

Université de Montréal

**Applying 3D Modelling Technology to Traditional Craftwork:
Rapid Prototyping in Artisanal Jewellery Making and its Impact on the Perceived Value
of Jewellery**

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Résumé

Depuis la révolution industrielle, l'évolution de la technologie bouleverse le monde de la fabrication. Aujourd'hui, de nouvelles technologies telles que le prototypage rapide font une percée dans des domaines comme celui de la fabrication de bijoux, appartenant jadis à l'artisanat et en bouscule les traditions par l'introduction de méthodes plus rapides et plus faciles.

Cette recherche vise à répondre aux deux questions suivantes :

- 'En quoi le prototypage rapide influence-t-il la pratique de fabrication de bijoux?'
- 'En quoi influence-t-il de potentiels acheteurs dans leur appréciation du bijou?'

L'approche consiste en une collecte de données faite au cours de trois entretiens avec différents bijoutiers et une rencontre de deux groupes de discussion composés de consommateurs potentiels.

Les résultats ont révélé l'utilité du prototypage rapide pour surmonter un certain nombre d'obstacles inhérents au fait-main, tel que dans sa géométrie, sa commercialisation, et sa finesse de détails.

Cependant, il se crée une distance entre la main du bijoutier et l'objet, changeant ainsi la nature de la pratique. Cette technologie est perçue comme un moyen moins authentique car la machine rappelle la production de masse et la possibilité de reproduction en série détruit la notion d'unicité du bijou, en réduisant ainsi sa charge émotionnelle.

Cette recherche propose une meilleure compréhension de l'utilisation du prototypage rapide et de ses conséquences dans la fabrication de bijoux. Peut-être ouvrira-t-elle la voie à une recherche visant un meilleur mariage entre cette technique et les méthodes traditionnelles.

Mots-clés : design de bijoux, prototypage rapide, fabrication de bijoux, artisanat.

Abstract

Since the Industrial Revolution, technology has transformed the world of manufacturing. Nowadays, new technologies, such as rapid prototyping, are breaking through in areas that once belonged exclusively to the domain of handicraft, such as jewellery making, by providing quicker and easier means of fabrication.

The methodology of this research uses a mixed approach to answer the two research questions:

- ‘How does rapid prototyping technology influence the practice of jewellery making and its outcome? In what way?’
- ‘How does the use of rapid prototyping technology influence potential users appreciation of a piece of jewellery? In what ways?’

During this qualitative research, data were gathered during interviews with three different jewellers as well as with two focus groups composed of potential consumers.

The results revealed that the use of RP is useful in overcoming some limits of the handmade techniques regarding geometry, marketability and finesse of details. On the other hand it creates distance between the hand of the jeweller and the created object, thereby denaturalising the practice. The technology was found to be regarded as a less authentic means of making jewellery as compared to hand made: the use of machines recalled mass production and the feature of reproducibility was perceived as something that decreased the emotional potential of a piece of jewellery.

This research provides a better understanding of the use of rapid prototyping technology in jewellery making and its implications. It will hopefully inspire the development of ways to better integrate the technology with the manual practice.

Keywords : Jewellery design, rapid prototyping, jewellery making, craftsmanship.

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List of Abbreviations

RP: Rapid Prototyping
CAD: Computer Aided Design
DMLS: Direct Metal Laser Sintering
SLA: Stereolithography
DLP: Direct Light Projector

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Preface

The inspiration for this research project came firstly from my previous studies in industrial design, where I was introduced to different methods of fabrication. It was there where I was first introduced to the rapid prototyping technology, which was presented as the future of manufacturing and the next ‘big thing’, especially within design. The application of the technology seemed to bring numerous advantages to every field it was applied to. I was drawn to the field of jewellery design, as it has been a field of interest to me for several years.

The way that jewellery is represented artistically in social, cultural and historical artefacts has always fascinated me.

To me the most interesting aspect about jewellery is the emotional function, as something that responds to our higher needs to self express.

Jewellery as an object goes far beyond answering the primal needs of human beings
Jewellery is an art form, along the lines of music, painting, sculpture, theatre, etc. you cannot call jewellery an applied art, because it's application is not purely functional like that of a ceramic pot. The function is emotional and very intimate. And it's worth something. Emotional function means you don't have to wear it. It function of our senses. Jewellery is an investment in emotion. (Elenskaya, 2013, p. 32)

Another aspect that has always interested me is the way that jewellery is traditionally made, crafted by hand. The passion and the curiosity towards this craft prompted me to undertake this research.

As I approached the research subject, within this new technology meeting traditional practice, I wanted to understand the use, and the differences of the manual practice. In contrast, I wanted to take a look from a different perspective, and distinguish the identity of the technology applied to jewellery making, craftsmanship has a clear and established identity of attributed values such as uniqueness, skills, experience and quality. I felt that RP did not have such an established image, particularly in the field of jewellery.

Especially after my work experience as a 3D jewellery designer at 123Proto I realized that the technology was deeply changing the nature of jewellery making. The space and the time that was once taken by traditional bench work techniques had been replaced by computers and 3D modelling. This change into a more 'detached' way of making jewellery made me wonder about the value attributed to the traditional handcrafted jewellery and how these values are affected by a different and new making process.

This work is an effort to understand how RP is used in jewellery making and to portray the state of penetration of RP into sector of jewellery making. This thesis aims to have a deeper understanding of the values and perceptions tied to the applications of rapid prototyping within jewellery making.

Chapter 1. Introduction

Within the last few years a lot of excitement and enthusiasm has been built around the development of rapid prototyping and 3D printing. It has been defined by President Obama (2013), during his State of the Union Speech, as the technology that has the potential to revolutionize the way everything is made. The Economist (2012) called 3D printing the third Industrial Revolution that followed mechanization in the 19th century and assembly line mass production in the 20th century. Because of RP's stand-out advantages such as the potential for mass customization, absence of design limitations due to machine constraints, reduced waste material, and reduced logistic costs (UBS, 2013), it reached an extensive and ever increasing, range of applications from engineering, medicine and architecture to more traditional fields such as jewellery manufacture.

This research aims to take a deeper look at a specific application of rapid prototyping, jewellery making. To discuss the effects and the implications of the use of RP in traditional jewellery making, as the artisanal method has been for a long time being the only way to create jewellery.

The traditional handcrafted practice of jewellery making, and rapid prototyping, find their meeting point in a common feature of low quantity but highly sophisticated production goods. But perhaps, since handcrafted objects are perceived as valuable because they are an emblem of uniqueness and human effort (Marzari, 2007), one should question how the technology compares to the manual practice.

This has been articulated in two research questions:

- 'How does rapid prototyping technology influence the practice of jewellery making and its outcome? In what way?'
- 'How does the use of rapid prototyping technology influence potential users appreciation of a piece of jewellery? In what ways?'

This study reports two interviews with professional jewellers and three focus groups discussions with potential jewellery users, to seek practical and empirical outlooks as well as the perspective of the perceived value of jewellery.

The mixed approach between phenomenology and field research, has helped to better understand implications of the application of RP to jewellery from different and complementary perspectives. Firstly, on how the technology is used by professionals today in order to understand strengths and weaknesses compared to traditional manual practice. Secondly, on how the technology is perceived and valued by potential users as a production method compared to the human hand.

The following chapter outlines the context of the research, by describing the three main research fields: jewellery, craftsmanship and rapid prototyping technology. Jewellery is explained through its functions and how those changed throughout history, jewellery needs are also discussed through Maslow's Theory of Social motivation, along with explanations on how perception and jewellery value are built. The field of craftsmanship is described as well as the elements that contribute to create higher value in handicrafts such as skills, experience and the ability of reshaping materials; it also illustrates the relationship between craftsmanship and the use of technology as well as the link to the concept of authenticity. Rapid prototyping is explained along with its features, history and latest applications.

