., 2011). This economic motivation has allowed the construction industry to increase the interest in implementing sustainability practices in its companies (Kats et al., 2003; Miozzo & Dewick, 2002).

In sum, the main challenge pertaining to the sustainable construction approach is focus on the operational connections between social, economic, and environmental dimensions (G. Atkinson, 2008). For many experts, the success of environmentally responsible management depends on interpersonal and cultural aspects more than on technological and procedural mechanisms (Bresnen et al., 2003). Two key aspects are essential here to understand both how knowledge is managed and how relationships between people influence project processes (Egbu, 2004).

2.2.2. Information, communication, and technology: the main prerequisites of knowledge management

It is well known that building projects are increasingly complex processes conducted within a dynamic environment, through fragmented production, prototype designs, and loosely coordinated by temporary multi-organizations (TMO) (Egan, 1998). All of

these characteristics generate significant challenges so as to manage knowledge in the construction industry (Ruan et al., 2012). In order to explain this argument it is important to clarify here the information hierarchy (Davenport & Prusak, 1998), also known as the "Knowledge Pyramid". This model represents the purported structural and/or functional relationships between data, information, and knowledge, (Ackoff, 1989). For Ackoff (1989), data is raw content with not meaning in itself; information is data that has been given a meaning by way of relational connection; and knowledge is the appropriate collection of information with useful meaning to people in a certain context. Rowley (2007) adds wisdom at the top of the pyramid, and considers it the ability to increase effectiveness. The data-information-knowledge-wisdom (DIKW) hierarchy (see Figure 8) is widely accepted, even though authors like Frické (2009, p. 132) stated that the "*DIKW pyramid should be abandoned*" as there is an intellectual and theoretical vacuum over the nature of the concepts and their interrelationships.
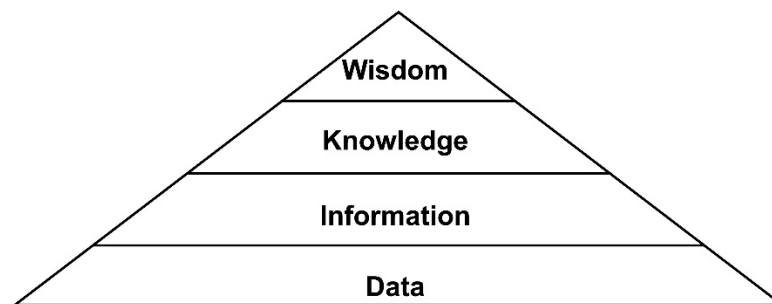
Figure 8. The DIKW hierarchy based on Ackoff (1989) and Rowley (2007)

There is a difference between tacit and explicit knowledge. While tacit knowledge generally concerns skills, ideas, and experiences that people have in their minds and are, therefore, difficult to access, explicit knowledge can be readily articulated, codified, accessed, and verbalized (Polanyi, 1958). The conversion from tacit to explicit knowledge is the most crucial organizational and inter-organizational method of knowledge creation (Nonaka & Takeuchi, 1995). Whereas the construction industry is slowly adapting explicit knowledge management (Kamara et al., 2002), the strategic level generally assumes that professionals already possess tacit knowledge and experience for certain projects. This knowledge is particularly important to organizations because once a project is finished professionals may

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leave the organization. Therefore, the use of knowledge from different sources is a key factor in construction project productivity and overall project success (Anumba et al., 2005).

Fragmentation in the building sector brings a serious challenge. If the industry is not able to capture and share knowledge, valuable knowledge is being lost (Dave & Koskela, 2009). Knowledge will seldom be shared or reused if it cannot be transferred effectively and correctly acquired. The construction industry consists of many working experiences dispersed in different construction projects and participants having a large volume of tacit knowledge (Tserng et al., 2010). The construction industry thus relies heavily on explicit knowledge to gain a competitive advantage (Dave & Koskela, 2009). A process to continually manage knowledge of all kinds (explicit and tacit) is therefore required. This process helps to meet existing and emerging needs and to identify and exploit existing and acquired assets (Egbu, 2004).

Rezgui et al. (2010) identified three generations of knowledge management in the AEC industry. The first generation is based on knowledge sharing; the second concentrates on the culture of conceptualization and nurturing knowledge, and the third pays attention on creating sustained organizational and societal values. The authors state that this last generation of knowledge management (value creation) is grounded in *"the appropriate combination of human networks, social capital, intellectual capital, and technology assets, facilitated by a culture of change"* (Rezgui et al., 2010, p. 226). The implementation of a knowledge management system therefore results in an *"improvement in the integration of people, process, and technology within an organization, an increase in the capacity of the organization to pull external knowledge, and thereby improve its own internal knowledge bank"* (Maqsood & Finegan, 2009, p. 297).

It can therefore be assumed that given the nature of construction projects, knowledge management based on collaboration is a key factor to capture tacit knowledge (Dave & Koskela, 2009) and share explicit knowledge (Carrillo & Chinowsky, 2006). Dealing with people requires managerial care (Badiru, 2008). In this context, the use of

appropriate information and communication technologies is increasingly seen as a key step to overcoming the obstacles of capturing and managing the knowledge required by project teams to make construction projects sustainable (Shelbourn et al., 2006).

2.2.3. "Green" project teams: a key factor for collaboration and innovation

Collaboration, coordination, and cooperation are often used as interchangeable terms in project management (Badiru, 2008). A subtle distinction exist however between these terms. Innovation cooperation, for instance, is defined by Tether (2002) as active participation in joint research and development with other organizations. According to Tether (2002, p. 949), *"it does not necessarily imply that both partners derive immediate commercial benefits from the venture. Pure contracting out work, where there is no active participation is not regarded as co-operation"*. For Kvan (2000, p. 410), cooperation is characterized by *"informal relationships that exist without a commonly defined mission, structure or effort. Information is shared as needed and authority is retained by each organization so there is virtually no risk"*. Instead, coordination implies *"formal relationships and understanding of compatible missions"*. Nevertheless, authority still rests with the individual organization. For Kvan (2000), collaboration is a higher level of integration that connotes a durable relationship which implies a commitment to a common mission where governance is determined by the collaborative structure.

Numerous studies have investigated the influence of collaboration in organizational performance and innovation success. Innovation has traditionally been defined as the generation, acceptance, and implementation of new ideas, processes, products, or services (Barret et al., 2008), in the construction sector, successful innovation is defined as the *"effective generation and implementation of a new idea, which enhances overall organizational performance"* (Sexton & Barrett, 2003, p. 616). This definition also implies that it is not necessary to distinguish between process and product innovation. Instead, the systemic relationships between products and

processes are captured in what is now known as "organizational innovation", which emphasizes integration and the improvement of internal capabilities (Lu & Sexton, 2009).

During the construction of sustainable projects, management teams play a key role in process integration (Baiden et al., 2006). Project managers and their construction teams thus require specific skills and knowledge to respond to sustainability principles (Gloet, 2006). Therefore, it is crucial to understand how teams work and which expertise are developed within them. Some definitions are important at this point. A construction project team is defined by Emmitt and Gorse (2007, p. 5) as "*a series of individuals and groups working towards individual and group goals in a temporary social system, composed of specialists operating in a disaggregated sector, each carrying different values and intentions to other team members*".

When this project team works particularly sustainability principles, it is also known as a "green team", which is defined by Jabbour et al. (2013, p. 60) as *"groups of workers formed, either voluntarily or involuntarily, to solve environmental problems or to implement programs to improve environmental performance and could either be functional or cross-functional".* Functional "green teams" are formed by members located at the tactical level and focusing on sustainable performance improvements at that level. Cross-functional green teams are formed by members from different levels and focus on strategic decision-making concerning corporate environmental management. Jabbour et al. (2013) also classify "green teams" by their responsibilities: i) top administrators' "green teams", which are responsible for developing the organization's sustainable policy; ii) action-oriented "green teams", which are responsible for evaluating opportunities to improve environmental performance; and iii) operative "green teams", which are responsible for implementing the environmental impact of specific productive processes.

According to Hwang and Ng (2013, p. 282), the main challenges that "green teams" have to face are: "*i) the longer time required during the pre-construction process; ii) difficulties in the selection of subcontractors who provide green construction services; iii) uncertainty with green materials and equipment; iv) the high cost of*

green materials and equipment; v) increased meetings and coordination required with green consultants and engineers; vi) alterations and variations with the design during the construction process; vii) difficulties in comprehending the green specifications in the contract details; viii) circumstances in executing green projects; ix) planning of non-traditional construction sequences; and x) planning of different construction techniques".

To manage and successfully respond to the challenges of sustainable projects, "green team" members, particularly project managers, require specific skills and knowledge. According to Hwang and Ng (2013), typical knowledge areas include: planning, cost, and stakeholder and communication management. Required skills include: analytical, decision-making, team-working, delegation, and problem-solving skills. Other stakeholders play different roles during the construction process. These roles can focus on a particular aspect of sustainable principles depending on interests, responsibilities, experience, or even decision-making power. However, due to the variety of economic, social, or environmental aspects involved, sustainable responsibility typically overpasses project limits and a wide range of external stakeholders are also needed (Sharma & Henriques, 2005). Therefore, it is important for organizations to visualize, map, and recognize the different types of the stakeholder's roles (Bourne & Walker, 2005) that affect sustainability practices.

Undoubtedly, "green teams" enhance collaborative skills through team-building strategies, which means formal and informal interventions that focus on improving social relations and clarifying roles (Chiocchio et al., 2011). Collaboration minimizes the effects of fragmentation, duplication, and distrust, and enables participants to face organizational challenges by using available resources wisely, sharing project risks across multiple domains, and enhancing staff and organizational motivation (Shelbourn et al., 2007).

2.3. From corporate social responsibility to sustainable management in organizations

Another challenge here is to understand the influence of sustainability principles on the management of organizations. Since the studies of Taylor (1911), management theory has evolved around to organization's complexity and the influence of other disciplines such as engineering (Gantt, 1919), sociology (Argyris & Schön, 1978), psychology (Gilbreth, 1973), systems theory (Von Bertalanffy, 1973), and organizational learning (Schön, 1983). Important influences include the theory of organizations (March & Simon, 1965), the concepts of bounded rationality (Simon, 1996), the structuring of organizations (Mintzberg, 1979), stakeholder theory (Freeman, 1984), and competitive strategy (Porter, 2008). Social and economic variables also increasingly affect the way in which organizations manage their responsibilities. Corporate responsibility according to Carroll (1991) must include four components: economic responsibilities followed by legal, ethical, and philanthropic responsibilities.

At a certain level of maturity, organizations also increasingly adopt sustainability (Gladwin et al., 1995) as part of their core values. Organizations now acknowledge that they have significantly contributed to environment degradation (Shrivastava, 1995). But Bansal and Roth (2000) argue that organizations have three other motivations to adopt sustainability principles: competitiveness, legitimating, and genuine environment protection. They emerge at the individual (project), organizational (strategy), and ecological (sustainability) levels. Therefore, three conceptual relationships (or alignments) are important to be recognized in this context: the interactions between project and strategy (Slevin & Pinto, 1987), between sustainability and strategic management (Robèrt et al., 2002), and between sustainability and project management (Silvius et al., 2011). Figure 9 shows these interactions and the most relevant publications in each field. These alignments will be covered in more detail in the following paragraphs.
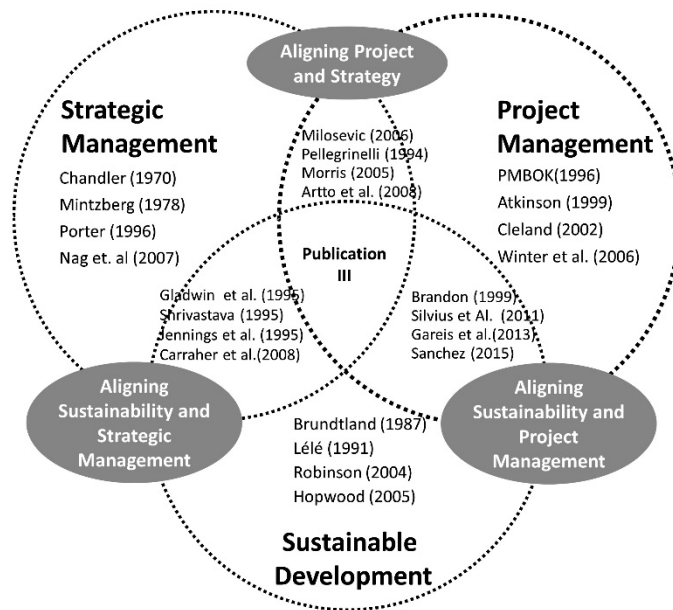
Figure 9. Relevant articles focusing on the relationship between sustainability and strategic and project management in the built environment

2.3.1. Aligning project and strategy

One of the main reasons that alignment between strategy and project objectives and methods has become crucial to organizations is that companies remain permanently competitive in a project-based market (Srivannaboon & Milosevic, 2006). On the one hand, the strategy is an instrument to identify how an organization's goals and objectives will be pursued and achieved (P. Morris & Jamieson, 2004). On the other hand, projects have become a widespread management tool with its own practical and theoretical developments. Projects must increasingly support the organization's strategy (Milosevic & Srivannaboon, 2006). However, gaps between strategy and project-linked tactics initially identified by Slevin and Pinto (1987) are increasingly frequent. Other studies in the same field provide evidence of the importance of aligning firms' strategies with internal organizational features and evaluating external opportunities and threats. For instance, Loch and Kavadias (2011, p. 2) state that: *"Projects fail not only because of incompetent execution, but also, and frequently, because of a muddled strategic context, inadequate scope, or unarticulated - and thus unresolved -tensions and/or trade-offs among the project stakeholders".*

Organizations often assume that all projects are similar and that they can be managed all in the same way (Shenhar et al., 2007). At the tactical level, managers are unaware of the total number and scope of projects, seemingly disconnected from the organizational strategy (Englund & Graham, 1999). For top managers, however, projects must deliver additional value to the organization which requires an effective alignment between them and the strategic aims of the organization (Dietrich & Lehtonen, 2005). According to Shenhar et al. (2007, p. 15): *"alignment of project management and business strategy is an internal collaborative state where project activities continually support the achievement of enterprise strategic goals"*.

Before aligning strategy and projects, top management has to overcome an important challenge: the fit between the strategy itself and its context (or external environment). Venkatraman and Prescott (1990) and Englund and Graham (1999) state that the co-alignment between environment and strategy has a strong positive impact on organizations and projects. Projects are increasingly chosen as vehicles to execute innovative business strategies so that they remain competitive (Srivannaboon & Milosevic, 2006). Furthermore, relatively new organizational processes such as corporate responsibility can potentially help aligning projects and strategy. Interestingly, the majority of authors accept the importance of aligning the organizational structure at different levels (Parisi, 2013); however, few of them explore sustainability as a mean to achieve this alignment.

2.3.2. Aligning sustainability and strategic management

As stated in the previous section, new approaches have recently emerged to reduce the gap between long-term management objectives and short-term management goals. Shrivastava (1993), Parnell (2008) and Stead and Stead (2008) have developed conceptual frameworks that specifically merge strategic management and sustainable development. Stead and Stead (2008, p. 73) call this approach Sustainable Strategic Management (SSM), an ambition defined as a *"comprehensive global view of strategic management, referring not only to the survival and renewal of the firm itself, but also to the survival and renewal of the greater economic system, social system, and ecosystem in which the firm is embedded"*.

This over-reaching ambition needs, however, construct's clarity to contribute to theory building and to help researchers identify category exceptions, produce innovative research questions, and use suitable and epistemologically consistent methods (Suddaby, 2010). For Parnell (2008, p. 39), SSM refers to the *"strategies and related process associated with the community of superior performance –* broadly defined– from both market and environmental perspectives". They then develop three main constructs: i) strategy; ii) performance; and iii) sustainability. Table 6 resumes the emerging sub-disciplines and concepts (right column) that Parnell (2008) used to develop each construct (left column) of the sustainable strategic management field.

Table 6. Sustainable strategic management constructs after Parnell (2008)

Constructs	Emerging sub-disciplines and other similar contributions
Strategy	Firm's strategy and existence (Steiner, 1979) Strategic planning perspective (Mintzberg, 1987a) Competitive advantage (Porter, 1996)
Performance	Financial Measures (Sieger, 1992) Marked-Based Measures (Amit & Livnat, 1988) Quality Measures (Parnell, 2000)
Sustainability	Market Sustainability (Barney, 1991) Environmental Sustainability (Stead & Stead, 2008)

The organization's strategy is often seen as a "*top management's unique plan to develop and sustain competitive advantage and superior performance so that the organization's mission is fulfilled*" (Parnell, 2008, p. 37). According to Mintzberg (1987b), it reflects the results of organizational learning by incorporating patterns of behavior that have worked best. Thus, it enables the organization to fully concentrate its resources and exploit its skills and knowledge with a competitive advantage (Porter, 1996). While the mission is the reason for the very existence (and pertinence) of the organization, and its vision is the ideal state of the organization in the future, the strategy defines the way to achieve that ideal state (Naaranoja et al., 2007). Strategic planning is based on the explicit description of the organization's mission, vision, and strategy (Byars, 1984). Strategies, therefore, identify the high objectives of the organization and dictate the long-term direction of the most important activities (Byars, 1984). Strategic management thus refers to a process that includes top management's analysis of the organization's internal and external

environments prior to formulating a long-term plan for implementation and control (Parnell, 2008).

The second construct, namely performance, is at the head of strategic management and focuses particularly on the objective's accomplishment and measurement (Shriberg, 2002). Firm performance can be measured through financial measures (Sieger, 1992), market-based measures (Amit & Livnat, 1988), and quality measures (Parnell, 2000). Parnell (2008, p. 39) pays special attention to qualitative measures because they "*can provide insight into organizational processes and outcomes that cannot be seen via financial measures*".

The third construct, sustainability, is seen by Parnell (2008) as two distinctive approaches. First, market sustainability which refers to an action that "works well" and sustains in time with constant performance. The notion of "sustainable competitive advantage" of Barney (1991) can be seen as an example of this concept. The second approach, environmental sustainability, typically links the strategy's success with the firm's ecological, economic, and social environment over the long term. Environmental sustainability is broadly defined as: *"a form of management, which clearly states that enhancing the value of a business is not simply about continuously increasing revenues and profits, but also about reconciling the economic goals of a business with environmental and social issues in an ethically correct way"* (Daub & Ergenzinger, 2005, p. 1001)*.*

2.3.3. Aligning sustainability and project management

The paradigm of sustainability has had an important influence in the development of projects. Yet, there is a gap between the perception of its importance and its actual and effective implementation in practice (M. Martens & Carvalho, 2016). Sustainability principles in projects are still perceived as expensive in time and cost and therefore not necessarily supportive to project success (Silvius & Schipper, 2015). Sustainability, however, is increasingly forcing project actors to collaborate earlier in the project. As a result, project management methods need to be adapted to the new challenges of increased collaboration and innovation (i.e. new materials,

new technologies, and new methods) while maintaining the cost and the delays of previous projects. Therefore, aligning organization strategies and project-based sustainability principles requires the analysis of alternatives based on their immediate costs, long-term costs, and their overall contribution to organizational goals (Sánchez, 2015). According to (Økland, 2015), only few academic contributions (Maltzman & Shirley, 2011; Silvius et al., 2011) rigorously consider the influence of sustainability in project management.

Despite the fact that insufficient research has addressed the gap between what is recommended in the project management literature and what is carried out in practice, the field is slowly emerging (Økland, 2015). Common suggestions to implement sustainability in project management practice include: adopting long-term view, addressing local, regional, and global problems, and carefully following up on stakeholder management (Bansal, 2005). According to Robichaud and Anantatmula (2011), if stakeholder management is initiated in the earlier stages of "green" projects, it increases the chances of financial success. Moreover, Wang et al. (2011), demonstrate that projects managed by the same stakeholder during the whole process have better chances of implementing the key principles of sustainability (social, economic, and environmental). Ideally, this stakeholder should provide continuity to the process, guaranteeing that the project goals are maintained as stated in the early phases. Eid (2009) concludes that the highest potential of sustainability implementation (strategies, policies, and standards) can be found in the early stages of the project management process.

However, the influence of sustainability in project management is regarded by these authors in various manners. Eid (2009) proposes that to understand the relationship between sustainability and project management in the construction industry, it is necessary to establish connections at the highest decision-making level through –he insists- strategies, policies, and standards. On the other hand, Robichaud and Anantatmula (2011) suggest that it is coordination, communication, and collaboration that are actually necessary to integrate sustainability in project management practices without increasing costs. Finally, Wang et al. (2011), prefer incorporating

sustainability practices in formal engagements such as contracts and procurement processes.

These studies have indeed produced crucial contributions to the field, but they have manifested important drawbacks on the understanding of the influence of sustainability in effective project execution, which will be referred in this dissertation as the "tactical level". For instance, Eid (2009) concludes that two decades later the standards for project management fail to seriously address the sustainability agenda. Given the nature of projects as temporary organizations, this conclusion may not be surprising, because as Silvius et al. (2011, p. 29) state, "*projects and sustainable development are probably not 'natural friends'* ". Wang et al. (2011), in spite of analyzing long-term projects, do not study the effects of sustainability in organization's strategies and policies. Finally, Robichaud and Anantatmula (2011) show the effects of sustainability in the project management life cycle but their study lacks any analysis of the impacts at the strategic level.

This section has presented relevant concepts to understand the relationships between management and sustainability. The constructs are drawn from different disciplines delving into topics that are just beginning to emerge or consolidate. The next sections will apply these recent knowledge contributions to the specific context of the built environment.

2.4. Universities as building organizations

In the following chapter, we will see that 3 out of 5 cases selected for the study were developed by a university. Therefore, it is important to clarify the characteristics of universities as a construction client. The current mission of universities is focused on the advancement of learning through teaching, research, and service to society. However, to accomplish this goal, universities need to develop additional functions and complementary activities, including building processes. Managing a campus, which includes planning, designing, building, and maintenance it, is an indispensable operation for universities to attain their mission. The way they manage these processes depends on their organizational structure.

According to Mintzberg (1979), there are five organizational structure types. Universities match the "professional bureaucracy" type, which fits for certain activities like the undergraduate and postgraduate teaching and research tasks through specialized departments (McAleer & McHugh, 1994). However, requirements from new stakeholders produce a need for the addition of internal and external bureaucratic structures (Jacob & Hellström, 2003). University units therefore have to address other complementary activities and require a different organizational approach. Despite the fact that universities are not considered "project organizations", as such, some divisions and units work under a project-based approach (McAleer & McHugh, 1994).

Campus Building Management Offices are loosely coupled systems formed by multiple groups of stakeholders (Peach et al., 2005), which manage multiple projects simultaneously. A single project management strategy is generally used for managing programs and portfolios (Blismas et al., 2004). The complexity, speed, and force of change currently taking place in the building sector and the new challenges in higher education organizations have increased the need for a more focused approach to managing building projects in a university context. For instance, Jacob and Hellström (2003) conclude that corporate forms of organization can help universities meet their needs and adjust their structures accordingly. Universities thus develop complex processes that support their organizational structure (Fugazzotto, 2009). Depending on the size, context, and characteristics of projects, universities choose, (in the early stages of the building project), a procurement method and decide how to manage its project-based challenges (Hashimshony & Haina, 2006). Generally, a university works with four main project procurement strategies or a combination of the four: Traditional, Design and Build, Management Contracting, and Construction Management (APUC, 2011), which have their own advantages and disadvantages. Figure 10 summarizes the risks that the employer/client or contractor face in each type of procurement strategy.

Procurement Basis	Risk	
	Employer / Client	Contractor
Design and Build		░░░░░░░░
Traditional	░░░░░░░	
Management Contracting	░░░░░░	
Construction Management	░░░░░	

Figure 10. Distribution of risk in project procurement strategies. After APUC (2011, p. 10)

Universities need to understand why and how stakeholders play different roles and have the power to affect project performance. Therefore, comprehensive university stakeholder management allows the stakeholders to identify their roles and apply strategies to deal with them (Tetřevová & Sabolova, 2010). Mainardes (2010) identified at least 12 categories of university stakeholders including their constitutive groups (see Table 7). These categories are differentiated according to their organizational structure. At one level, (rows i to iv), we find the stakeholders directly related to the mission of the university (research, teaching, and service) and at another level, (rows v to xii), the stakeholders related to the complementary activities that support university structure. Most activities in this level are managed by projects.

This analysis of universities as building organizations provides a framework to understand the influence of a specific construction client in the project. Previous sections (2.1, 2.2, and 2.3) present the concepts in which this dissertation is embedded. They showed the fields of convergence of three discourses: sustainability, strategic and project management, and built environment, also their related concepts and paradigms, and how the three fields evolved mainly on an independent basis over time. The convergences that occurred, which were also highlighted, were also crucial to defining the conceptual basis of this research. The methodology selected to develop such a theory will be presented in the next chapter and followed by a description of the research results and conclusions.

Table 7. Higher education institutional publics. Source: (Mainardes, 2010, p. 85)

Stakeholder category	Constitutive groups, communities, among others
i. Governmental entities	The government, boards of management, boards of directors, sponsors, support organizers.
ii. Management	Rectors/presidents, vice-rectors/vice-presidents, directors.
iii. Employees	Teaching staff, administrative and support personnel.
iv. Clients	Students, parents, social financing entities, service partners, employers, employment agencies.
v. Suppliers	Secondary school institutions, former students, other universities and institutes, food providers, insurance companies, service suppliers, utilities.
vi. Competition	Direct: public and private higher education establishments. Potential: distance higher education institutions, new alliances. Substitutes: company training programs.
vii. Donors	Individual (including directors, friends, parents, former students, employees, industry, research boards, foundations).
viii. Communities	Neighboring, school systems, social services, chambers of commerce, special interest group.
ix. Government regulators	Ministry of education, support entities, state financing agencies, research boards, research support bodies, fiscal authorities, social security, patent offices.
x. Non-governmental regulators	Foundations, accreditation bodies, professional associations, religious sponsors.
xi. Financial intermediaries	Banks; fund managers, analysts.
xii. Alliances and partnerships	Alliances and consortia, co-financiers of research and teaching services.

3. RESEARCH METHODS

To create a better understanding of how sustainability principles influence in the Built Environment, the specific features of building projects and their relations with sustainability principles were explored. This chapter describes the research approach, methods, and tools that were used in the doctoral project. The general studies that were carried out within the doctoral project are briefly described as well as the more general methods used. Additional descriptions of specific research methods and tools used in the doctoral project can be found in each article.

3.1. Research process and publications

The starting point and motivation of this dissertation is the need to understand the influence of sustainability principles in the building sector project processes. The dissertation focuses on organizational processes and not on the external results (outputs) that buildings represent. In order to do so, seven case studies were conducted between 2009 and 2015. Three publications discuss the following topics: the understanding of strategic and project management, collaboration and innovation processes, and stakeholder approaches to sustainability.

The research process benefited from the author's experience and academic background in the fields of architecture, management, and sustainability. After many years of practice, several theoretical questions emerged to connect these disciplines. The doctoral project gave way to the development of a specific question presented to the supervisor and research group, and later validated by other academics and practitioners in different international conferences (Herazo, 2010; Herazo & de Blois, 2011; Herazo & Lizarralde, 2010, 2011; Leoto et al., 2014; Lizarralde, Herazo, et al., 2011). This validation initiated the process of developing a rigorous case study research published in three peer review journals. It included several iterative processes during which individual process publications provided new knowledge, perspectives, and ideas to understand the influence of sustainability in the building sector. The initial objective of the research evolved but at the same time helped develop supplementary questions and theoretical frameworks. The role of individual

publications and their own research processes in the overall dissertation is described below.

Publication I presents the foundations of the research problem: the relationship between strategic planning, project management, and sustainable development in the construction sector (Herazo et al., 2012). It includes the development of a large part of the research's theoretical framework. In the first part, a conceptual analysis helps to understand how companies consider the sustainability principles as a key tool in aligning their strategic plans with specific objectives and procedures for project management. Then, the case studies of three building projects (at different scales) developed by an institutional client in Canada are examined through the analysis of project feasibility studies, construction project meeting transcripts, contract documents, organization and internal policy documents, as well as through semi-structured interviews with stakeholders involved in the projects. The study finds that the sustainability principles transcend the short-term project needs; they connect projects with the long-term liability of organizations and facilitate the alignment of strategic and tactical plans.

The findings of the first article motivated the researcher to further study the impact of strategic decisions on project processes. Consequently, Publication II focuses on one of the studied cases and compares it with two new case studies (Herazo & Lizarralde, 2015). The cases selected are "green" certified building projects having a similar scale. Most research in the built environment has focused on the influence of sustainable development in the final product. This publication, however, attempts to understand how "green" certifications influence the processes of innovation and collaboration in building projects. The research applies a framework for mapping techniques and analyzes the strategies used to obtain "green" certifications, followed by a classification of innovative strategies within organizations and an examination of inter-organizational innovative practices. The article shows that "Green" certifications influence decision-making at different levels: strategic, tactical, and operational; "green" certifications require additional processes as well as the involvement of additional stakeholders, and also new experts in the early stages of

the project. It also finds that organizations rarely generate knowledge that can be transferred to a future "sustainable" project reducing in this way their ability to develop a real knowledge capital.

Publication III further develops some of the ideas introduced in Publications I and II by investigating the different approaches that building stakeholders adopt toward sustainability principles. This article analyzes the evolution of tensions between stakeholders caused by a variety of approaches to sustainability (Herazo & Lizarralde, 2016). The research states that various approaches to sustainability principles influence the processes of building projects. A long exploratory case study is used to understand the influence of stakeholders on sustainable performance. The research includes a literature review, an analysis of the project phases and the configuration of stakeholders, including a typology of stakeholders followed by a mapping of stakeholders' sustainability approaches. The research results show that stakeholders' tensions affect the initial objectives. During the construction phases, tensions are more frequent than in other phases. Finally, the study shows that approaches also vary during different project phases.

In general, the research process can be considered as a spiral process in which the results of each article generated new questions, perspectives, and ideas that help to build new knowledge. In parallel with the literature review in different disciplines, a first-case study was initially launched and three topics were explored: sustainability, management, and the built environment. An interaction between empirical analysis and literature was constant, allowing that each individual publication to be enriched by previous results; this interaction brought forth relevant contributions to subsequent studies. All publications had in common sustainable projects at different scales but developed specific aspects of management theory, collaboration, innovation, project, strategic, or stakeholder management that were thoroughly developed. The results were compared with conflicting or similar literature to identify relevant theoretical perspectives for futures studies (Yin, 2003).

To create a better understanding of how authors contributed to each publication a description follows. For the three publications, the first author was the research

project leader. He conceived the idea of the research, planned the research framework, developed the empirical research, and wrote the first version. The second author provided guidance during the entire research process, commented drafts of the paper, and provided feedback on the writing. Feedback from the guest editors of the International Journal of Project Management, the Journal of Construction Management and Economics, and the Sustainable Cities and Society Journal as well as a total of nine anonymous reviewers influenced the final version of the publications. Only for Publication I, a third author was invited to provide an outside perspective different from the fields of the two other authors and to recommend additional literature specific to organizational alignment.