Chapter three discusses the research topic. It examines how the three research fields interrelate with each other. Jewellery making with the two different production processes considered in this study are: crafts and rapid prototyping. First the craft of jewellery making is illustrated with its different techniques along with its significance also determined by the artistic and the aesthetic experience contained in the handmade process. The application of RP technology in the jewellery industry is explained in detail with the description of the different production technologies available and the 3D modelling process. In this section also presented is a short report on a personal work experience at 123Proto, a business that specializes in rapid prototyping services for jewellery. The insight presented in the report serves to enrich the

understanding of the application of the technology in the field. The problem statement is also highlighted in this section, comparing the value of the two making process and questioning how potential users respond to jewellery in terms of its manufacture. Subsequently, the two research questions are posed.

Chapter four focuses on the methodology applied in the research. Firstly the research approach is declared with the research main objectives, the details regarding the two research tools, interviews and focus groups are explained in detail along with the criteria of participants selection, research instruments, data collection, methods and analysis.

Chapter five reports the data collection of the three interviews with jewellers and two focus groups with potential users. Interviews are reported mostly in prose while the focus groups' discussion is reported with direct quotations from participants.

Chapter six analyses and discusses the data gathered in the previous section. First the interviews are examined and compared to each other, then the focus groups content are analyzed, singularly at the beginning and then related to each other. The second part of this section is devoted to discussing the results of the experiments with the intention of answering the two research questions.

Finally, chapter seven offers a general summary of the research along with the research limitations and suggestion for topics for future investigation.

Chapter 2: Context

This Chapter of context aims to explore and define individually the three major fields considered in this research: jewellery as the subject matter, craftsmanship and rapid prototyping with two production methods considered in this research.



Figure 1: The three research fields.

In this section jewellery is defined as an object through which people place various meanings and values, but it can also serve as a functional item. It also portrays the development and changes of jewellery during different historic periods, to show how these decorative items transformed their features overtime and how the technological advancement has influence on their production. The needs of jewellery are explained with the Maslow's pyramid and its Human Motivation theory, alongside with its social value and perception.

The second research field, Craftsmanship, is also defined as a production method with an overview on its added values, its relationship with technology and on the link between the concept of authenticity and crafts.

Finally the third research field that is presented is rapid prototyping technology. The function and features of the technology are explained also with an overview of its background and rising applications.

2.1 Jewellery

Jewellery is a type of object that could have different physical features, significances and functions (Tythacott 2011). An item of jewellery is often a personal object, but it could also be an object belonging to a family, which is transmitted from generation to generation, as in the case of a family heirloom.

Jewellery is used to fulfil various tasks, both practical and representative. In some cases jewellery is used as a currency and a means to display or store value. In numerous cultures, families pass on wedding dowries of jewellery to store value. It is used as a means to embody different values and features, such as status symbol and reference to a memory. Jewellery is also symbolically invested with meaning, allowing it to communicate different values: beliefs (religious, faith), emotional values (wedding, engagement) and group membership (symbol that unites a group of people together) (kunz, 1915, p.314). A jewel's symbolism depends on the culture and context in which it is created/used. The complexity in understanding the world of jewellery lies in understanding the value of their underlying symbols and the plurality of their meaning in different contexts.

The field of Jewellery is therefore hard to define because it does not have a single prevailing function (Morris, 1999). Nonetheless, a jewel's meaning can be assessed according to three notable factors:

1. The context in which it is handled;
2. Its materiality and relation to individuals;
3. Its creator and its user.

2.1.1 History

Since the dawn of time, driven by different intentions, humans have felt the need to adorn the body. The birth of body adornment dates back to the origin of humanity. This study is an excellent means to reconstruct the history of humankind through its costume, traditions and beliefs, to technological knowledge and aesthetic tastes. The ornaments are signs of communication, instruments that have a particular function and possess a specific purpose (Codina, 2012, p.14)

Jewellery is a category of ornamental objects that comes from a long history and tradition. In the past jewellery tended to be oriented towards representation. The meaning of the object had more relevance than its actual form.

2.1.1.1 Ancient Jewellery

Many civilizations produced their own versions of simple decorative items during prehistoric times, but sudden the rise of technology in ancient Egypt and Mesopotamia proved to be an instrumental moment, in which jewellery finally started gaining shape of modern items that are in use today. Ability to forge bronze and copper began around 7 thousand years ago and it finally enabled the creation of highly detailed jewellery that carried designs of animals or other elements, something that could never be done before.

2.1.1.2 Egyptian Jewellery

The Moment that defined the start of Egypt rise in jewellery production was the discovery of gold and the ways to easily collect it from available riverbeds some 5 thousand years ago (Ancient Egyptian Jewelry, 2013, para. 2). The Egyptians viewed the softness of gold as perfect material for creation of elaborate jewellery designs. Golden jewellery quickly became symbol of status, power and religion, which enabled it to become a lifetime focus of many royal and noble families. Egyptian nobles did not carry their expensive jewellery during everyday life; they wore it in death, left by their side in elaborate burial ceremonies.



Figure 2: Bracelet of Tutankhamun with Scarab. Gold, Lapiz Lazuli, carnelian, turquoise, quartzite. New Kingdom: 18TH Dynasty. Retrieved from: <http://www.egyking.info/2012/03/ancient-egyptian-jewelry.html>

2.1.1.3 Jewellery in Mesopotamia

Mesopotamia, so called "birthplace of human civilization", was one of the first places on earth where rise of the technology, religion, science and knowledge enabled our race to exit prehistoric times and enter into modern era. With the spreading of technology and rise of nobility and royalty, human need to express themselves and showcase status, power and religious affiliation gave birth to the sprawling and advancing tradition of jewel making.

Because of their immense wealth, the use of jewels in Mesopotamia was not confined only to nobility, royalty and religious leaders, the entire population accepted decorative items and jewels into their daily routine (Development of Jewelry in Mesopotamia, 2013, para. 2).

Their jewellery had many motifs. Most notably they used leaves, branches, twigs, grapes, cones, spiral objects that were imprinted into the jewellery by the means of engraving, granulation, filigree and many other techniques.

2.1.1.4 Ancient Greek Jewellery

Jewellery in ancient Greece was viewed as a symbol of power, social status, ward against evil, celebration of the gods and was mostly used by female members of wealthy class. Development of great Greek Mycenaean civilization brought the first great rise of jewellery

use. Gold became primary decorative raw material, although silver, lead, bronze and various alloys were also used.

The Hellenic period and arrival of Alexander the Great brought an influx of gold, precious gems and oriental influences to Greece, but the fall of Greece under the control of the Roman Empire in 2nd century BC brought many drastic changes to their style of jewellery making. Influences of Christianity and formation of Byzantine Empire enabled the renaissance of their style, spreading of high quality jewellery and great regard toward the skilled jewellers.(History of Ancient Greek Jewelry, 2013, para. 1)



Figure 3: Hoop earring terminating in the head of a maenad, Greek, Hellenistic Period, about 250–160 B.C. Retrieved from <http://educators.mfa.org/ancient/hoop-earring-terminating-head-maenad-75637>

2.1.1.5 Jewellery in Ancient Rome

Due to its long realm and the influential position in the European continent, the Romans managed to collect influences of many conquered and neighbouring civilization. With the ability to access a wide range of raw materials from their extensive resources around the continent and the knowledge from the civilizations near them, jewellery from the Roman

Empire was considered to be of a very high grade, both in art form and manufacturing process. (Jewelry in Ancient Rome, 2013, para. 2)

However, even with the abundance of various decorative items produced by their neighbours, the Roman population preferred to dress simply, and only wear a few pieces of jewellery. One of the most common and popular items of the Roman time was used to secure clothing together, and rings, which were considered as one of the only pieces of jewellery that was acceptable to be worn by men (Jewelry in Ancient Rome, 2013, para. 2). It was this style of carrying rings that gave birth to "signet rings", used to impress sigil of the wearer's rank or family crest into the wax. In addition to that, Romans also used jewellery such amulets, talismans, bracelets, earrings with which to protect from evil spirits and curses (evil eyes).