The choice of journals was an important part of the methodological approach. First, the chosen journals focus on three different knowledge fields: project management, construction, and sustainability, and thus they permit to validate the results with different peer reviewers in each discipline. Second, journals have different readerships. For instance, the Project Management Journal includes a wide world network of more than 16 million professionals and academics from around the world. The Project Management Institute (PMI) organization considered Publication I "the best article of the year" (2012) for its contribution and originality. The Journal of Construction Management and Economics targets mainly academic readers and the article was selected and included in the book Construction Economics: A new approach (Myers, 2017). The Journal of Sustainable Cities and Society focuses on fundamental and applied researchers who aim at reducing the environmental and societal impact of cities. Third, the journals chosen have been recognized as the best in their fields with a high impact factor (the SJR - Scientific Journal Rank indicator is 0.967 for the Journal of Construction Management and Economics, 1.01 for the Project Management Journal and 0.81 for the Journal of Sustainable Cities and Society). Finally, the decision to include only articles that have completed the entire publication process was made in order to consider the maximum of peer review feedback before the presentation of the dissertation.

3.2. Research design, methods, and tools

A goal research framework design and a selection of appropriate research methods are crucial for obtaining satisfactory results in answering the research questions (Easterby-Smith et al., 2002). Thus, examining the strengths and weaknesses of different available methods and how they fit in different paradigms is necessary before selecting and implementing the chosen methods (Amaratunga et al., 2002). For this doctoral project, the main methodological challenge was to examine contemporary approaches (i.e. sustainability and management) in the context of the built environment. A second challenge is to align the scope of research methods in terms of time scales; for instance, project management focuses on the short-term and is typically practical and pragmatic, whereas sustainability is broader, explorative, forward-looking, and long-term oriented.

The study of sustainability in the management of projects in the built environment benefits from contributions in social sciences, engineering, and management. These disciplines have their own bodies of knowledge and research methodologies and are influenced by the ontological and epistemological position adopted by the researcher. The research design is based on Eisenhardt (1989) and Yin (2003) models that propose a deductively oriented approach that follows positivist/post-positivist thinking.

Case studies rely on multiple sources of evidence and typically combine different data collection methods for reducing the potential for bias and reach triangulation (Dainty, 2008). In this dissertation, data was collected through 38 semi-structured interviews (note that some interviews were used for more than one publication), the analysis of 11 direct observations on site, 7 meetings and 5 public audiences, and the analysis of more than 200 public and private documents, reports, archival records, press and media releases, and project site visits (see Annex IV). Table 8 summarizes the research methods, sample, data collection and data analysis technique employed in each individual publication.

Table 8. Synthesis of the research methods and tools used in each of the publications

Publication / Journal	Research method	Sample	Data sources and data collection	Data obtained	Analysis
Publication I Project Management Journal	Multiple case study	Three different scale building projects conducted by same public client	• 7 semi-structured interviews (45 to 120 min) + 6 participants not directly involved in the project • Organization policies and docs. • Reports of sustainability • Project related documentation • Public consultation meetings • Newspaper and press articles	• Individual representations and experience on the managerial approach • Description of sustainable approaches • Project champion roles • Strategies for sustainability	• Case analysis • Identification of sustainable strategies in temporary multi-organization diagrams • Conceptual model sustainability influence on temporary multi-organizations
Publication II Journal of Construction, Management & Economics	Multiple case study	Three same scale building projects conducted by different clients (private and public) Green certification	• 19 semi-structured interviews (40 to 120 min) + 4 participants not directly involved in the project • Project related documentation • Project meeting proceedings • Public consultation meetings • Organization annual reports • Websites • Case study reports	• Individual representations and experience on the innovation and collaboration processes • Key areas that influence innovation and collaboration processes • Interaction patterns of innovation in sustainability	• Case analysis • Organizational tensions that influence innovation and collaboration processes • Model of sustainability pressure generated by external stakeholders
Publication III Journal of Sustainable Cities and Society	Longitudinal case study	One urban building project (public) Green certification	• 23 semi-structured interviews (30 to 90 min) + 4 participants not directly involved in the project • Organization policies and docs • Project related documentation • Project meeting proceedings • Public consultation meetings • Organization annual reports • Websites • Case study reports • Newspaper and press articles	• Individual representations and experience on sustainable approaches • Identification and categorization of different stakeholders • Project timeline participation • Mapping sustainability approaches	• Case analysis • Longitudinal Approach analysis towards sustainability • Sustainability approaches evolution • Causes of changes in sustainability approaches

3.2.1. Philosophical foundation and methodological choice

The epistemological perspective of this research is based on the constructivist paradigm, which focuses on how humans create meaning in relation to the interaction between their experiences and their ideas (Patton, 2002). The initial underlying philosophical assumption was that the understanding and application of sustainability principles in building organizations varies according to social, economic, and political pressure. Given this philosophical election, and in addition to the first question proposed, a qualitative research method was suggested to understand how these processes are carried out and influence their context. According to Patton (2002, p. 55), qualitative research is "*particularly oriented toward exploration, discovery, and inductive logic*". Qualitative research is oriented more to processes of inquiry than to specific quantitative goals, measures, and hard results (Olander, 2006). In qualitative research, people's beliefs, understandings, opinions, and views are investigated in detail through the perspective of the researcher (Richard Fellows & Liu, 2008). Unlikely quantitative methods, qualitative research accepts that there may be a multitude of different realities and assumes that reality is subjective and needs to be interpreted rather than measured (Olander, 2006). Among the categories of qualitative methodology, the exploratory research was selected due to its iterative and dynamic character that helps to fill the limited amount of knowledge in the research problem (Naoum, 2007). It is also explorative because the research projects developed within the doctoral process have been influenced by empirical findings, existing theory, previous research, and continuous dialogues with academics as well as with building stakeholders.

The three publications adopt the case study approach. Two reasons motivated this choice: first, case studies are suitable for examining a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident (Yin, 2003). Second, the nature of this doctoral project is an attempt to understand the "how" and "why" of a contemporary phenomenon, which is the kind of questions that case studies can effectively answer

(Yin, 2003). Additional reasons are presented in each publication. Figure 11 summarizes the research design followed by this doctoral project.
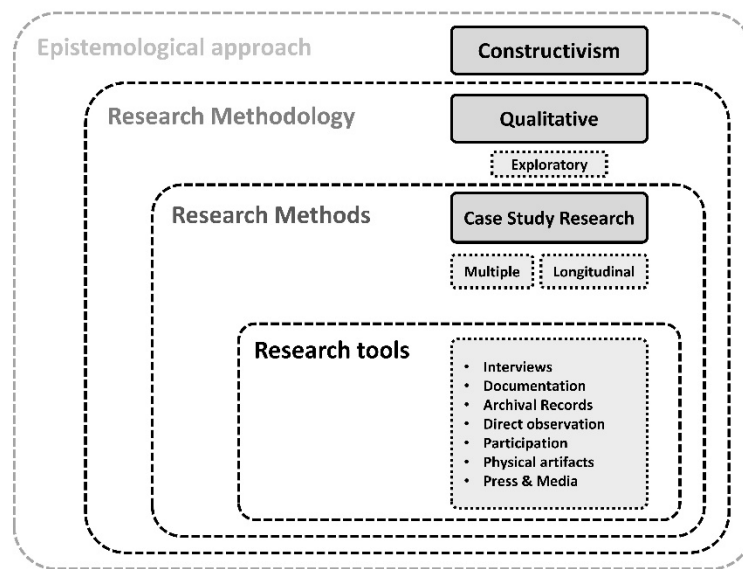
Figure 11. Research Design for sustainability in organizational management

3.2.2. Analytical approach

The research process selected of this dissertation was inductive, which tends to let the data lead to the emergence of concepts and eventually theory building (Yin, 2011). At this point, it was necessary to choose a method of qualitative data analysis. Two main methods are initially considered to construct a database that can be used for the identification of patterns: coding and qualitative content analysis. Coding is probably the most popular technique of data analysis. However, for the purpose of this research, coding has two problems, namely an overload of codes and an overload of texts (Gläser & Laudel, 2013). Instead, content analysis is the method of qualitative data analysis that best fits this doctoral research. It is the only method that begins by separating the data from the original text, systematically reduces the amount of information, and structures it according to the aim of the investigation (Gläser & Laudel, 2013). This first part of the method replaces the material provided by interviewers or documents by a reformulation of that information in an analytic language, which is manageable, more concise, and better adapted to the research concern.

3.2.3. Unit of analysis

The selection of the unit of analysis was an important step in the project. Given that this research aims at understanding the influence of sustainability principles in built environment organizations and processes three units of analysis were required: The first unit of analysis is the *organization* itself seen here as an open system, limited to project boundaries. This unit led to a better understanding of the organizational interrelations between strategic and tactical management and the manner in which sustainability principles influences these relationships (Publication I). The second unit of analysis comprises the relationships between project stakeholders. This unit permits to identify tensions and controversies during interactions between project stakeholders (Publication II). The third unit focuses on the stakeholders' approach to sustainability on a timeline scale and provides a dynamic perspective of this evolution (Publication III).

3.2.4. Sampling strategy and data collection

The case studies were carefully selected. The first challenge was to select building projects and clients that allow wide access to documentation, professionals, and stakeholders. Stakeholders in building projects are often cautious, prudent, and protective with the information and knowledge they share (Smyth & Pryke, 2008). Nonetheless, stakeholders in construction projects in the educational sector, which are typically developed by secondary clients (organizations who require buildings to enable them to house and undertake their own main activities), are generally more open to sharing experiences than other clients. Another challenge was to select organizations that "at least in theory" consider sustainability beyond law and regulations. As knowledge centers, universities often attempt to apply their findings in a practical way (Lombardi et al., 2002). Therefore, building projects on university campuses are particularly more sensitive to the implementation of sustainability (Fonseca et al., 2011; Richardson & Lynes, 2007). Given all these reasons, three case studies were selected on the university campus and two in institutions with an educational vocation. Figure 12 shows that the publication process began by

determining question 1 and its corresponding literature reviews. The preliminary results were then presented in different conference papers. An extended and adjusted paper with final results was then published in a scientific journal (Publication I, cases A, B and C). Publication II (cases D, and E) and Publication III (case A) were also produced after the presentations of research findings at several scientific conferences (and proceedings papers).
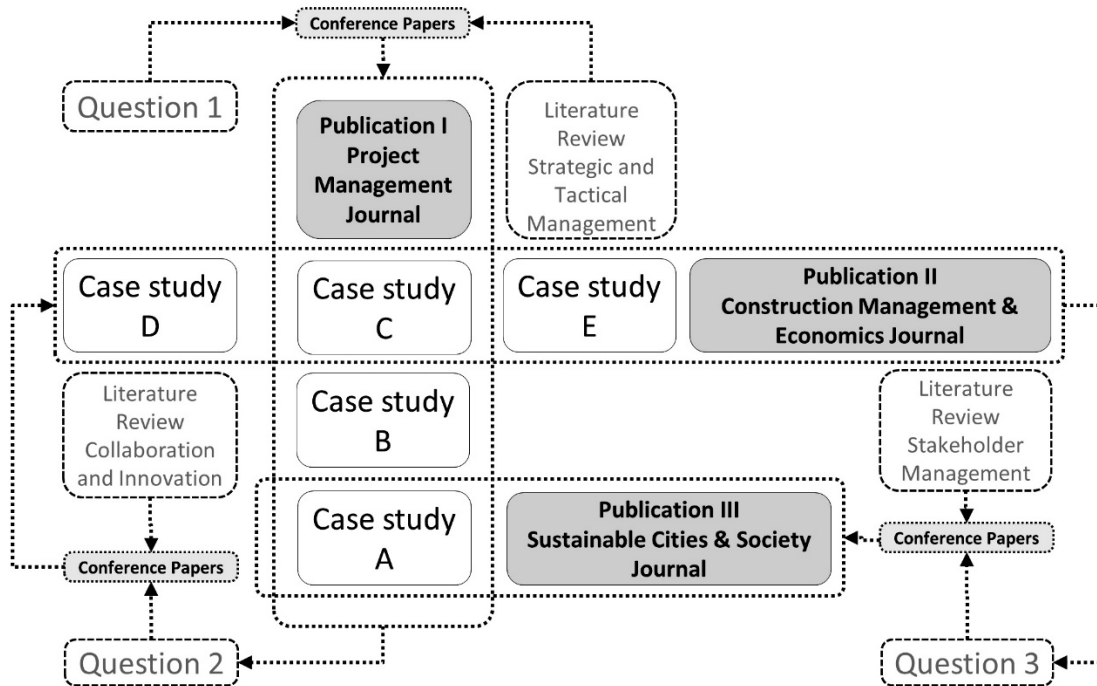
Figure 12. Case studies selection and publication process

3.2.5. Ethical considerations

Ethical considerations are presented here to show how participants were approached. According to the research ethical protocol approved by the Université de Montréal, participants of each case study of this doctoral project were sufficiently informed about the study and were required to sign a consent form before interviews or meetings (see Annex III. Ethics approval and consent form). This protocol included procedures to ensure the anonymity, privacy, and confidentiality of participants and the protection and security of data. However, due to the project's characteristics, it is possible to identify some organizations in the case studies. Participants were informed of this risk and they decided to maintain their participation.

4. RESULTS

4.1. Sustainable Development in the Building Sector: A Canadian Case Study on the Alignment of Strategic and Tactical Management (Publication I)

The Project Management Institute (PMI) organization considered this publication the "Best article of the year" (2012) for its contribution and originality.

4.1.1. Abstract

Increasingly, organizations view sustainable development (SD) principles as a key tool in aligning their strategic plans with specific objectives and procedures used for managing projects. However, more research is needed to identify how sustainable development contributes to aligning longer-term strategic management of clients in the building sector with their short-term needs for construction project management. We present a multi-case study of three construction projects conducted by an institutional client in Canada, developed through a review and evaluation of project feasibility studies, construction project meeting transcripts, contract documentation, organization and policy documents, and seven semi-structured interviews with managers involved in these projects. We found that the principles of sustainable development transcended both short-term needs and long-term responsibility, facilitating the alignment of the strategic and tactical plans.

Keywords: Sustainable development, strategic management, sustainable construction, project management.

4.2. The influence of green building certifications in collaboration and innovation processes (Publication II)

4.2.1. Abstract

While the paradigm of sustainable development has largely influenced architecture projects worldwide, Green Building Certifications (GBCs) have become the new (increasingly mandatory) standard of project performance. Numerous studies have concentrated on the influence of Sustainable Development (SD) in the final product - the building. However, more research is still needed in order to understand how GBCs have influenced building processes, particularly, collaboration and innovation within architecture projects. In order to fill this gap, this study presents results from 19 interviews with professionals in the built environment and examines three architecture projects conducted in Canada that received a widely popular GBC and were significantly influenced by SD principles during the design and building process. The research applies recent frameworks for exploring stakeholders' interests on GBCs and the collaboration and innovation practices developed by them. Research results show that processes within these projects are shaped by at least four tensions that can either enhance or hinder collaboration and innovation: Strategic-Tactical, Collaborative-Competitive, Participative-Effective and Individual–Collective. The study highlights the importance of understanding GBC as a process and not only as a final outcome, and thus, to better manage these tensions so that they contribute to product and process performance.

Keywords: Green Certifications, innovation, collaboration, project management, sustainable development.

4.3. Understanding stakeholders' approaches to sustainability in building projects (Publication III)

4.3.1. Abstract

Project stakeholders in the building sector adopt different approaches to sustainability, based on diverse definitions and perceptions of what is to be considered "sustainable" and the means to achieve it. These differences create tensions, which in some cases lead to better interventions and, in other cases, to conflicts. It is, therefore, crucial to understand these differences and examine both their theoretical and practical implications. Nonetheless, while attempting to do so, two problems often arise. First, scholars tend to classify stakeholders in groups, labeling them and oversimplifying their differences in power and the dynamic character of their approaches. Second, insufficient knowledge still exists on whether and how differences between stakeholders' approaches to sustainability influence building projects. The longitudinal and detailed analysis of the evolution of stakeholder decisions and tensions in a building project in Canada overcomes these two limitations. The study includes a comprehensive stakeholder analysis during early project phases, and the mapping and examination of the evolution of sustainability approaches. Results illustrate how differences in sustainability approaches influence the project process and its final outcome. They show that sustainability approaches are dynamic and create tensions that significantly impact the initial project goals and the planning and design phases. From a theoretical perspective, these results suggest a method for mapping the dynamic character of sustainability approaches. From a practical perspective, these findings can help clients, project managers, and design professionals anticipate possible tensions and make informed choices, ultimately creating projects that better respect the environment and society.

Keywords: Stakeholders, Building, Sustainable Development, Sustainability Approaches, Project Management

4.4. Examples of narratives identified in the study: From an urban fringe to a green campus and a university building

Before proceeding to present the theoretical contributions of the dissertation, this section illustrates two specific processes that were analyzed in the case studies. The confidential restrictions of the research, and the number of words imposed by journals, in published articles, did not allow the author to go into sufficient detail on the empirical results. Thus, two processes that were briefly discussed in publications I and III are detailed in this section and presented as examples of the results summarized in the publications. The first one analyzes the alignment between long-term strategic management and the short-term needs of construction project management. The second example illustrates the tensions that emerge among stakeholders' approaches to sustainability.

It is worth noting that current theoretical approaches rarely deal with the building sector's organizational aspects. The project organization, the relationship between different management levels and project sustainability have been seldom studied together. The two process examples described here show evidence of the relationships, influences and tensions that occur between different organizational levels. Although this detailed narrative is presented separately, it is an integral part of the empirical study published in the academic journals.

4.4.1. Narrative of the Influence of sustainability on the alignment between strategic and tactical levels. Case A, Publication I.

The narrative below explains how a set of sustainable initiatives were born, grew up, and eventually disappeared or were minimized, during the planning process. It also shows how these initiatives influenced various organizational levels. This analytical description is part of the controversial design process of the new university campus summarized in Case A, in Publication I. In this analysis it is essential to understand the complete set of sustainable initiatives that were initially proposed and not only

one initiative. This allows us to understand their evolution, the interrelation between them, and their influence on the strategic level of the client organization. The analysis of one single initiative would make look this impact insignificant and with very little capacity to influence overall management structures. During this narrative, initiatives will enter and leave "*the scene*" according to their role and importance in the process.

Design decisions behind this case involved various actors and organizations in a project that extended over a very long period of time and which current narrative ends with the construction of the first building[1]. The project idea emerged in December 2004, when planners working in the university administration delivered a campus plan to the University Council. One of the first urban representations of the project, developed by the Montreal firm Cardinal-Hardy, is presented in Figure 28. The university was in the process of updating its infrastructure as a result of increasing demand for more space. The new campus became the most important initiative among many other infrastructure projects.

Figure 28. Project Image presented by Université de Montréal in a Public Consultation in 2007 to develop the urban fringe in Outremont. Source: Cardinal-Hardy, 2006.

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[1] The first public report about public participation in this project is: *Convercité. (2006). Bâtir un consensus. Montréal: Université de Montréal.*

Not surprisingly, diverse actors, within and outside the university, adopted different opinions concerning the new campus. This eventually fostered the creation of two main positions: supporters and opponents. This is, of course, two oversimplified categories that gradually faded away or transformed during the long process. However, they will be useful to understand the main controversy. The opponents criticized the creation of a new campus, instead of consolidating the one existing campus. They advocated for renewing existing buildings, densifying the actual sites, and constructing new facilities on the existing campus. For instance, some professors and faculty members called the first building "The Pavilion of Wrath"[2]. Others criticized its sustainable approach, wondering whether the new campus was actually "green" or "wrong"[3] (See Figure 29).

Figure 29. Article about project discussions. Source: McFalls, 2009

A group of residents became furious and demanded authentic participation in the planning process[4]. At a certain point, a group of professionals boycotted the planning process, a reaction that was recorded in local newspapers (Figure 30). However, the university board and the city administration were determined to develop the new campus.

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[2] This is a blog published by: *Ung, Y. (2015). Le Pavillon de la Colère/The Pavilion of Wrath. https://consanguinephysics.wordpress.com*

[3] The complete article in: *McFalls, L., & Royle, P. (2009, March 2009). Vert ou pervers? . L'Autre Forum, 13, 18-19.*

[4] This is one neighborhood group that express their opinion in public forums: *Front commun des citoyens de trois arrondissements. (2007, November 29). Le Progres Villeray.*

Figure 30. Newspaper articles about architects' boycott of the new campus. Source: Marchal, 2012

The university initially planned the first construction phase from 2006 to 2012. Nevertheless, site preparation began in April 2012, and construction of the first building started in 2016. In the first phase, diverse stakeholders, inside and outside of the university, community, were happy with the idea of a new, modern, campus. A series of proposals were presented in the public consultation process which included 13 audiences led by André Beauchamp, the public consultation president[5] at the OCPM (*Office de Consultation Publique de Montréal*). These public meetings allowed gave a voice to 21 experts and 56 presentations in which stakeholders expressed their ideas in an open and transparent forum with the participation of more than 1200 people[5]. Some of these stakeholders, such as the teachers' union, had expressed their disagreement with the project. They considered the new campus an unnecessary "fragmentation of knowledge in space"[6]. Despite this particular opposition, the project continued.

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[5] The list of participants, expert workshops and presentations can be consulted in: *OCPM. (2007). Rapport de consultation publique. Gare de triage d'Outremont Rapport de consultation publique. Office de consultation publique de Montréal.*

[6] More detailed information on: *Syndicat des professeurs et professeures de l'Université de Montréal (SGPUM). (2008). Enquête du meilleur scénario possible. Pour la préservation et l'essor durable du campus de l'Université de Montréal. Montréal : Université de Montréal.*

Undoubtedly, the public consultation process played a crucial role in the motivation to adopt a variety of sustainable initiatives. Without public audiences, individuals and community associations would probably have never had the opportunity to voice their ideas, reach a broad audience, and be heard by the university top management. Although the loudest opposition[7], other stakeholders participated and their green initiatives began to be slowly adopted. Several initiatives were proposed during these audiences[8] including: green roofs, community gardens, car-free pedestrian zones[9], a bicycle path system, city-campus integration options[10], local job generation solutions, rainwater harvesting systems, and geothermal power solutions.

Nevertheless, tensions between stakeholders also emerged during the public consultation process. Several initiatives began to be voiced by local neighbors generating an impact on local authorities and, the university top management. Members of the Outremont community became upset with university decisions and attitudes towards the project specially towards the participation process[11] (see Figure 31 for example).

Figure 31. Headlines of newspaper articles about the participation process. Source: Cote, 2013

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[7] More detailed information on: *Richard, R.-B. (2007). Mémoire: Pour un nouveau campus intégré. Consultation publique. Gare de triage d'Outremont. Office de consultation publique de Montréal.*

[8] The complete list of sustainable initiatives is presented in Table 28.

[9] An example of sustainable initiatives can be found at: *Corbeil, J.-M., & Bergeron, R. (2007). Mémoire: Pour un campus sans autos. Projet Montréal. Consultation publique. Gare de triage d'Outremont. Montréal: Office de consultation publique de Montréal.*

[10] An example of sustainable initiatives can be found at: *Comité Citoyens Gare de Triage d'Outremont. (2007). Mémoire: Projet d'aménagement, Gare de triage d'Outremont Consultation publique. Gare de triage d'Outremont. Montréal: Office de consultation publique de Montréal.*

[11] The complete article in : *Mathieu Côté-Desjardins. (2013, January 17). Gare de triage Outremont: Planification participative mise en doute Epoch Times. Edition francophone.*

A petition with 3117 signatures was presented to the Montreal City Council to claim improvements in the urban plan[4]. The neighborhood community wanted to be heard and taken into consideration. In particular, some residents resented the lack of communication and extreme confidentiality of information[12]. Here is where sustainability emerged as a unifying factor of different visions and stakeholders.

As a result of the concerns raised by different stakeholder groups, the OCPM report recommended a collaborative process between the University, the City of Montreal, the city of Outremont, and the neighborhood organizations[13]. The idea was to elaborate the first phase of the project in greater detail and in collaboration between as many stakeholders as possible. According to one of the interviewees, at this point, "the University decided to include in its organization and in its budget some mediators that would soften the relations with the stakeholders who opposed the project". Indeed, after the first public consultation audiences, three "mediators" could be identified: The Faculty of the Built Environment[14], at the academic level; the real estate committee[15], at the university management level; and an external consulting firm, at the level of the city.

Before public audiences, the project had adopted mainly a top-down approach. But, as a result of the public consultation meetings held in 2007, and the role played by the Faculty of the Built Environment, the process began to adopt more of a bottom-up approach. Despite having both project opponents and supporters, this faculty played a significant role in the discussions about sustainability and helped to bring the subject to academic discussions and debates. A few faculty members made recommendations to the project and supported the sustainable initiatives proposed during the public consultation process[14].

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[12] This was expressed in the newspapers by: *Seymour, M. (2008, September 17). Gouvernance des universités : une loi cosmétique, Opinion, Le Devoir.*

[13] This author compares the Outremont Campus with a similar McGill Project: *Chan, C. F. (2008). A Comparative Analysis of The McGill University Health Centre Glen Campus and the Proposed Université de Montréal Campus Developments. Working Paper (p. 22). Montréal : McGill University.*

[14] The role of the Faculty in this phase of the project can be found here: *Faculté de l'aménagement, U. d. M. (2009). Le développement durable au cœur du projet d'université. Groupe de réflexion ad hoc sur le développement durable. Montréal : Université de Montréal.*

[15] The objectives and composition of this committee is presented here: *Université de Montréal. (2008). Comité sur l'immobilier. Vade-mecum. Section Conseil. (Vol. 12-06-01).*

A series of public events and online platforms helped to showcase these sustainability initiatives. In a conference held in April 2011 in an architects' event, the urban planner made a summary of the most relevant initiatives that could be implemented in the project[16]. The sustainability initiatives presented at the consultation process began to be discussed in different university platforms, including various meetings that concerned the creation of a new institute focused on sustainability[17]. At the same time, the City of Montreal adopted a regulation concerning mandatory LEED certifications for its most relevant buildings[18]. An urban, economic, and social development plan for the affected neighborhoods was presented and discussed in eight audiences held in 2013[19]. The project was presented in more than 20 conferences to the university community during different project phases between 2008 and 2012[20]. Also, two design charrettes and three visions and branding workshops were devoted to different sustainable initiatives.

Despite that only a few initiatives that came from the tactical level were ultimately integrated into the final project, most of the other initiatives served to provide support to the sustainable strategy adopted by the University's Facility Management Office in an internal document called "Sustainable Development Master Plan". This Master Plan includes eight principles that help regulate operations and infrastructure initiatives in relation to sustainability principles. At the highest strategic level, the University adopted a general sustainability policy in May 2014[21].

For a better understanding of how a group of decision processes shaped different sustainability initiatives, an analysis of events is necessary. In this analysis, sustainable initiatives are defined as ideas or design proposals that may be found in

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[16] *Dufresne, M., & Careau, L. (2011). Campus Outremont de l'Université de Montréal : Les défis d'un quartier universitaire durable [Video File]. Conférence des Mardis verts. Ordre des architectes du Québec. OAQ. Retrieved 2013, April 19, from http://vimeo.com/23039505*

[17] A complete reflection of the creation of the institute can be found in: *grIEDD. (2010). Rapport du groupe de réflexion sur un Institut de l'environnement et du développement durable (grIEDD). Montréal: Université de Montréal.*

[18] The official communication of the city can be found at: *Ville de Montréal. (2009). Communiqués : Adoption de la politique montréalaise de développement durable pour les édifices municipaux - Toutes les constructions neuves de la Ville seront désormais certifiées LEED Or.*

[19] The detail of 6 public meetings and their results can be consulted here: *OCPM. (2013). Rapport de consultation publique sur le projet de Plan de développement urbain, économique et social (PDUES) des secteurs Marconi-Alexandra, Atlantic, Beaumont et De Castelnau. Montréal: Office de consultation publique de Montréal.*

[20] One example of project presentations: *Beauchamp, Y., Cohendet, P., Simon, L., Bove, F., & Stojak, L. (2014). Conférences MOSAIC: une démarche créative pour un quartier universitaire innovant.*

[21] *Université de Montréal. (2014). Politique de développement durable In d. Recueil officiel. Règlements, politiques et procédures (Ed.), 10.50 CU-0610-4.4. Montréal.*

articles, statements, news releases or bylaws. They can be individual or collective, and in this particular example, they represented a unifying factor for heterogeneous ideas that emerged among stakeholders. Table 28 lists 20 sustainable initiatives that were identified during the design project phases, from 2005 to 2011. Stakeholder groups that publicly presented one or more initiatives of these are also listed. Therefore, it is possible to identify the proponents or adherents of each initiative. Both, the initiatives and the stakeholders were identified through personal interviews, project reports, public documents, public presentations and press news. All sources are listed in Annex IV except for the personal interviews that have confidentiality restrictions.

Table 28. Sustainable Initiatives in Case Study A (Publication I) and Stakeholder Groups that proposed or supported initiatives.

Sustainable Initiatives	a) Client	b) Users	c) Community	d) Consultants	e) Government	f) Civil Society	g) Analyst - Media
1. LEED certified buildings	●	●		●	●	●	
2. LEED certified neighborhood	●					●	
3. Integrated design goal-setting charrettes		●		●			
4. Campus densification		●	●			●	●
5. Space optimization and reorganization		●				●	
6. Low-waste program		●		●			
7. Energy efficiency	●		●				
8. Water conservation		●					
9. Solar energy		●	●	●			
10. Sustainable water sources			●				
11. Rainwater harvesting systems				●			
12. Green roofs - living, vegetative roofing alternatives	●	●	●			●	
13. Low VOC (volatile organic compounds) in paint		●		●			
14. Compact fluorescent bulbs				●			
15. Use of recycled materials		●		●		●	
16. Purchase and use of local materials		●				●	
17. Tree preservation and relocation		●					
18. Low-flow plumbing fixtures				●			
19. Geothermal power solutions		●		●		●	
20. Alternative transportation solutions (bike, rapid bus, etc.)		●		●		●	●

Sustainable initiatives were classified in seven scenes according to their origin and the phase in the design project in which they were created. More specifically, initiatives grouped in Si0 were presented in the first project brief, Si1 groups

initiatives that emerged from internal stakeholders; Si2 includes initiatives that arose from external stakeholders. Si3, Si4, and Si5 were initiatives that originated in previous steps and were proposed by other groups but evolved and were maintained in the project. Si6 and Si7 compile initiatives that were included in final design documents. A Decision Group represents a milestone in the project where it is possible to identify the decision-making that affected the sustainable initiatives. Decision groups are divided according to the organizational level and phase where decisions took place. Table 29 summarizes the sustainable initiatives, their classification and the decision group to which they belong.