Figure 4: Golden ring with a garnet, Roman, 3rd Century AD. Retrieved from: <http://www.sixbid.com/browse.html?auction=823&category=17990&lot=808915>

2.1.1.6 Middle Ages

During the first 500 years, the Middle Ages in Western Europe remained mostly isolated due to frequent wars, famine and technological stagnation. The only preservers of art and interest in keeping the jewellery making alive were Nobles, royal families and the Catholic Church.

A more general stability was brought after 1000 CE and enabled the resurrections of many art forms, including jewellery making, especially since most of European population converted to Christianity that enables easier sharing of art and advancement of technology. By the end of 13th Century, the rise of the middle class brought the wealth and art to the general masses and enabled Europe to prepare itself for the birth of the Renaissance (Codina, 2012, p.20).

2.1.1.7 Renaissance

Between the 17th and 19th century Europe experienced a rapid expansion of knowledge, technology, art, science and exploration. These later had a profound impact on the jewellery making industry. During this period, the expansion of crafts and developing geographical exploration and trade, increased availability of a wide variety of gemstones and influenced the jewellery market through two factors: materials and shape. As the wealth started to flow evenly to the lower classes of people, acquisition of jewellery and valuable raw materials (gold and gems) quickly become a widespread norm that enabled everybody to invest in small and portable items (History of Renaissance Jewelry, 2013, para. 2).

At the beginning of the 19th century, Napoleon Bonaparte revived the style and grandeur of jewellery in fashion; at that time “parures,” were introduced, suites of matching jewellery and cameos. At that time the distinction also emerged between *bijoutiers*, jewellers who worked with cheaper materials, and *joailliers*, those who worked with more expensive and finer materials.

2.1.1.8 Jewellery During the Romantic Era

After the Renaissance, the European jewellery style was deeply influenced by the reign of Queen Victoria, which brought fascination to archeology and ancient treasures. Between 1861

and 1885 'mourning' jewellery was first introduced, which were made of jet, onyx and black glass. Before that time it was not custom to wear jewellery during mourning.



Figure 5: Example of mourning jewellery during the Victorian period. Retrieved from: <http://www.braunschweiger.com/custom.aspx?id=2>

During the 19th century there was a profound impact on the development of western jewellery due to the change of social condition occasioned by the onset of the Industrial Revolution. This modified the quality of life in all parts of the Western world. Thanks to this, jewellery items became more and more affordable even for those who did not belong to the bourgeoisie. The impact of the Industrial Revolution on European society of the second half of the nineteenth century is the context in which the innovative ideas of John Ruskin and William Morris emerged. They denounced the mechanization and division of labor that did not allow an authentic relationship between the worker and the manufactured products. (Codina, 2012, p. 20) In the context that involved new social ideas and a romantic vision of medieval tradition, the value of craftsmanship and the introduction of art in everyday life, these proposals constituted the ideology of the British movement of Arts and Crafts.

These innovative ideas are reflected at the end of the 19th century in a new international style, whose strong social roots radically transformed the world of arts, and more particularly applied arts.

2.1.1.9 Art Nouveau

A new style with naturalist inspiration appeared, Art Nouveau, encompassing many distinct features, including a focus on the organic and the female form, and an emphasis on colour. For the first time in the history of jewellery more value was given to creativity and imagination than to the materials used. This revival gave more freedom of creation to jewellers and allowed some of their works to reach the rank of true works of art. (Codina, 2012, p. 20).

Some of the most celebrated jewellery artists were Georges Fouquet, Lucien Gaufrat, Louis Comfort Tiffany and René Jules Lalique.



Figure 6: Brooch from René Jules Lalique (1860 - 1945), gold, opals and turquoise. Retrieved from: <http://www.aboutjewellery.it/public/2011/5/rene-lalique-7/#!prettyPhoto>

2.1.1.10 Art Déco

With the advent of Art Déco, the second great movement of industrial arts, jewellery making developed a trend in which the value of materials predominates, but also an industrial production base of new artificial materials such as galalith, bakelite, nickel and chrome. The main features of Art Déco were rich colours and bold geometric shapes.

During the same period, Walter Gropius and the German Bauhaus movement, with their philosophy of "no barriers between design, artists and craftsmen" and with the integration of creation to the industry, pioneered interesting and stylistically simplified forms in jewellery using modern materials such as plastics and aluminium.

2.1.1.11 Contemporary Jewellery

Between 1980 and the end of the '90s, conventional jewellery lost its connotations of being ostentatious and luxurious and developed a style with sober and elegant lines using gold and precious stones. Simultaneously, creative jewellery divided in two distinct trends, marking the end of the twentieth century and continuing today. On one side there is jewellery associated to the universe of fashion and trends; on the other hand there is the kind of jewellery that engages in the expression of universal values, reflects self-expression, and the complicity with the person who wears the jewel and responds to simple aesthetic pleasure (Codina, 2012, p.21).

Also in the postmodern era jewellery went through an even wider democratization, not only regarding materials but also of styles, numerous forms and inspirations from the past have been brought back into fashion, where every style became available again thanks to the extensive knowledge, communication and technologies. (Contemporary Jewellery, 2014, para. 10)

The function and appearance of jewellery have evolved over time. In early history the meaning of the jewel was much more relevant than the physical properties were. However, later in history, appearance became the new "function" of jewellery, with the continuous evolutions of different styles, with technological advancement and the discovery of new materials. Appearance became important for the presence of the object to capture attention and

impress its audience (Dormer & Turner 1994, p. 62). Jewellery became so perceptible that it was an easy target for social comparison (Kaiser, 1998) as well as a conceptual vehicle: both a container and creator of cultural meaning, a fully loaded artefact that has evolved to reflect our society (Skov 2008).

2.1.2 Jewellery Needs, Values and Perceptions

By taking a look at the pyramid of Maslow from his Human Motivation theory, it can help us understand where the needs of jewellery comes from and where it is located in the famous pyramid of basic needs.



Figure 7: Maslow hierarchy of needs. Retrieved from: <http://www.simplypsychology.org/maslow.html>

In the Maslow's hierarchy needs are shown from low level to high level; physiological (basic needs), safety and security (shelter etc.), socialistic (acceptance, friendship), egoistic (success, self esteem), and self actualization (enriching experiences) (Arnould et al, 2004, p. 270). By looking at jewellery in the Maslow Pyramid, it can be said that it corresponds to the third and fourth levels, socialistic and egoistic needs. The needs of jewellery it is also interestingly linked to the concept of social motivation; it contains the needs for social contacts or affiliation of being accepted by others, and having power over others (Antonides and Raaij,

1998 p. 167). Jewellery is also a tool through which people project their self-image and one can easily observe that many use jewellery perhaps to gain social recognition (Jokinen, 2011 p. 18). Even more, jewellery causes emotions; it is evident that emotions are an element effecting consumers and users perception of aesthetic objects (Lagier and Godey 2007, p.39), this means that the individual can regulate his on her emotion to achieve desired states by using the product.

The perception of jewellery, as the identification and interpretation of sensory information regarding decorative items can be grouped in a few key entities: the *product*, its *materials*, the *brand*, the *seller*, the *store*, the *manufacture* and the *origins* of the product, and the *individual* who is making the purchase. These factors are crucial to build perception. In fact users and consumers often do not have full access to all information about such products. Details such as cost, scarcity of the material, experience and technical knowledge to make the object, hours of work are indeed elements that play a relevant role in the perception of a product, often related to luxury, such as jewellery.

The essential way to describe luxury is principally beautiful objects, object that have certain images and emotions attached to them. (Such as quality, durability or performance, status and wealth). For example one of the key images related to jewellery is craftsmanship, due to its characteristics of high price, high cost, limited distribution, low promotional activity, and advertising with no sophisticated copy strategy (Jokinen, 2011 p. 30).

2.2 Craftsmanship

The world of crafts is characterised by a very long history and tradition that derives from our culture. Crafts are a meaningful way to produce, because they represent the human capacity to adapt to the surrounding environment through the manual construction of tools and artefacts (Sennett, 2008). It embodies the ability of the hand to reproduce whatever the eye sees or the mind imagines (Trilling, 2001, p.61).

The method of manufacturing handicrafts is exactly the opposite to the one adopted in industrial production. The latter produces objects in series that are identical one to another; it

makes them cheaply, through the economy of scale, to produce a large quantity of identical items to be sold to many consumers at an affordable price. Handcrafts on the other hand feature little or no economy of scale.

2.2.1 The Added Values of Crafts

One of the greatest strengths of crafted products is the emotional connection that it can trigger in its users. The values of crafts lies in the consumers' engagement through skills, materials and experiences, the combination of these three elements produce higher value goods (Montgomery. 2012, p.11).

Skills: The evolution and maintenance of skills in craftwork represent the centre of the practice. Few factors influence the perceived value of a skill: in proportion to the need for it, the respect and the desire for it and whether or not we possess that skill (Montgomery, 2012, p. 17).

Experiences : The relationship between craft value and experience is dictated by different factors, as price, the experience the item promise and the status conferred by ownership or use. Crafted objects often hold experiential characteristics: uniqueness, high quality, bespoke fit, known origin and tactility all of which influence the way they are consumed.

Materials in the raw state are defined by its financial value in the global market. It is through craft's ability that the materials are subjected to reshaping, personalisation. These later elevate the materials, that bares a higher meaning and it is where the value it is found.

The value and appreciation brought into products through craftsmanship is through the sense of narrative and the user's desire to be included in the process. Which makes it much more than the mere action of buying or owning, but engages the consumer in the whole experience of understanding and bonding with the objects.

Craftwork give the consumer a connection with the item they have bought, it offers more than instant gratification, it delivers a dialogue with the consumers each time it is used (Montgomery, 2012, p.11)

As Richard Sennet (2008) stated “Thinking and feeling are contained within the process of making”, crafted objects constitute a mean through which these senses are passed on to users, that find crafted products meaningful, aesthetically pleasing and that have a story to tell about how and why they were made.

Good craftsmanship encourages emotional bonding not just between the work and its creator but also the work and the consumers, for whom the appreciation of the product and its narrative can trigger gratifying associations and memories (Montgomery, 2012, p.6)

2.2.2 Handicrafts: Limitation Suggested by Tradition

For hundreds of years, manufacturing was done by physical labor, in which a person with hand tools used craft skills to make objects. Since the industrial revolution two hundred years ago, machinery has played an increasing role in manufacturing. (Kenneth, 2001, p. 1)

Since the Industrial Revolution, crafts have been subjected to a major downsizing and have become in some ways obsolete, in the sense that nowadays crafts do not really reflect our contemporary way of producing, using or consuming products.

The Industrial Revolution dramatically increased the availability of consumer goods. Products were available in outstanding quantities, at outstandingly low prices, being thus available to virtually everyone (Ritzer, 2007, p. 12). This phenomenon limited crafts to areas that large-scale industry could not satisfy. Crafts nowadays serve more of a niche, the gift market for instance. The obsolescence of crafts is mainly due to the fact that craftsmanship is so strongly tied to traditional methods of production. There are limitations imposed by tradition: crafts look backwards, which is no longer supposed to be a virtue in our contemporary times when we are surrounded by high-technology, high-performance devices that make our society totally projected toward the future. (Alfoldy, 2005, p.215)

2.2.2.1 The Dilemma of the Machine

The greatest dilemma faced by the modern artisan-craftsman is the machine. Is it a friendly tool or an enemy replacing work of the human hand? In the economic history of skilled manual labor, machinery that began as a friend has often ended up as an enemy. (Sennett, 2008, p.99)

The relationship between the artisan and the machine has become difficult. Since craftsmanship is based on the development of practical abilities, that is, repetitive and concrete practice, the division of the mind and the hand along with the use of the machine ultimately threaten and damage the quality of the outcome. When technology is used to replace the manual labour too quickly, craftsmanship finds itself confronted with contrary criteria of quality (Sennett, 2008).

As machine culture matured, the craftsman in the nineteenth century appeared ever less a mediator and ever more an enemy of the machine. Now, against the rigorous repetition of the machine, the craftsman has become an emblem of human individuality.

One of the biggest limitations on crafts is the rejection of technology for fear of losing authenticity (Alfoldy, 2005, p.13). Handicrafts never renew their means of production, considering the hand as the one and only means by which they legitimately operate. The means of the hand are conceptually very powerful and meaningful, but it is also a limit in itself.

In history crafts were born as a necessity, nowadays they exist more for pleasure and privilege (Margetts, 1991). What was once a way to produce functional items has become a practice to produce items where function is no longer obligatory but is just mere proof of the “*savoir faire*”, where the object, at times, has no thinking behind and the use of the skill is itself the justification (Alfoldy, 2005).

2.2.3 The Authenticity of Crafts

The complexity of this relationship between the hand and the machine is arduous as well as ambiguous to define, as there are no written rules about the use of the technology into craftwork, yet the hand processing of material is considered more authentic, as it is capable to imbues an object with deeper meaning to its consumers. In other words, authenticity carries with it an almost sacred, cultural type of interpretation that conveys value (Frazier et al., 2009).

The concept of authenticity has a plurality of definitions, the ones that support the discourse regarding crafts work are those that derive from existential philosophy that states that authenticity conveys moral meanings about the values and choices embedded in an object. Or also from Grazian's (2003, p.10): the meaning of Authenticity refers to the "credibility of an object and its ability to come off as natural and effortless".

The idea of authenticity is sociologically defined as a socially constructed phenomenon, which means that certain aspects of a product somehow are perceived and treated as more authentic by audiences in a particular social context. (Carroll, 2008, p.11)

The perceived authenticity is something that belongs to the world of craft work, first because of the general fascination to products made with traditional methods, which reflects a reaction against the loss of personalized self in contemporary mass society. Crafted objects emphasize self-expression and quality of life (Holt, 1997, pp. 326-350) especially in western society where the choice of objects is used to make personal statements.

2.3 Rapid Prototyping

Rapid prototyping (RP) is a technology that permits the automatic construction of physical objects and models using an additive manufacturing technique (Noorani, 2006). At first, this technology was intended for the production of models and prototypes and verification of concepts with the possibility of having aesthetic and mechanical properties. Nowadays RP is also used to produce finished products, printed either locally where items are needed, or remotely, and marketable right away.