Table 29. Sustainable Initiative Scenes included in Decisions Groups.

Decision Groups.	Sustainable Initiative Scenes	Sustainable Initiatives included in decision groups	Time Frame	Rationality of classification
Decision Group 1 (Tactical level) in the University organization	Si0 Si1 Si2	1, 2, 7 3, 4, 5, 6, 8, 9, 12. 13, 15, 16, 17, 18, 20 4, 5, 7, 9, 10, 11, 12, 14, 15, 19, 20	2005 2006 2007	Project Concept Internal Brief External Brief
Decision Group 2 (Project level) in the Project organization	Si3 Si4 Si5	1, 2, 3, 7, 9, 12, 16, 19, 20 1, 2, 3, 7, 9, 16, 19, 20 1, 2, 3, 7, 16, 19, 20	2008 2009 2009	Concept Phase Concept Phase Design Phase
Decision Group 3 (Strategic level) in the University organization	Si6	1, 2, 3, 7, 9, 16, 20	2010	Construction-Docs. Phase
Decision Group 4 (Tactical level) in the University organization	Si7	1, 2, 3, 7, 20	2011	Initiatives included in Final Phase

Figure 32 presents the basic sequence of Decision Groups. It starts with the scene of sustainability initiatives Si0 and it is followed by Decision Groups D1, D2, D3, and D4 finalizing with Si7. The four groups of decision processes are located at the two management levels (strategic and tactical) of the temporary-multi-organization (TMO). This figure helps to understand the organizational alignment between the strategic level and the tactical level in Case Study A, corresponding to results in Publication 1. A detailed process diagram is presented later.

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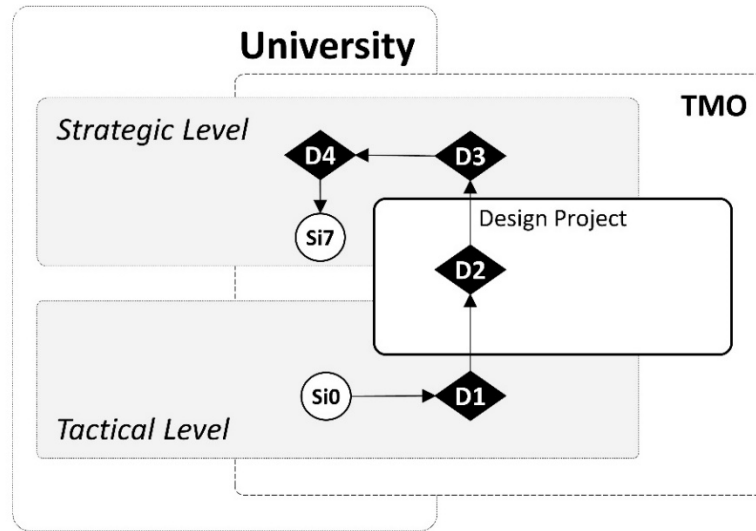
Figure 32. Simplified decision-making group sequence of sustainable initiatives (Case A, Publication I).

For more clarity about the decision processes during project design, it was necessary to identify the phases in which they appeared and the set of decisions that modified or left aside some of the sustainable initiatives. Figure 33 presents this additional information. Definitely, the most influential factors in these decisions were: (i) the budget (ii) a very tight schedule, and (iii) internal and external pressure to start the construction of the first pavilion as early as possible.
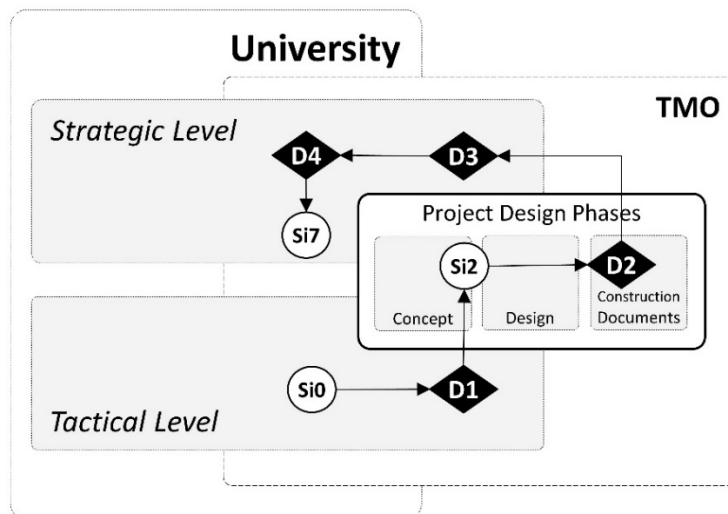
Figure 33. Simplified decision-making sequence of sustainable initiatives including Project Design Phases (Case A, Publication I).

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Figure 34 explains in detail additional sequences and relates the types of decisions to the phases in which they occurred while identifying the stakeholders involved in each level. The period of time reviewed in this study was from 2005 to 2011. In order to identify and monitor changes in sustainability initiatives, it was necessary to compare (triangulate) the information obtained from project reports (pR) and public documents (pD) with media news (M) and personal interviews (pi). The recursive relationships between the tactical and the strategic levels are also highlighted. The decision-making cycle (to be read counterclockwise) illustrates the importance of the interrelationships between processes, and especially the link of project processes with organization processes. Dividing the cycle into stages allows for a better understanding of its dynamics and the figure itself. The dynamics of this process are analyzed below through four groups of decisions. In the figure, the size of circles Sustainable Initiatives (Si#) corresponds to the quantity of propositions according to Table 29. The circle captures the fact that these initiatives were gradually watered down in the project; thus, evolved from a high expected tactical proposition into a very moderated strategic decision.
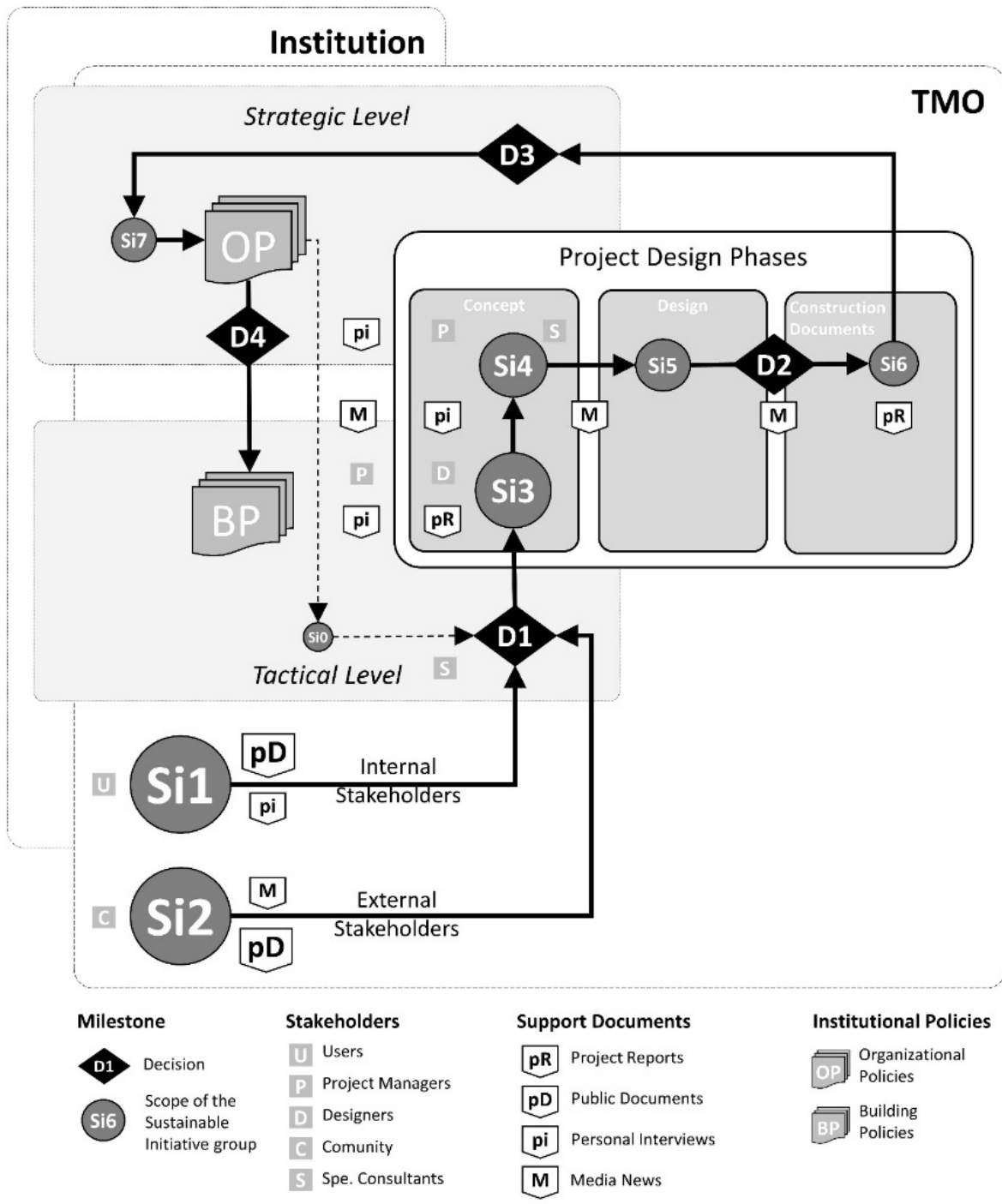
Figure 34. Decision-making sequence of sustainable initiatives (Case A, Publication I) that contributed to the organizational alignment of the TMO. (Please read this diagram counterclockwise starting from Si0, Si1, Si2)

<u>Decision Group 1 (D1):</u>

The announcement of a new construction project for the university generated reactions among, both internal (E) and external (C) stakeholders. Internal stakeholders include occupants (faculty, professors and staff), users (students) and consultants. External stakeholders include community, government, civil society, analysts and media. Some of these reactions eventually became propositions related to sustainability principles, including Si1, Si2 in Figure 34. For example, the political group *Projet-Montreal* proposed five ideas, including a large walkway that would link the subway station to the first building, instead of a small bridge, which proposed by the university[22]. Other specific propositions came directly from the client at the strategic level and included in Si0.

In concept phase (2005), numerous expectations regarding sustainability were raised (Si1, Si2) notably by green certifications. Some of them were radical, other conventional and, in some cases, they were contradictory. One group of citizens claim for a reduction of parking lots[23]. Another group of citizens requested an increase in parking areas[24]. This situation created tense relations between the client and the promoters of these initiatives, including some analysts and media. Tensions arose mainly due to significant conceptual differences between stakeholders. During the process of decision-making group (D1), the strategic level of the client organization had to include participation consultants (S) to handle the initial tensions generated by the project. Prior to the public consultation, the University hired the firm *Convercité*[25]. However, according to one of the interviewees, "*the university needed an in-house personnel to handle the number of complaints and requirements they received permanently*". The participatory processes served to give "voice" to the different stakeholders who felt excluded from the project, and generated sympathy

[22] *The detail of these five ideas can be seen in: Corbeil, J.-M., & Bergeron, R. (2007). Mémoire : Pour un campus sans autos. Projet Montréal Consultation publique. Gare de triage d'Outremont. Montréal : Office de consultation publique de Montréal.*

[23] *Comité Citoyens Gare de Triage d'Outremont. (2007). Mémoire : Projet d'aménagement Gare de triage d'Outremont Consultation publique. Gare de triage d'Outremont. Montréal : Office de consultation publique de Montréal.*

[24] *Lefebvre, C. (2007). Mémoire : Des copropriétaires du condominium In Le Syndicat des copropriétaires du condominium Le Phénix (Ed.), Consultation publique. Gare de triage d'Outremont. Montréal : Office de consultation publique de Montréal.*

[25] More information in : *Convercité. (2006). Bâtir un consensus Dans le cadre du développement de la Gare de triage Outremont. Montréal: Université de Montréal.*

for having included their proposals. In this regard, the mayor of a neighboring district said: "*We have everything to gain with the citizen's participation*"[26]. However, radical proposals, such as further densification of the main campus, were systematically ignored by the university management.

Decision Group 2 (D2):

The new version of the Sustainable Initiatives (Si3) was maintained almost entirely during the concept phase. The design team (D) and the managers (P) were concentrated in other types of decisions and did not make major changes to the initiatives presented, yet, two initiatives ignored (Si4). "*The design solutions will remain until the budget says otherwise*" said one project manager. Similarly, during the design and construction phases, other initiatives were watered-down such as (Si5) which includes ideas in solar energy and green roofs. A set of sustainable proposals were negotiated between the design team and the project managers and were presented to strategic level (Si6). However, resources were limited, and changes were thus required. As one of the interviewees said paraphrasing George Washington: "*We must consult our means rather than our wishes*".

Decision 3 Group (D3):

The strategic level adopted and approved (D3) a series of modest initiatives that the design team and managers incorporated in the last phase of project design and were registered in construction documents, "*We try to incorporate small sustainable ideas that do not have a big impact on the budget*", express an interviewee. However, at this point it is necessary to clarify that the project suffered a series of major changes in subsequent stages that are not part of this study such as the call of tenders or the construction phase.

Parallel to these processes, a new version of the organization's sustainability policy (OP) was being developed. At this stage, the design team and managers seized the opportunity to include different sustainable initiatives (Si7) in the ongoing policy

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[26] Pronounced by *Annie Samson, mayor of Parc-Extension in: Favereaux, A.-L. (2011, February 29). Gare de triage : les citoyens se font toujours entendre, Opinion, Le Progres Villeray.*

making discussions. One top manager explained: "*In our process of elaboration of the sustainability policy of the University, we take into account the new campus designs and their innovations*". This is mainly because the participation process generated an impact beyond the project itself.

Decision 4 Group (D4):

Finally, the university's sustainability policy (OP) began to influence other organizational levels including the Building Management Office (BMO) where a sustainable committee was being created. A draft of a sustainable policy for the BMO was developed 2010, and included concepts presented in different sustainable initiatives in various building projects. One manager explained: "*With these sustainable internal regulations, we can positively influence hundreds of contractors and external suppliers*". The process of alignment between the tactical and the strategic level that initially began with a "top-down" approach in Si0 concluded or restarted with the adoption of Si7 in the institution's sustainable building policies. One manager said: "*From each project we learn great lessons, even from those ideas that seem insignificant*".

4.4.2. Narrative of the Evolution of Sustainability Approach Tensions. Case A, Publication III.

The previous narrative highlights tensions during the project design phase in different organizational levels. We now focus on the tensions that emerged in relation to the different approaches to sustainability. The objective of detailing this narrative is to reveal the facts that led to changes during an extended timeline of the project. After the narrative, an analysis follows to contextualize the process of developing the new university campus summarized in Case A, Publication III.

First phase:

The announcement of the project did not go unnoticed by members of the university community and local residents. Rapidly, several stakeholders wanted to comment on the advantages and disadvantages of the project. They used different means to voice their concerns, including articles, local papers, radio, national newspapers, social networks, and temporal pieces of arts. There were as many voices as ideas. However, there was a common pattern in most proposals. They wanted to take advantage of the project to improve environmental conditions, in what was, for many years an urban fringe in one of the poshest neighborhoods in Canada. Some stakeholders proposed not to build anything on the site. One of them said: "*let nature take its course*". Others, proposed intense interventions rich in eco-technological features. Despite the differences, and once the decision to build was made, the enthusiasm of a significant urban change grew so much that, for a moment, everyone seemed to agree on the benefits of intervening the Outremont urban fringe. However, it soon became clear that something was not right. Stakeholders had the sense that they were "*talking about the same thing*". But the meaning and scope of their objectives and expectations were different. Not only were their sustainability objectives different, but so were the measures, methods and systems required to make them happen. In short, the project soon became a truly tower of Babel.