The ability to create, reproduce and change the features of an item is achieved by using virtual designs from computer-aided design (CAD). The process begins with the creation of geometric data, through 3D modelling or 3D scanning. Through computer software, these designs are ‘sliced’ in three-dimensional horizontal sectioning. This organization of superimposed layers, allows a layer-to-layer physical building process. This technology, in principle bridges the gap between software and hardware, between virtual and real.



Figure 8: Layer by layer printing process. Retrieved from: <http://www.3ders.org>

2.3.1 Features

Traditional manufacturing processes set constraints on the shape of a produced object. In contrast, one of the most important features of RP is the almost absence of constraints on form and an acute sensitivity to highly precise designs. As the designs are created through 3D modelling, which is the procedure of developing a 3D model using specialized software, it removes the geometrical restrictions of conventional techniques, allowing lighter, more energy-efficient parts with the same mechanical properties as conventionally manufactured ones to be made (Wang 2013, para. 4). The outcome demonstrates an endless array of possibilities and options in terms of the complexity of a given design, which cannot be found in mass-produced items. Rapid prototyping is thus an instrument of great potential for modern design and the experimentation of new shapes and geometric particularities.

Other key characteristics of this technology include:

- The possibility of customization: there is no need for preliminary manufacturing; it is possible to make changes by modifying the 3D model, thus creating the possibility of 'mass-customization', that corresponds to producing goods and services to meet individual customer's needs with near mass production efficiency"(Tseng, Jiao 2001, p.685)
- The possibility to cater exactly to individual consumer needs (mass individual marketing).
- Tools for refinement: detailed verification of an object's features before committing to production (savings in the manufacturing of moulds and extrusion machines for the prototypes that are subject to change).
- Decentralized fabrication: a digital model of an object can be sent in numerical format through the internet, via email, making business relations faster and more effective (lower distribution costs and on-demand production and logistics advantages). Manufacturing can be demand-driven (an item can be printed only when requested by a customer) and not supply driven (mass items are produced by factories in large quantities for warehouses).
- Production is more cost-efficient, involving the minimization of trial and transportation costs; overall waste reduction, also known as 'lean production' because it provides a way to do more with less while remaining customer-oriented and attentive to the particular needs of each client. There are added valued advantages all over the supply chain, from raw materials to customers' satisfaction.

The materials that can be used in rapid prototyping are diverse, ranging from polymers to paper and metals, leading to its adoption for prototyping purposes in various industries.

2.3.2 History and Applications

Rapid prototyping represents quite a recent technology, the first rapid prototyping stereolithography system was used for the first time in the late eighties. Since then the technology has shown exponential growth, firstly through the companies and service bureaus that made the RP available, secondly through many competitive technologies that were released.

When Z Corporation began selling its 3D printing system, in 1996, the technology broke two barriers; speed and cost. This combination was a recipe for success. By addressing the user demands of faster and cheaper rapid prototyping technology, the company also spurred the development of a new industry segment, 3D printers (Grimm, 2004, p.20). Between 1988 and 1997, the industry had tremendous growth, averaging 57% per year (Wohlers, 2003).

The impact of rapid prototyping reached far and wide. There is diversification in the application of the technology nowadays, the common element being that RP is faster and cheaper (Grimm, 2004). The application of this technology varies from manufacture, industrial design, engineering, biomedical development and jewellery manufacture. Latest trends show that additive fabrication is already making its way in the field of medicine with the printing of living tissue and organs.

One of the latest trends within this technology is the shifting of the market towards affordable machines addressed directly to private consumers, for entertainment and education. RP is still a relatively recent technology, so the future of RP is hard to predict. Yet there are some predictions that can be offered, firstly that this technology is here to stay, secondly that as the industry quickly develops, new methods, new applications and new materials will expand the impact of RP (Grimm, 2004, p.47).

2.5 Conclusion

This section was devoted to describing and defining the three main research fields: jewellery, craftsmanship, and rapid prototyping.

Jewellery has always served as a social and cultural vehicle and has been transformed throughout history, its function is becoming more and more connected to physical appearance. As time evolved jewellery was ever more devoted to reach aesthetic perfection but also exploring new methods and materials.

The needs of jewellery were explained through Maslow's theory with socialistic and egoistic needs, such as acceptance by others and to project self-image. The identification of jewellery needs gives a better understanding of the nature and the importance of such items within society and culture.

Craftsmanship is a meaningful and traditional means of production and represents the ways in which people adapt to their environment by producing artefacts and tools. Crafting was an art that began out of need; however, it evolved into decorative art when the industrial revolution fulfilled the functional and utilitarian needs of man. The strength of craft is represented by creativity, uniqueness and individuality as well as the emotional connection that crafted object can trigger in their users, through skills, materials and experiences and authenticity. The relationship between handicrafts and technology has always been difficult to define, on one hand technology could represent a way to renew the means of craftsmanship, on the other it threatens its authenticity.

Rapid prototyping is a recent production technology that is changing the rules of manufacturing by enabling customization, decentralized fabrication, a more cost efficient and on-demand production. This technology is growing quickly due to its flexibility, the on going expansion of the materials used, and the rising number of fields in which is integrated.

As rapid prototyping is enlarging its domain of action, the technology is starting to be used in fields that not long ago exclusively belonged to the field of craftsmanship, such as jewellery.

The two production processes explained in this section are brought together in the next section as two distinct methods of jewellery manufacture. As these two approaches show remarkable differences, this research focuses on their common implications in the field of jewellery.

Chapter 3: Research Topic

This section correlates the main research field of jewellery to the other two: craftsmanship and rapid prototyping. As the general features of these two production methods are illustrated in chapter 2. This section describes more specifically the two making processes regarding jewellery.



Figure 9: Research model with three research fields put into context.

First, the attention is brought on the craft of jewellery making with an explanation of the different techniques of metalworking and wax sculpting. The significance of the craft of jewellery making is illustrated as well as the link with the aesthetic theory of Dewey regarding the artistic and aesthetic experience of making and undergoing art (more specifically regarding the jeweller and the user).

Rapid prototyping application for jewellery is delineated through the explanation of the different production technologies along with the modelling methods. In addition, this section reports a description of personal working experience at 123 Proto, a Company based in Montreal, specialized in jewellery production with rapid prototyping technology. The insights offered are an integration of the knowledge about RP in the traditional sector.

Finally, the discussion is brought together in the problem statement and successively in the generation of two main research questions concerning the two complementary standpoints on the issue, the one of the maker and of the potential user:

1- ‘How does rapid prototyping technology influence the practice of jewellery making and its outcome? In what ways?’

2- ‘How does the use of rapid prototyping technology influence prospective users appreciation for jewellery? In what ways?’

3.1 Making Processes

Jewellery objects can be made in different ways: both industrially and by hand, depending on the materials used and on the purpose of the user. There are a variety of materials that a piece of jewellery could be made up of; the biggest distinction is between precious and non-precious jewellery.

In modern times, fine jewellery mostly uses materials like gold, white gold, platinum, palladium, titanium or silver. The handling and the processing of such material is traditionally done by hand by craftspeople: silversmiths, goldsmiths, and lapidaries. Another system widely used for the production of jewellery is wax carving for the ‘lost wax’ casting process. Until a few years ago this method was executed entirely by hand.

Nowadays, technology makes it possible to create a wax model either through subtractive manufacturing such as CNC machining or through additive manufacturing technology such as rapid prototyping. In order to understand the nature of these two distinct processes, craftsmanship and rapid prototyping technology, further sections are dedicated to illustrate their key features and capabilities.

3.1.1 The Craft of Jewellery Making

Handmade jewellery making is the jewellery which has been assembled and formed by hand rather than a machine (Bone, 2012, p.8). The handmade processes in jewellery making include

a large variety of techniques, which are generally divided into two categories: metal working and wax sculpting.

3.1.1.1 Metal Working

Metalworking is the creation of jewellery through the manipulation of various metals, these techniques are divided in two kinds: hot and cold connections.

3.1.1.1.1 Cold Connections

This term means to join or ‘cold join’ materials without the use of flame or solder. This technique allows an artisan to join materials that would otherwise melt in the soldering process (Bone, 2012, p.34). Cold connections are done in different ways, from the cutting, filing and shaping of a metal to its forging, riveting, chasing and texturing.



Figures 10 and 11: Examples of cold connections, chasing (left) and texturing metal (right).

3.1.1.1.2 Hot Connections

These techniques involve the use of soldering as a method of joining metals using an alloy (solder)(Chin, 2011, p.58). The main tools used in the soldering process include a torch to heat the metals, tweezers and picks to apply the solder. Texturing techniques are also executed by

reticulation, where the heat is used to deliberately melt the surface of the metal and create a texture.



Figures 12 and 13: Examples of the use of soldering into jewellery making (left) and reticulation (right).

3.1.1.2 Wax Sculpting

Wax sculpting is the shaping manual processing from a solid block of wax with the help of files and chisels. By sculpting a piece of jewellery into wax, it is possible to duplicate the sculpture into metal through investment casting.



Figure 14: Hand Carved Wax for a Multiple Marquis Cut Diamonds Band Ring. From diamondgalleriesd.com

3.1.2 The Significance of Hand Making

Handcrafted jewellery is generally perceived in Western society as more valuable than pieces that are made industrially (Marzari, 2007, p. 4); due to the positive value placed on variations, flows and irregularities in hand work. (Sennett, 2008, p. 149).

In traditional handmade jewellery making each piece is processed individually and it is typically not possible to recreate an object identical to another. Uniqueness is indeed the strength and appeal of handmade jewellery. Whether this is exhibited by tiny imperfections or the minor differences in shape from one piece to the next, rarity is ultimately a distinctive feature that invites people to identify with handcrafted items and resonates a particular meaning within them. Indeed, crafted goods can become instilled with an individual's personal value, especially when these objects are kept continuously close to the body, as in the case of jewellery.

3.1.2.1 Artistic and Aesthetic Experiences

A relevant theory regarding the significance of hand making, and more in general to the making of art, has been elucidated in by John Dewey, regarding experiencing art, which belongs to the Aesthetic theory. Dewey has explained the relationship between the experience of making a work of art and the experience of perceiving it. Also meaning the work of art as an outcome of crafts.

Since the actual work of art is what the product does with and in experience, the result of this relationship can be quite hard to define, In addition, the perfection of some of these products, such as the outcome of crafts, because the prestige they possess and a long history of unquestioned admiration, it can creates conversations that impede fresh insight on the matter. (Ross, 1994, p. 205)

Having an experience is defined as knowledge or skill of something gained through involvement in or exposure to a thing or an event (Experience, 1989), it is also defined by Dewey as a flow from something to something else, "as one parts leads to an other and as one

part carries on what went before, each gain distinctness in itself'. In this case we can consider two different kind of experiences: making and undergoing art, which distinction between aesthetic and artistic, that ultimately are brought together through the work of art, or crafted object.

Artistic Experience

In the artistic experience, the art denotes a process of doing or making, in which the artist's expression is made of personal action and the objective result, both creates the product or work of art. The individual contribution of the artist makes the object expressive, which is able to say something about its creator. This process of expression is also significant as a process of discharging personal emotion.

Craftsmanship to be artistic in the final sense must be 'loving'; it must care deeply for the subject matter upon which skill is executed. The doing or making is artistic when the perceived result of such a nature that its qualities as perceived have controlled the question of production. The act of producing that is directed by intent to produce something that is enjoyed in the immediate experience of perceiving has qualities that a spontaneous or uncontrolled activity does not have. The artist embodies in himself the attitude of the perceiver while he works.... (Ross, 1994, p.208)

Aesthetic Experience

The word 'aesthetic' refers to experience as appreciative, perceiving and enjoying. It denotes the user's rather than the producer's standpoint. The potential user relates to the artist through the perception of the product. Since the experience is imaginative, there is always a gap between the interaction and perception of the present moment and the past interactions.

The experience become conscious, a matter of perception, only when meanings enter it that are divided from prior experience. (Ross, 1994, p.218)

The result of our past interaction constitutes the meaning with which we grasp and understand what is now occurring. Because of this gap, all the conscious perception involves a venture of the unknown. When an aesthetic object is separated from its condition of origin and operation in experience, a wall is built around it and that makes the significance of the object unclear (Ross, 1994, p. 218).

Dewey's Aesthetic theory explains the relationship between the artist, the artistic object and the user that can be easily applied to a similar system: jeweller, piece of jewellery and user. The relevance of this theory could support this study to assess how different means of production such as RP influence the perception of jewellery as an artistic and aesthetic object.

3.2 RP: a Flexible and Capable Technique

The introduction of rapid prototyping is slowly changing the traditional ways of jewellery production and providing the field with effortless and quicker ways of fabrication compared to traditional methods (Brown, 2011, para 4).

This technology also overcomes formal constraints, such as the limitations dictated from the hand making process. Due to its capacity to build very complex shapes with no waste of material, RP can meet the new needs of emerging trends from jewellery forms.



Figure 15: Layer Twist ring in brass, designed by Nervous System. Retrieved from: <http://www.shapeways.com/materials/brass>

This change in jewellery forms, which highlights the beauty of intricacy, denotes the will to challenge style in many ways: complexity, structure, materials, process, form and content; all join forces in these works to pursue the exploration of beauty through radical and sometimes subversive action (McFadden et al. 2008, p. 35).

3.2.1 Rapid Prototyping Application for Jewellery

The application of additive manufacturing to jewellery making represents both a hybrid process, in which the automated manufacturing process is combined with traditional hand processing of the material, and a completely automated process that enables direct metal production which can almost eliminate hand processing all together.

The incorporation of this technology in the jewellery sector is typically seen as being advantageous for highly complex, low batch products which are produced with expensive raw materials (UBS, 2013, p.28).

3.2.1.1 Production Technologies

For jewellery applications, the additive processes that produce parts with the tightest tolerances and the highest resolutions have driven deepest into the sector. The processes that have had notable success within the jewellery market are: DMLS (direct metal laser sintering) process from EOS, the Perfactory process from Envisiontech, the SLA process from 3D System, and Solidscape's range of additive machines, utilizing wax materials. (Park, 2013)

DMLS - Direct metal laser sintering is a layer-building technology to quickly manufacture high quality metal parts. The machine for DMLS operates with a fine 20 micron thick powdered metal that is evenly dispersed across the build area. A laser melts or fuses the individual grains together, leaving an end product that is 98% dense with a semi-finished surface. DMLS is the only technology that prints directly into metal, all other processes use polymers.



Figure 16: Necklace made with DMLS EOS machine, printed directly in gold.

Perfactory - Is a technology that allows printing high-resolution pieces using direct light projection technology. It builds solid 3D objects by using DLP (direct light projector) to project sequential voxel planes into liquid resins, which then causes the resin to solidify.