This story focuses on the different sustainability approaches that the University (The client, Group A according to publication III) adopted during the five early stages

covered by this study. According to the analytical framework used (see page 118) and the Hopwood classification adopted in the empirical study (see page 133), in phase 1, the client is considered a reformer and not a transformative agent, this will be better understanding after reading Table 30 later on. The first evidence is found in the position adopted by the University when the Sustainable Development Policy of the Quebec Province was presented to the public[27]. Eventually, the university also presented the principles and guidelines for the elaboration of a campus master plan[27]. In that regard, one interviewee explains: "*the university will always be politically correct at the sustainability level, but it will never propose something really transformative*". About, at the same time, one of its affiliated schools École Polytechnique de Montréal, inaugurated the first Gold LEED building on the original university campus[28] (see Figure 35). At this point, several documents, and stakeholders' comments and actions expressed the relevance of increasing participation, and using technology, science, information, new materials and energy efficiency to attain sustainability objectives. As a result, the client was classified as a Reformer level on the *Brundtland* subcategory in Hopwood (2005) scale. Please refer to the description of each category in Hopwood's scale presented in page 120.

Figure 35. Lassonde Buildings, Source: Polytechnique Montréal, Productions punch Inc.

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[27] Complete document at : *Université de Montréal. (2006). Principles guidant l'élaboration d'un nouveau Plan directeur des espaces de l'Université de Montréal. Montréal: Université de Montréal.*

[28] The first LEED building in the campus: *École Polytechnique. (2005, January 24). L'École Polytechnique de Montréal inaugure les pavillons Lassonde. Nouvelles Polytechnique.*

<u>Second phase:</u>

During the second phase of the project, in which public consultations were held, the client (the University) joined the increasing "*green euphoria*" of other environmentalists. A linear park of 23,000 m2 was included in the project. Buildings were to have large green roofs. Participation of local committees was to be required in the design. Social housing was going to be built on the site[29]. The project design and supporting studies[30] submitted to the consultation expressed the new ambition of a client's position regarding sustainability. One of the first images of the project (Figure 28) shows both the green roofs, the generous park and the vast in green areas that were proposed at this stage. "*This will be the most ambitious project in terms of sustainability in the whole province*," expressed the project director at the time. The work and the systematic consideration of initiatives coming from civil society, in addition to the desire of social justice and social protection that characterized this 2nd phase, let us to classify the client at the level of Transformation in Hopwood's scale.

<u>Phases 3 and 4:</u>

But phases 3 and 4 of the project became a reality check. The client had to obtain financial resources and was forced to make significant adjustments face a weakened local economy. Additionally, mobility studies, real estate studies and the realization that a major soil decontamination was needed let the university to downgrade several sustainability ambitions.

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[29] Project presented: *Groupe Cardinal Hardy, & Provencher Roy + Associés Architectes. (2006). Analyse et orientations du projet d'aménagement, Campus Outremont, Université de Montréal. Montréal: Université de Montréal.*

[30] Project Studies: *Groupe Cardinal Hardy, & Provencher Roy + Associés Architectes. (2006). Étude des criteères écologiques applicables. Campus de Outremont, Université de Montréal. Montréal: Université de Montréal.*

Figure 36. Plans of transformation of urban project. Source : Université de Montréal, Campus MIL

The urban layout suffered several transformations (see Figure 36). Subsequently, the presentations that the University Principal made to the community, the agreements with the municipality, and the adjustments to the project, generated a new wave of reactions by local residents. Many of them were presented in the 2013 public consultation hearings and in the media (see Figure 37). "*The university initially sold us a green project and now it will build a gray wall*," said a community member in an interview. A university professor added: "*The university is a flagship institution in society and refuses to fit into the urban pattern, as if it were something impure*". Observers found that at this point the university was focusing on market opportunities. The urban project was largely reduced to a means to respond to current regulations. At this stage we classified it in the Reformist category, at the green economists and green consumers subcategory in Hopwood scale.

Figure 37. Newspaper article about the project's urban effects. Source: Laurier, 2011

Phase 5:

In the 5th phase, the client adjusted the urban project again and adopted a more traditional position in relation to sustainability actions. The impacts of these changes became were clear in the presentations that the client made to the community and the university assembly. Serious questions opposing views were raised by the media and the academic community (see Figure 38). In response to mounting pressure to keep the original sustainability goals, one of the managers said in an interview: "*first, we are going to build the LEED building; then, if there is money and determination, we will incorporate other green ideas*". After many changes to the project, the client gave priority at this phase to the use of technologies to deal with environmental challenges. The university focuses on compliance with existing regulations, adopted a more traditional management approach and showed a weak commitment with other stakeholders. For these reasons, the client was placed in the category of *Status Quo* level in the *Word Bank* subcategory in Hopwood scale.

Table 30 shows the empirical evidence that helped to place the client in the different categories of Hopwood scale.

Figure 38. Newspaper articles about eco-gentrification and the project. Source: Sirois, 2018

Table 30. Project phases and Sustainability approaches according to Hopwood scale

Project Phase (Year)	Sustainability Approach adopted by the client organization (and sub-category)	Empirical Evidence additional to comments obtained from the interviews
1 (2004-2006) Preliminary studies	Reform (Brundtland)	• University position about the Québec Sustainable Development Plan[31] • First Sustainable Building in the campus (Polytechnique)[32] • Principles and bases for the elaboration of an internal Space Master Plan[33] • University Environmental Policy adopted in 2004
2 (2006-2008) Public Consultation	Transformation (Social – Ecologist)	• Project Analysis and Criteria [29] • Project Studies [30] • Official Project Presentation[34]
3 (2008-2011) Urban Design	Reform (Green Economist)	• Mobility study [35] • Residential development study[36] • Environmental Rehabilitation[37] • Challenges of a sustainable university district[38]
4 (2011-2013) Site Preparation	Reform (Green Consumer)	• Conference University President[39] • Agreement between University and Municipality[40] • Participation Report[41] • Social Housing Disappearance[42]
5 (2013-2015) Procurement	Status Quo (Word Bank)	• University Presentation to community[43] • Presentation at the University Assembly[44] • Quebec sacrifices quality for cost[45]

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[31] For University's position see page 5 of this document: *Université de Montréal. (2005). Mémoire de l'Université de Montréal aux fins de la Consultation sur le projet de Plan de développement durable du Québec. Montréal: Université de Montréal .*

[32] The first LEED building in the campus: *École Polytechnique. (2005, January 24). L'École Polytechnique de Montréal inaugure les pavillons Lassonde. Nouvelles Polytechnique.*

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Figure 39 shows the different sustainable approaches adopted by the client during each of the 5 initial phases of the project. On the vertical axis are the categories and subcategories identified by Hopwood. The dotted line shows the trend variations in the client approaches. Although, this matrix only represents 5 moments of the project, the access to more detailed (but restricted) information would allow the elaboration of a more precise curve. At this point it is necessary to see what happened, at least with another stakeholder of the project and to overlay their approaches to give evidence of the tensions that were presented in Publication III and in pages 111 to 144.
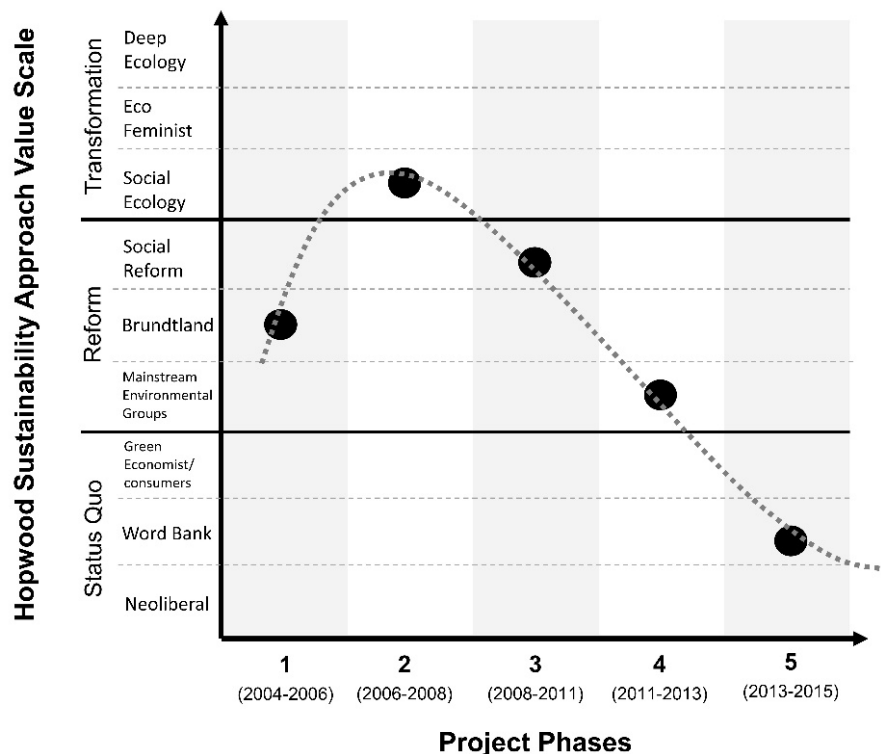
Figure 39. Evolution of Client Sustainability Approaches during Project Phases

To better understand the tensions that emerged between stakeholders, a comparison between the Client located in Group A, with the users located in Group B, (each group is explained in section 4.3.4 page 128. Users is composed of professors, students, staff and their internal organizations) was selected. These two groups were chosen because of their differences in their approaches during the

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project phases. Figure 40 represents the evolution of these approaches. To locate the sustainable approaches adopted by Group B (users), the same methodology explained before for Group A was followed. This graph shows that differences of approaches between the client and the users appeared already is the first phase, generating the first tension. The tensions in each period are explained below.
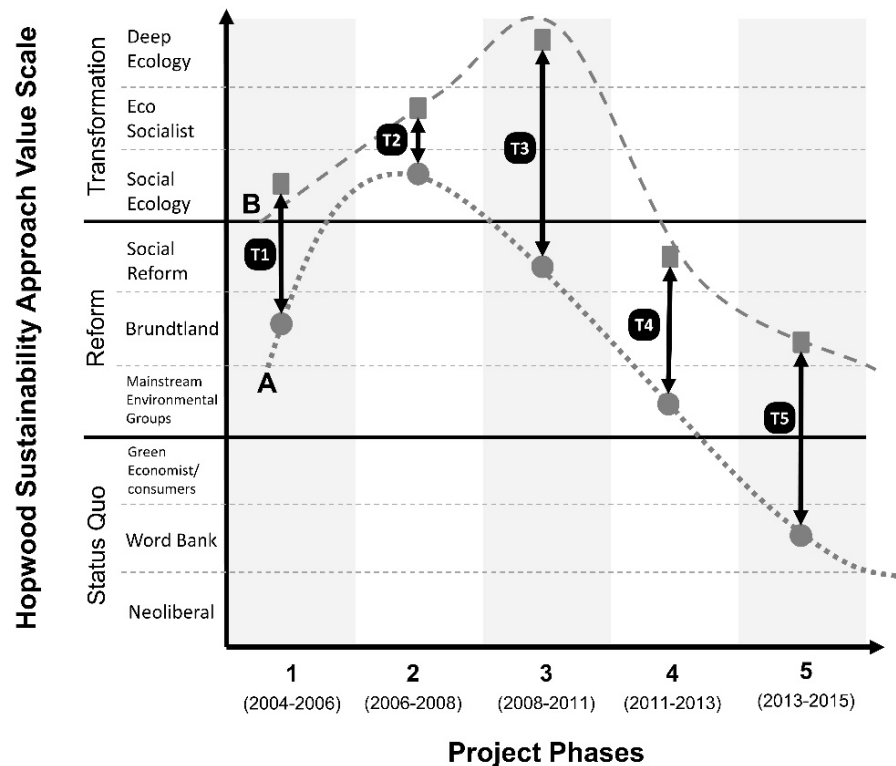
Figure 40. Evolution of Client and Users Sustainability Approaches during Project Phases

<u>Tension 1 (T1):</u> As mentioned above, the client adopted a conservative approach (Reformist-Brundtland) during phase 1. On the other hand, users express the need for a more radical approach (Transformation-Social Ecology). Please note that this includes only the users who were in favor of the construction of a new campus. Those who opposed the new campus were not taken into account. The differences underline the tensions that emerged in the different academic, professional and media spaces. One of the interviewees stated that at that time the users expected the project to be "*a real laboratory of their knowledge*", of which only the "*laboratory*" remained.

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Tension 2 (T2): At the time of the public consultation, the client took a much more avant-garde approach in terms of sustainability and came very close to the users in relation to their needs and expectations. Although there were tensions during this phase, they were much lower than at the beginning of the project. The effort made by the client with respect to citizen participation allowed tensions to decrease, particularly during the project approval period. One of the local residents interviewed said: "*the university managed to convince us at that time that we were all part of the project, but later we realized that it was not like that*".

Tension 3 (T3): The public consultation generated increased users' expectations regarding sustainable goals and opportunities. Citizens believed that, having been heard in a public assembly, their demands were going to be addressed in the design options. On the other hand, for the client this new phase brought a change in focus. Initial sustainability goals were diminished or eliminated from the urban design. Many of these modifications responded to results found in detailed studies that were conducting during this phase. One of the client managers said: "*unfortunately, the financial reality was more (sic) than our good intentions*". These conditions led to confrontations that took place outside the organization, particularly through the media.

Tension 4 (T4): Although users drastically reduced their expectations in this phase, tensions with the client continued. This is explained by the ongoing change in the client's approach to sustainability, which left aside certain commitments, generating discontent among local residents and the university community. As one of the users expressed it, the client took on the task of explaining the project and "*selling it everywhere*".

Figure 41. University Principal and the City Mayor in Montreal City Hall. Source: Le Devoir, 2012

<u>Tension 5 (T5):</u> In this last phase, users were exhausted after several years of effort and commitment to the project. Unlike the client, which had sufficient means to promote and present the project in numerous public events (see Figure 41), users had only a few platforms to voice their discontent and their concerns. Despite this difference in resources, tensions emerged in the university media. Mass media and local and national newspapers did not showcase these controversies. One of the professors said: "*Now, there are more differences between us and the university regarding the project, but that is not news anymore, we are invisible again* ".

5. DISCUSSION AND CONCLUSIONS

This chapter discusses the key contributions of this dissertation. It begins by explaining how the dissertation provides new insight into project management and sustainable development literature, particularly in the building sector. In addition, the contributions of the study to knowledge on project organizations and stakeholder management are explained. Whilst prior research on how sustainability influences project organizations and management is limited and focuses on a product-centered approach, this research builds on a process-centered approach to add new knowledge to existing theory. There are five main contributions to the project management and sustainability literature from this dissertation. Figure 42 shows the connections between the research questions and the contributions.
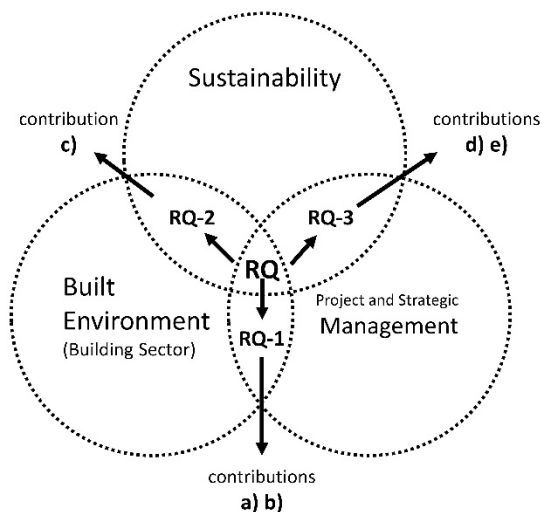
Figure 42. Research questions and their main contributions

a. **Alignment between project management and business strategy:** Sustainability was found to be an enabler of the alignment process between project management and business strategy. A conceptual framework was proposed and tested to explain the process by which sustainability creates bridges between the management approaches adopted by different organizational levels.

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b. **Sustainability principles and practices generate tensions within the TMO:** The findings also suggest that the implementation of "green" certifications in building projects generate a series of tensions that influence project management processes and practices. The manner in which they are managed by organization members has a positive or negative impact on the organizational structure and project performance, particularly on innovation and collaboration processes. Leadership, the internal organizational culture, and learning (knowledge capital) are crucial to reduce these tensions and transform them into opportunities. However, this study showed that this opportunity is not fully recognized/seized by client/owner organizations.

c. **Diversity in stakeholder sustainability approaches:** By examining their sustainability approaches, this study offers new insight on, and understanding of the relationships between project stakeholders. Stakeholder approaches towards sustainability in the building sector are different and not necessary aligned. Whereas some stakeholders adopt strong positions to transform the current system and implement a radical model of sustainability, others maintain a "status quo" position that demands a minimum of changes. Between these extreme positions, stakeholders apply some convenient changes based on moderate views about transformation potential.

d. **Stakeholders' approaches towards sustainability change at different stages of the project:** Variations in sustainability approaches exist among project stakeholders and this, during different project phases. The causes of changes in sustainability approaches are diverse and depend on a combination of internal and external drivers. The former includes organizational decisions, budget, engagement, leadership, and knowledge management. The latter are related to social and political concerns like social pressure, political implications, corporate image, and government regulations.

e. **Stakeholders' approaches towards sustainability generate tensions:** Although stakeholders consider 'normal' that their own approach towards sustainability changes, variations in other stakeholders' approaches generate uncertainty and uneasiness. These changes are often seen as disengagement, abrupt focus, or opportunistic behavior. This research expands the view of project stakeholder tensions as being static and recognizes the existence of a dynamic system that actively interacts with its own context.

The next section highlights the key theoretical contributions of the dissertation, followed by a summary of managerial implications. It also presents the validity and reliability of the empirical research, the limitations of the dissertation and ends with some emerging questions for future research.

5.1. Validity and reliability of the empirical research

According to Yin (2003), the validity and reliability of case study research can be evaluated through construct validity, internal and external validity, and reliability methods. Three of the four tests are considered in the context of this study. Note that the logic of internal validity is inapplicable to descriptive or exploratory studies such as this one.

For construct validity, various methods have been proposed in literature (Biklen & Casella, 2007), including triangulation, which implies the use of multiple sources of evidence and data collection strategies (Jick, 1979; Yin, 2003). All of the publications presented here employed multiple sources of evidence. Publication I relies on public documentation and interviews, while Publications II and III rely on interviews, public documentation, news media, and institutional documents to create hard evidence. In all cases, interviews were conducted with individuals from different organizational levels (strategic, tactical, and operational). In addition, five participants were interviewed twice in order to establish control points in the longitudinal case. Selective quotations were also presented to support the main findings. According to ethical protocols, the case study documentation is maintained and interview files

saved for a period of seven years. Finally, in Publication I, descriptions of project organizations were sent by email to three project managers and their feedback from the case was included. Final publications were sent to the key interviewees in order to improve project knowledge.

Limited external validity is recognized as a weak point of the case study method and is it the main reason why multiple case studies are recommended. Multiple cases increase external validity of the study (Saunders et al., 2012) because its replication logic can be regarded as equivalent to multiple experiments. In this dissertation, Publications I and II rely on multiple case studies whereas a longitudinal single case study is presented in Publication III. In all cases previous theory was used in order to improve the generalization of the findings as suggested by Yin (2003). Furthermore, the separate publications addressed the same cases from different viewpoints, increasing the validity of the study by offering the opportunity to compare the effectiveness of the approaches.

To ensure reliability in case studies, the rigorous use of protocol and databases are suggested by Yin (2003). The case study protocol developed by the IF research group (grif) was adapted to the specific needs of this dissertation. The interview protocol was improved through a pilot test with four researchers and experts in sustainability. The ethical and interview protocols were sent to the interviewees before the interviews, including the information concerning the objectives of the research. In addition, for each research, the data collected was recorded and organized in a case study database. The case study database contains notes of interviews, recorded interviews, case study documents, design and construction plans, and initial case descriptions, among others. A second researcher took part in the case study interviews of Publication III.

5.2. Limitations

Several limitations exist with respect to the examination of the results of this research. In this dissertation, the methodological challenge was resolved with multiple case settings (Publications I and II). On the other hand, for the longitudinal single case study (Publications III), the generalization of the findings is lower than it is for multiple case studies. However, their long-term exploratory analysis opens up the possibility of collect strong evidence. A significant limitation concerns the narrow focus on one single project, rendering our findings contingent upon this specific context.

The objective of the overall research process of this dissertation is to enhance the understanding of the influence of sustainability on the organizational management of building projects with more emphases on processes than in products. Only a limited number of organizational processes and some aspects of stakeholder management are explored in this dissertation. The justification of the relevance of the selected approaches is based on empirical evidence and existing theoretical knowledge. In addition, this research was based on institutional clients with building projects located in Canada, most of them with a specific green building certification at a particular period of time. All of these limitations naturally limit the generalizations of the findings. Results, therefore, have to be used with sufficient prudence in other contexts.

All the case studies use interview-based evidence. While interviews are considered to be an effective method to collect rich empirical data, they often also generate the reaction that the data are subjective. This challenge was solved by using other internal and external sources of information, public newspaper articles, and collecting evidence from public participatory meetings that were able to show the studied phenomena from different perspectives.

5.3. Theoretical implications

This study is mainly centered on the field of project management in the building sector. Through the analysis of sustainability principles, the dissertation examines questions concerning how sustainability principles influence the management processes of projects and how a project organization adapts management practices in the context of building projects.

The results showed that project management in building projects is not entirely aligned with strategic management. They also show how the temporary perspective of building projects creates conflicts with the long-term principles of sustainability, answering to the first research question **(RQ1)**. The findings suggest that in order to achieve sustainable buildings there is a need to adopt a perspective that fully integrates both the technical and social aspects of project management, responding to the second research question **(RQ2)**. The suggested shift from "green" building to sustainable building is not just a "label change"; it also signals that in order to manage sustainability in the building sector there is a need to go beyond the project-centred and carefully looking for a dynamic process-centered approach, answering the third research question **(RQ3)**. Exploring organizational features and sustainability practices in building projects and their relations with management processes has yielded the following theoretical implications:

RQ1. Sustainability was found to be an enabler of the alignment process between project management and business strategy. This research develops a theoretical framework based on the model of Milosevic and Srivannaboon (2006) and incorporates sustainability as a new construct that articulates strategic and tactical management practices. This triangle between sustainability and strategic and tactical management was previously explored by Baumgartner and Ebner (2010), who argued in a conceptual manner that sustainability appropriately fits in with the general strategic orientation of the firm. However, this study provides empirical evidence that sheds light on this triad in the building sector.

RQ2. The investigation on the implementation of sustainability practices, particularly green building certifications, reveals that at least four tensions appear within the inter-organizational processes: i) between strategic and tactical levels; ii) between collaborative and competitive practices; iii) between participation and efficiency; and iv) between individual and collective processes. Leadership is by far the most influential factor in the tensions found. For instance, client/owner leadership is imperative in order to successfully conduct the certification process, particularly a sustained engagement in intense interaction and communication required between management levels. Additionally, leadership styles help to determine the level of tension between collaboration and competition.

RQ3. Tensions in sustainable practices raised key questions about how stakeholders are positioned in relation to the challenges of sustainability. Based on the model by Hopwood et al. (2005), this research shows that stakeholders' approaches towards sustainability are not necessary aligned. More importantly, our longitudinal study reveals that these approaches change at different stages of the project. Stakeholders' approaches in our sustainability mapping vary notably. These differences generate tensions and, sometimes, conflicts, and they influence organizational processes. Stances in sustainability approaches are not self-recognized immediately by project stakeholders. In fact, long-term project changes in stakeholders' approaches are more easily identifiable than in short-term projects.

In sum, there is a need to interpret the different stakeholders' approaches towards sustainability including long-term and short-term perspectives, process-centred and product-centred approaches, and their diverse sustainability stances to understand the influence of sustainability in the organizational management of building projects. The way "green" practices have been implemented has transformed sustainability concerns into administrative products which threatens to transform the sustainability challenge into simple paperwork. "Green" projects, in this context, lose the true meaning of sustainability principles.

5.4. Further research

This study provides an enhanced understanding of how sustainability impacts organizational and project management practices in the building sector. However, since research on sustainable management in building projects is in its early stages, further research is still required to provide more empirical evidence on this field. Throughout this study, several topics for future investigations have been established.

The results of Publication I have made it possible to propose new research questions for consideration in future studies. These questions are presented in section 4.1.5. However, the most important aspect of these results is the applicability of the model presented in Figure 14, through empirical studies of more diverse types of clients, projects, and organizations. In fact, aligning corporate strategy and project management is increasingly considered a key issue in building research and more empirical evidence can reinforce or modify theoretical propositions.

Even though sustainability is recognized as an important subject in project management research, it has received only limited attention. Future research could include other representative cases (real estate projects, for instance) and locations in order to validate, modify, or refute, the conclusions drawn here. The following steps might also include comparisons with other cases and in other geographical regions. Research can also further explore the causes of changes in stakeholder strategies including the role of internal leaders as well as economic and political conditions.

Based on the findings of this dissertation, it would be interesting to conduct a detailed examination of the dynamic interactions between the stakeholders' approaches toward sustainability practices and the explicit and tacit knowledge generated during the building process. Moreover, additional longitudinal case studies can help to understand how stakeholders use in real life/time knowledge management systems to improve sustainability. Results about the evolution of knowledge management, sustainability, and stakeholder approaches during the different project phases can provide an original contribution to literature.

5.5. Practical implications

The framework proposed here addresses the four common problems found in the industry: first, industry fragmentation, by helping stakeholders to focus their resources on a common vision. Second, industry complexity, by promoting new approaches and tools to integrate multiples perspectives. Third, the dynamic and complex character of building projects, by encouraging cooperation and knowledge management and encouraging decision-making at the strategic level. And fourth, the fact that construction companies that are mostly small and medium-sized, by implementing organizational learning and strategic plans. A conceptual framework was proposed and revised to explain how the process of sustainability creates a bridge between different organizational levels.

The implementation of sustainability in the sector has a considerable influence on the management and organizational processes in building projects. As the findings of this dissertation demonstrate, the imperative of sustainability in the building sector is on the rise, which implies (at least in theory) a shift from a product to a process approach. However, stakeholders - and particularly top and project managers - have in reality paid insufficient attention to the process-related aspects of sustainability and their managerial consequences. In fact, traditional project management related to sustainability practices is typically addressed through short-term goals, product delivery, and significantly narrow responsibilities, such as the reduction in energy and water consumption. One reason for this is that little knowledge has been developed and disseminated about the organizational implications of sustainability practices and their management, including who is involved, what tools and drivers exist, which processes are included, how stakeholders try to influence the project, and what the best practices to improve sustainability processes in the project are.

Even though this dissertation does not develop the relation between "green" buildings and project performance indicators, it contributes new knowledge useful for managers by producing new, empirically-based knowledge about stakeholder attitudes and managerial responses to sustainability. Finally, understanding

sustainability's influence in building projects helps top and project managers in the generation of innovative and collaborative working spaces.

Results from Publication I specifically provide top and project managers with a better understanding of how sustainable initiatives influence the project organization at several levels. The key message is that sustainable initiatives, despite their organizational level origin (top-down or bottom-up) help to align corporate strategy and project's management. The results provide managers with a practical tool that allows them to compare strategic management and tactical management practices with the theoretical and practical mechanisms of sustainability principles and how to apply them (see Table 9). Similarly, Publication I offers practitioners a graphical model (see Figure 17) about how sustainability principles contribute to connect organizational strategic and tactical levels of management (in both directions) and how this relationship can be used by both external and internal stakeholders to justify and legitimize decisions in project settings. In addition, the study shows the crucial role that managers can play. As "project champions", managers are able to articulate strategy, tactics, and operations by coordinating and motivating people in the organization. But what happens inside a "green" building certification? What processes are conducted and how do they affect project management practices? Results of Publication II provide answers to these questions.

In fact, Publication II adopts the perspective of a particularly sustainable practice (green certifications) and provides new knowledge about inter-organizational processes in relation to innovation and collaboration. Previous research in innovation and collaboration has produced models of key innovation conditions (Toole et al., 2013) and innovation stages (Bossink, 2007a) for project managers. However, there is no empirical evidence on how these models respond to sustainability practices. The results of Publication II reveal four tensions that appear during the certification process. How they are assumed by managers have either a positive or negative impact on the organization and project performance, particularly on innovation and collaboration processes. The results show how practitioners can intervene in certain project phases and organizational levels to improve project performance. Similarly,

this framework provides a better representation of the Green Project-Champion, illustrating its role, status, and importance in sustainable initiatives.

Publication III provides practitioners with a typology of sustainability approaches and how they evolve during a long-term project. Project managers and professionals can benefit from recognizing that differences between stakeholders' approaches to sustainability can potentially create conflicts during project development. However, these differences can also be seen as an opportunity to improve collaboration and innovation processes. Since the potential for stakeholders to influence the project may vary during the project phases due to modifications in their attributes (Mitchell et al., 1997), continuous stakeholder analysis during project phases is of prime importance. More specifically, decision-makers can also anticipate that approaches will evolve during the early project phases and that there might be a moment in which expectations and ambitions get higher, followed by a "reality check" that can potentially bring participants back to more conservative positions.

The findings of this dissertation further highlight the fact that the presence of complex and increasingly frequent sustainability practices generates new challenges for managing the project organization. The implementation of sustainability practices has different impacts at project phases and organizational levels. In addition to the focus on internal and external project issues, project managers can benefit from maintaining a holistic perspective of processes and project phases. Therefore, it is suggested that practitioners in project-based firms must be aware of the diversity of stakeholder approaches to sustainability and so focus their attention on project stakeholder management processes.

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7. ANNEXES

Annex I. Glossary of terms

Most terms in this dissertation are used in the way they are typically used in professional practice by the architecture and construction community. Given the scope and objective of the dissertation and the existing long debates about semantics in the sustainable development field, we avoid dwelling on a discussion about the meanings and representations associated with terms in this field of knowledge – something we believe is a dissertation on its own. Certain specific meanings are described below:

Alignment: In the field of management, alignment examines explicitly the relationship between strategies, structure, and management methodologies within organizations (Reich & Benbasat, 2000), providing the link between intangible project outcomes and tangible project outputs (Nogeste and Walker (2008). Similarly, Pulaski (2005) describes alignment as the relationship between the objectives of sustainability and those of the construction process itself.

Architectural Management: Is the *"strategic management of the architectural firm that assures the effective integration between managing the business aspects of the office with its individual projects in order to design and deliver the best value to all stakeholders"* (Alharbi et al., 2015, p. 162).