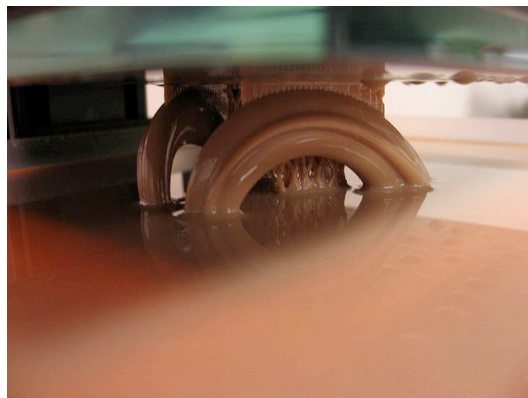


Figure 17: EnvisionTEC Perfactory 3D printer in process.

SLA - This system consists of ultraviolet laser, an optical scanning system, a vat of photosensitive epoxy material, an elevator platform, and software that controls exposure and position of the laser and the elevator. The laser hardens each of the ultra thin resin layers to build up, layer by layer, precise parts with a very fine surface structure.

SolidScape's Additive Machines - 3D Wax printers for rapid prototyping and creating master moulds used for investment casting. This 3D printing technology builds a model by depositing wax onto a build plate to create 3D models.

3.2.1.2 Modelling Process

Another important factor concerning the application of rapid prototyping is digital 3D modelling, the first stage of the rapid prototyping process. 3D modelling is a process of creating a wireframe model that represents a three dimensional object. The model is created using a set of points in a 3D space, which are connected by various geometric entities such as lines and curved surfaces. Nowadays, there are many 3D modelling software packages and tools for different purposes. 3D modelling represents the link between the idea and the prototype or finished product in the rapid prototyping process, as it is the way the designer interacts with the technology.

3D CAD software has a significant effect on jewellery design, as it allows jewellery designers to virtually design around an existing stone. This gives the possibility to personalise the model or also the ability to create complex geometries that were previously not possible. The use of these kinds of CAD softwares allows for more control and precision over the design of a piece of jewellery and also alterations of the virtual model without having to start over again each time.

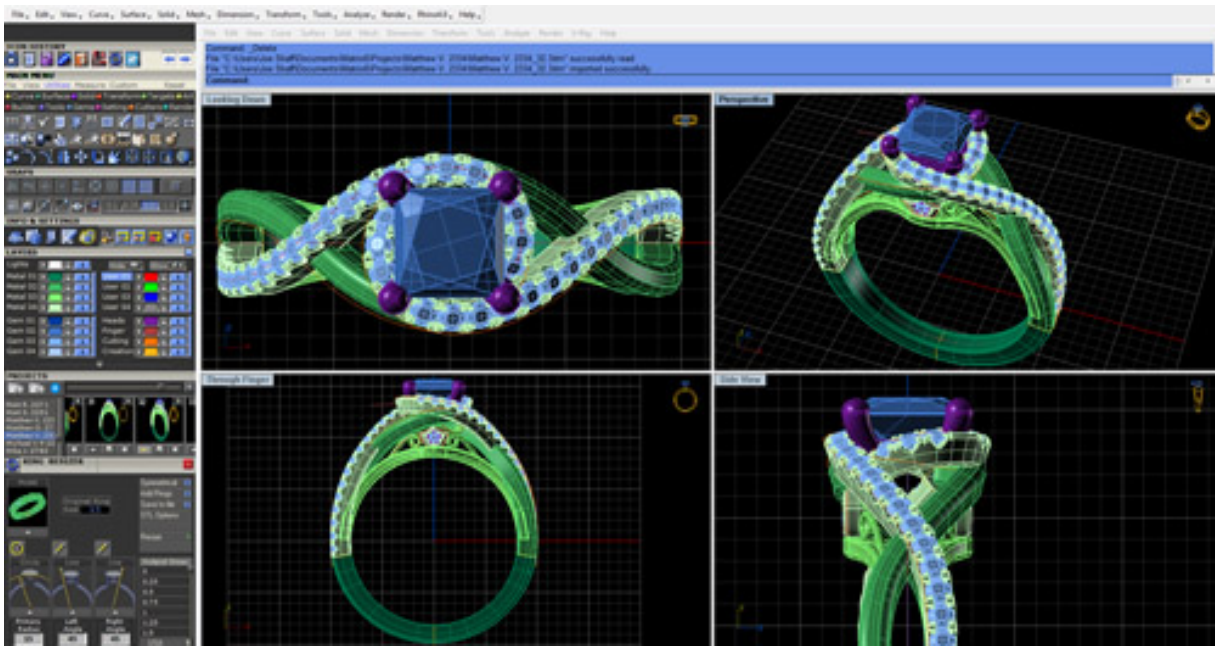


Figure 18: 3D model of a Joseph Jewellery Custom Wedding ring.

Moreover, new devices are available which bring 3D modelling beyond the mere use of a computer, such as 3D scanning and haptic technology.

3D Scanners are devices that collect information about form and appearance of objects or environments. 3D scanning is used today in the jewellery sector to recreate organic and natural shapes.

Haptic devices, on the other hand, provide tactile feedback during the 3D modelling, by applying forces and vibrations to the user through the device. This mechanical stimulation integrates the sense of touch to 3D modelling. Haptic devices could represent a big potential for the jewellery industry since they would preserve the sense of the ‘touch’ of the artisan using the technology, with the possibility of the craftsman to virtually carve the wax. Since the production is made on a piece-by-piece basis, a designer could introduce differences into each individual piece of their jewellery.

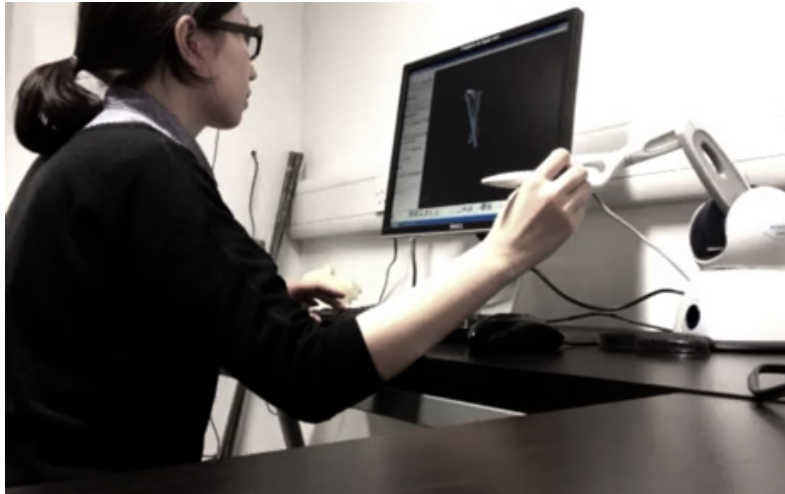


Figure 19: Jewellery designer Dorry Hsu using the haptic arm to draw her 3D models.

Rapid prototyping processes have had a great influence on the jewellery sector and how jewellery is made. The way that jewellery can be designed, as well as the way it can be produced, whether in single, low or high volumes, has changed dramatically in recent decades (Park, 2013, para 3). It has been attributed to the fact that the use of RP offers certain advantages over traditional production methods, one of which is the ability to design and build parts with complex undercuts.

Personal Work Experience: 123 Proto

This brief section notes personal observation regarding a personal work experience as an intern at 123Proto, a jewellery company located in Montreal who made the use of RP technology into jewellery their specialization and trademark. This company provides the jewellery industry with CAD/CAM services such as 3D jewellery design, 3D printing, rapid prototyping, precious metal casting, polishing and finishing services (123Proto, 2009). This firm effectively assists the creation of jewellery through each individual process, from the ideation stage that implies sketching and 3D modelling to the printing of prototypes and models, and finally to the casting, stone setting and finishing.