Built Environment: Is an interdisciplinary field that addresses the design, construction, management, and use of these man-made surroundings as an interrelated whole as well as their relationship to human activities over time (rather than a particular element in isolation or at a single moment in time). The field is generally not regarded as a traditional profession or academic discipline in its own right, instead of drawing upon areas such as economics, law, public policy, public health, management, geography, design, engineering, technology, and environmental sustainability (Chynoweth, 2009).

Building Sector: In this dissertation is deemed to comprise the architecture, building science and engineering, construction, landscape, and urbanism. The project organization and its individuals have been in focus and not the project itself or the constructions, i.e. building, roads, and facilities. This means that phenomena related to the construction process including the project organization and individuals involved in construction projects have been objectives for the studies.

Construction Client: A client is a person or organization who at a particular moment in time has the power to initiate and commission design and construction activity with the intention of improving the performance of an organization's social or business objectives.

Construction Enterprise: It refers to *"any business entity involved in an aspect of construction. Thus, it encompasses much more than a contractor or building company. The review that follows and the techniques outlined are relevant to many types of business organization in the construction sector including general contracting firms, specialist contractors, architectural or engineering design partnerships, cost consultancy practices and development companies"* (Betts & Ofori, 1992, p. 512).

Paradigm: A "*cluster of beliefs and dictates which for scientists in a particular discipline influence what should be studied, [and] how research should be done*", different research paradigms will inevitably result in the generation of different kinds of knowledge about the industry and its organizations (Bryman, 1988). In science and philosophy, a paradigm /ˈpærədaɪm/ is a distinct set of concepts or thought patterns, including theories, research methods, postulates, and standards for what constitutes legitimate contributions to a field.

Procurement Systems: The framework within which construction is brought about, acquired, or obtained. A procurement system includes elements such as contract strategy, culture (e.g. trust and institutions), and finance, should deserve more attention from the construction and project management fraternity (Rowlinson & McDermott, 1999).

Project management: Specific problem-solving method of delimiting and grouping activities by using various types of techniques and methods (Söderlund, 2004, p. 184). Project management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements (Project Management Institute, 2008). In project management research two main approaches exist. Engineering science and applied mathematics, interested in the planning techniques and methods and other in the social sciences (sociology, organizations, and psychology), interested in organizational behavioral aspects of project organizations.

Stakeholders: Stakeholders are individuals or groups who have an interest or some aspect of rights or ownership in the project, and can contribute to, or be impacted by, either the work or the outcomes of the project (D. Walker & Rowlinson, 2008).

Strategic management: Is based on the explicit description of the organization's mission, vision, and strategy (Byars, 1984; Nag et al., 2007). The organization's strategy is often seen as "*top management's unique plan to develop and sustain competitive advantage and superior performance so that the organization's mission is fulfilled*" (Parnell, 2008, p. 37). Other authors defined strategic management as "*the major intended and emergent initiatives taken by general managers on behalf of owners, involving utilization of resources to enhance the performance of firms in their external environments*" (Nag et al., 2007, p. 942).

Strategy: Strategy is a plan - some sort of consciously intended course of action, a guideline (or set of guidelines) to deal with a situation. By this definition strategies have two essential characteristics: they are made in advance of the actions to which they apply, and they are developed consciously and purposefully (Mintzberg, 1983).

Sustainable Building: A sustainable building can be defined as a healthy facility designed and built in a cradle-to-grave resource-efficient manner, that resorts to ecological principles, social equity, and life-cycle quality value, and promotes a sense of sustainable community (Berardi, 2013a).

Sustainable Construction: Is "*a holistic process in which the principles of sustainable development are applied to the comprehensive construction cycle, from the extraction and beneficiation of raw materials, through the planning, design, and construction of buildings and infrastructure, until their possible final deconstruction, and management of the resultant waste*" Du Plessis (2002, p. 6).

Annex II. Green building barriers by Darko and Chan (2016)

Code	Barrier	Number of times a barrier was reported
B1	Lack of information, education, research, knowledge, awareness and expertise	35
B2	Cost (too high)	33
B3	Lack of government incentives/support	21
B4	Lack of interest and demand	17
B5	Lack of GB codes and regulations	14
B6	Technological difficulties	13
B7	Lack of communication and interest among project stakeholders	13
B8	Risks and uncertainties	11
B9	Project complexity	09
B10	Scarcity of resources	08
B11	Resistance to change	08
B12	Project duration	07
B13	Lack of authority and efficiency in enforcing GB laws and regulations	07
B14	Lack of promotion	06
B15	Training difficulties	06
B16	Distrust about GB products	05
B17	Lack of financing mechanisms	05
B18	Attitudes, culture, lifestyle and behaviors	05
B19	Rigid requirements	05
B20	Lack of or inadequate certification systems	05
B21	Inadequate and unstable building regulations	05
B22	Political and legal issues	03
B23	High market values of GBs	03
B24	Lack of property valuation systems	03
B25	Imperfect or limited testing standards or tools	03
B26	Non-compliance with existing building regulations and inadequate checks	03
B27	Lack of integrated design methods	02
B28	Insurance/liability issues	02
B29	Lack of green materials suppliers	02
B30	Long pay-back period	02
B31	Lack of importance attached by leaders	02
B32	No consideration for GB measures by stakeholders	02
B33	Lack of adequate, tested and reliable local GB materials or products	02
B34	Project location	02
B35	Poor quality of GB designs	02
B36	Bureaucracy	02
B37	Company size	02

Annex III. Ethics approval and consent form

Université de Montréal

Comité plurifacultaire d'éthique de la recherche (CPÉR)
Facultés de l'aménagement, de droit, de musique, des sciences
de l'éducation et de théologie et de sciences des religions

███████████████

Benjamin Jose HERAZO CUETO
████████████

OBJET: Certificat d'éthique – « Relation entre la gestion des projets de construction
soutenable et la planification stratégique de l'organisation: étude de cas des universités »

Monsieur Herazo Cueto,

Le Comité plurifacultaire d'éthique de la recherche (CPÉR) a étudié le projet de recherche
susmentionné et a délivré le certificat d'éthique demandé suite à la satisfaction des
exigences précédemment émises. Vous trouverez ci-joint une copie numérisée de votre
certificat; copie également envoyée à votre directeur/directrice de recherche et à la
technicienne en gestion de dossiers étudiants (TGDE) de votre département.

Notez qu'il y apparaît une mention relative à un suivi annuel et que le certificat comporte
une date de fin de validité. En effet, afin de répondre aux exigences éthiques en vigueur
au Canada et à l'Université de Montréal, nous devons exercer un suivi annuel auprès des
chercheurs et étudiants-chercheurs.

De manière à rendre ce processus le plus simple possible et afin d'en tirer pour tous le
plus grand profit, nous avons élaboré un court questionnaire qui vous permettra à la fois
de satisfaire aux exigences du suivi et de nous faire part de vos commentaires et de vos
besoins en matière d'éthique en cours de recherche. Ce questionnaire de suivi devra être
rempli annuellement jusqu'à la fin du projet et pourra nous être retourné par courriel. La
validité de l'approbation éthique est conditionnelle à ce suivi. Sur réception du dernier
rapport de suivi en fin de projet, votre dossier sera clos.

Il est entendu que cela ne modifie en rien l'obligation pour le chercheur, tel qu'indiqué
sur le certificat d'éthique, de signaler au CPÉR tout incident grave dès qu'il survient ou de
lui faire part de tout changement anticipé au protocole de recherche.

Nous vous prions d'agréer, Monsieur, l'expression de nos sentiments les meilleurs,

████████████████

FB/sh

Président
Comité plurifacultaire d'éthique de la recherche
Université de Montréal

c.c. ████████████████

p.j. ████████████████

Université
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Comité plurifacultaire d'éthique de la recherche (CPÉR)
Facultés de l'aménagement, de droit, de musique, des sciences
de l'éducation et de théologie et de sciences des religions

CERTIFICAT D'ÉTHIQUE

Le Comité plurifacultaire d'éthique de la recherche (CPÉR), selon les procédures en vigueur et en vertu des documents qui lui ont été fournis, a examiné le projet de recherche suivant et conclu qu'il respecte les règles d'éthique énoncées dans la Politique sur la recherche avec des êtres humains de l'Université de Montréal.

TITRE DU PROJET : **Relation entre la gestion des projets de construction soutenable et la planification stratégique de l'organisation: étude de cas des universités**

REQUÉRANT : **Benjamin Jose HERAZO CUETO**, candidat au doctorat, Faculté de l'aménagement, Université de Montréal,

DIRECTION DE RECHERCHE : **Gonzalo LIZARRALDE**, professeur adjoint, Architecture, Faculté de l'aménagement, Université de Montréal

MODALITÉS D'APPLICATION

Tout changement anticipé au protocole de recherche doit être communiqué au CPÉR qui en évaluera l'impact au chapitre de l'éthique.

Toute interruption prématurée du projet ou tout incident grave doit être immédiatement signalé au CPÉR.

Selon les règles universitaires en vigueur, un **suivi annuel** est minimalement exigé pour maintenir la validité de la présente approbation éthique, et ce, jusqu'à la fin du projet. Le questionnaire de suivi est disponible sur la page web du CPÉR.

Comité plurifacultaire d'éthique de la recherche
Université de Montréal

Date de délivrance

Date de fin de
validité

adresse postale
C.P. 6128, succ. Centre-ville   Faculté des sciences de l'éducation   Téléphone : 514-343-6111 poste 4579
Montréal QC H3C 3J7   Pavillon Marie-Victorin   Télécopieur : 514-343-2283
                                    90, av. Vincent-d'Indy, bur. B-516   cper@umontreal.ca
                                    Montréal QC H2V 2S9   www.scedu.umontreal.ca/recherche/ethique.html

Université
de Montréal

FORMULAIRE DE CONSENTEMENT

Titre de la recherche : Relation entre la gestion des projets de construction soutenable dans la planification stratégique des organisations: Étude de cas des universités

Chercheur : Benjamin Herazo-Cueto étudiant au doctorat, Faculté de l'aménagement, Université de Montréal

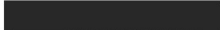**Directeur de recherche :** Gonzalo Lizarralde Ph. D. Professeur adjoint, école d'architecture, Faculté de l'aménagement, Université de Montréal.

A) RENSEIGNEMENTS AUX PARTICIPANTS

1. **Objectifs de la recherche.**
   Ce projet de recherche se concentre sur la relation entre la planification stratégique, la gestion de projets de construction et le développement durable dans un contexte universitaire. Il examine l'implication de la "gestion de projets de construction durables" par la planification stratégique des universités.

2. **Participation à la recherche**
   La participation consiste à faire une entrevue (par téléphone, par vidéoconférence, par rencontre personnelle ou par courriel) à un moment et dans un lieu que vous choisirez. Cette entrevue portera sur votre expérience personnelle en gestion de projets de construction et /ou planification stratégique des universités. Un questionnaire anonyme peut être envoyé pour compléter information. L'entrevue pourrait enregistrée si le participant autorise.

3. **Confidentialité**
   Les renseignements que vous nous donnerez demeureront confidentiels. Les entrevues seront transcrites et les enregistrements effacés. Chaque participant à la recherche se verra attribuer un numéro et seul le chercheur principal et/ou la personne mandatée à cet effet auront la liste des participants et des numéros qui leur auront été attribués. Aucune information permettant de vous identifier en tant qu'individu ne sera publiée. Le document ne comprendra pas les conflits d'ordre personnel (disputes et tensions entre individus) survenus pendant le projet. Cependant, l'étude de cas peut présenter des informations susceptibles d'identifier les organisations qui participent au projet, si ces informations sont nécessaires à la compréhension de son déroulement. Certains postes clés pourront être mentionnés, par exemple : « le gestionnaire de projet a organisée une activité de partnering… ». Les entrevues ne peuvent collecter des informations sur la vie privée des participants au projet. Ils cherchent à collecter exclusivement les informations liées au déroulement du projet et à la participation des compagnies et des organisations. Ces renseignements personnels seront détruits 7 ans après la fin du projet. Seules les données ne permettant pas de vous identifier seront conservées après cette date, le temps nécessaire à leur utilisation.

4. **Avantages et inconvénients**
   En participant à cette recherche, vous pourrez contribuer à l'avancement des connaissances et à l'amélioration des services offerts aux enseignants. Votre participation à la recherche pourra également vous donner l'occasion de mieux vous connaître et de mieux comprendre vos réactions. En participant à cette recherche, vous ne courez pas de risques ou d'inconvénients particuliers.

5. **Droit de retrait**
   Votre participation est entièrement volontaire. Vous êtes libre de vous retirer en tout temps sur simple avis verbal, sans préjudice et sans devoir justifier votre décision. Si vous décidez de vous retirer de la recherche, vous pouvez communiquer avec le chercheur, au numéro de téléphone indiqué ci-dessous. Si vous vous retirez de la recherche, les renseignements qui auront été recueillis au moment de votre retrait seront détruits.

6. **Indemnité**
   Les participants ne recevront aucune indemnité.

7. **Diffusion des résultats**
   La thèse imprimée et des copies numériques seront livrées à l'Université. Aussi, articles académiques seront publiés dans des revues scientifiques.

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B) CONSENTEMENT

Je déclare avoir pris connaissance des informations ci-dessus, avoir obtenu les réponses à mes questions sur ma participation à la recherche et comprendre le but, la nature, les avantages, les risques et les inconvénients de cette recherche.

Après réflexion et un délai raisonnable, je consens librement à prendre part à cette recherche. Je sais que je peux me retirer en tout temps sans aucun préjudice, sur simple avis verbal et sans devoir justifier ma décision.

	Oui	Non
Je consens à ce que les données recueillies dans le cadre de cette étude soient utilisées pour des projets de recherche subséquents de même nature, conditionnellement à leur approbation éthique et dans le respect des mêmes principes de confidentialité et de protection des informations	☐	☐
J'accepte que des images du projet et de son environnement puissent apparaisse sur le document de recherche	☐	☐
J'accepte l'enregistrement d'audio ou vidéo pour cette entrevue.	☐	☐

Signature : _____ Date : _____

Nom : _____ Prénom : _____

Je déclare avoir expliqué le but, la nature, les avantages, les risques et les inconvénients de l'étude et avoir répondu au meilleur de ma connaissance aux questions posées.

Signature du chercheur : _____ Date : _____

Nom : _____ Prénom : _____

Pour toute question relative à la recherche ou pour vous retirer du projet, vous pouvez communiquer avec Benjamin Herazo (étudiant au doctorat), au numéro de téléphone : +1 (514) 343-2108 ou à l'adresse courriel: bj.herazo.cueto@umontreal.ca

Toute plainte relative à votre participation à cette recherche peut être adressée à l'ombudsman de l'Université de Montréal, au numéro de téléphone +1 (514) 343-2100 ou à l'adresse courriel suivante: ombudsman@umontreal.ca (l'ombudsman accepte les appels à frais virés).

Un exemplaire du formulaire d'information et de consentement signé doit être remis au participant

Annex IV. Case Study documents, reports, studies and press releases

Abrassart, C. (2014, 26 August). Site Outremont : Tisser des liens avec les quartiers avoisinants. Conference presented at the Séminaire Grif-ÉnsaV: Innovation, collaboration et participation dans la création de la ville contemporaine, Montréal et Québec, Canada.

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Ali Sirois. (2018, March 6). Not All Green Spaces Are Made Equally. The Link, 38, 40-41.

Antonat, D. (2011). Architecture et mission pédagogique : regards sur le campus de l'Université de Montréal et de l'école des HEC à l'ère d'une société de la connaissance. MSc., Université de Montréal, Montréal.

Arrondissement d'Outremont. (2012). Réunion du comité d'accompagnement de la mairesse de l'arrondissement d'Outremont. 29 mai 2012: Ville de Montreal.

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