During my internship I covered the position of 3D jewellery designer, where I learnt the

process of virtually 3D designing jewellery to be printed into wax for lost wax casting process. This experience allowed me to observe the application of rapid prototyping technology in jewellery making. One of RP's great advantages is that it provides better flexibility and freedom within the creative process.

One of the first considerations concerning the application of RP in such an ancient and traditional process of fabrication, is that this new technology has taken over an important step of the process: the fabrication of waxes to perform lost wax casting.

Personally, what I found to be interesting is how both this antiquated technique and this new technology, belonging to two completely different historical periods, coexist and are used in the same production process. The use of RP was indeed adapted to fit this ancient casting technique. RP was introduced, albeit in a partial way, to a traditional production process that, until a few decades ago, eschewed technological innovation since only the human hand was considered to be able to create unique and authentic objects.

Before the use of rapid prototyping, waxes were made by hand and sculpted directly into a block of wax by the jeweller - a fairly long process that could take from one to several days of work and which required competence, precision and a craftsman's dexterity. The final outcome of handmade work would be more likely to evoke "hand details" or small imperfections that, in some cases, give the objects value since it directly shows the work of a craftsman, his time, his passion and the expression of the object's 'soul'.

From the advent and the utilisation of rapid prototyping, the process of making waxes is divided into two stages. The first is 3D modelling that includes the conception of the object. The second stage consists of the building process done by rapid prototyping machines. This process does not require the physical presence of the jeweller or any other person. Like all RP machines, it builds the model in an automated way, overlapping thin layers of wax one on top of the other. This gives the possibility to run a production overnight and, ultimately, to create waxes in a faster way and with less effort. The added value of this technology is that it allows

for a better control over the geometry and shape of the final piece. The digital way to design the model allows extreme precision of details and perfect symmetry. On the other hand, the negative outcome of using this technology is that the final work could look less precious or unique; especially for those that require numerous stone settings. If the model is “pre-set”, this means that the hollows for the stones have been previously incorporated in the 3D digital model and consequently the wax is already produced with the holes. If a piece of fine jewellery is “pre-set” it is most likely to have a more generic look and perhaps appear less ‘precious’ since the holes for the stones were prefabricated, sometimes making it more difficult to polish around the pre-set cavities - meaning that the finish is much less refined compared to a piece of jewellery that was entirely made by hand.

The internship experience 123 Proto proved to be an interesting insight into the world of jewellery making and its application of RP. Through this personal experience I was able to understand and witness the difference between the use of RP technology and traditional jewellery making, it has also pushed me to question the value of this technology within the jewellery field.

3.3 Problem Statement

The need of jewellery to push forward its aesthetics and innovate its production methods is met with the use of rapid prototyping due to its capacity to overcome formal constraints and push the limits of the aesthetic functions of jewellery.

Rapid prototyping represents a democratic means through which to produce jewellery, bringing back the value of design from the hands to the head, giving more importance to ideas than “savoir faire”. At the same time, one should question what the effects of RP are, concerning the physical outcome and its perceived value, compared to the handicraft methods. Crafts already have a well-established image and identity, crafted objects are an emblem of uniqueness, authenticity and human effort. The result of handicraft practice is to enhance the value of the object itself, especially in the case of jewellery, as it is a personal item, in contact

with the body and often loaded with meaning. The individual contribution of the artisan makes the object expressive and able to discharge personal emotion.

The emphasis on the link between man's body and an object is also attested by the fact that many people consider the most valuable jewellery to be made by hand: the contact that exists between hands and metal during construction of the jewellery gives more importance to it. (Marzari, 2007)

Keeping in mind the perceived value of the handicraft practice, one should wonder how the value of RP compares. Does this technology represent a valuable mean by which to make jewellery compared to manual work?

This brings up more questions about the differences in the production processes and in the value perceived by the outcome, such as:

- Does the outcome change due to its process?
- How does the manufacture method influence the perceived value of a piece of jewellery?
- How do users respond to jewellery in terms of its manufacture?
- Is an item of jewellery made by a rapid prototyping machine perceived as less valuable than one made by an artisan?

In order to better organize the content of these issues, two main research questions were generated concerning jewellery making and its perceived value.

Two main points of view can help encompass the inquiries raised above. From the maker's perspective, we can understand the pros and cons from professional points of view. From the consumer's perspective, we can find out how the making process influences the perceived value of jewellery.

3.4 Research Questions

1- 'How does rapid prototyping technology influence the practice of jewellery making and its outcome? In what ways?'

2- 'How does the use of rapid prototyping technology influence prospective users appreciation for jewellery? In what ways?'

3.5 Purpose of the Study

The objective of this research is to provide a better understanding of the jewellery sector today and how it will evolve in the future. More particularly, this research will clarify how rapid prototyping technology is influencing the practice also the appreciation of jewellery as an outcome, compared to more traditional ways of manufacture such as handicrafts.

This research will also provide a better view of the sector of craftsmanship for jewellery today, to determine if it is a practice that is finally embracing technology to renew itself, or if it is, on the contrary, tending to stick to more traditional means. This study will also provide a better understanding of the point of view of professionals today, on what works or does not work for their craft.

Chapter 4: Methodology

This study will follow a research method that will identify makers and potential users' reactions and appreciation for RP application in jewellery making. With a focus on the traditional (handmade) techniques of production compared to the rapid prototyping technology and its implications on the jewellery making practice. This investigation will also consider how RP, as a production process, changes the value attributed to jewellery.

For the purpose of this study and to gain evidence, qualitative data collection tools will be applied in order to answer the two main research questions:

1- 'How does rapid prototyping technology influence the practice of jewellery making and its outcome? In which way?'

2- 'How does the use of rapid prototyping technology influence prospective users appreciation for jewellery? In which way?'

In order to answer these questions, this methodology approach is divided into two parts.

The first part of the research method focuses on the influence of rapid prototyping on jewellery making and its outcome. To answer this first part of the research, 3 semi-structured interviews will be held with jewellers who work with traditional techniques.

The second part, concerning potential users' appreciation of different fabrication methods, will be measured through two focus groups that will observe and react to two pieces of jewellery, each made in different ways, one made by hand and the other by rapid prototyping.

4.1 Research Approach

The research approach used in this study is a mixed approach between phenomenology and field research. The purpose of the phenomenological approach is to illuminate the specific, to identify phenomena through how they are perceived by the actors in a situation. Phenomenology is concerned with the study of experience from the perspective of the

individual. These approaches are based in a paradigm of personal knowledge and subjectivity, and emphasises the importance of personal perspective and interpretation. As such they are powerful for understanding subjective experience, gaining insights into people's motivations and actions, and cutting through the clutter of taken-for-granted assumptions and conventional wisdom (Lester, 1999, p. 1).

Phenomenological approach is used in this study to describe and understand participants' experience regarding the application of RP into jewellery making. Also, integrated into this method, this research also uses a field research approach, which implies the direct observation and use of RP in the making of jewellery. This approach regards particularly the production of research tools for the focus groups' discussions such as the making of the rings and the completion of a short video documentary of the two processes.

4.2 Objectives

The first objective of the study is to document the traditional methods of jewellery making and the application of rapid prototyping technology within it. The research will also look to identify the strengths and weaknesses of both processes by comparing them to each other.

The second part of the study will document different potential consumer's appreciations towards pieces of jewellery that are made both by hand and with RP.

4.3 Semi-Structured Interviews

Interviewing is one of the most common methods used in small-scale educational research. The interviewer sets up a general structure by deciding in advance the ground to be covered and the main questions to be asked. The detailed structure is left to be worked out during the interview, and the interviewee will have a fair degree of freedom in how he or she decides to answer (Drever 1995).

A semi-structured interview is a flexible means for qualitative research that allows an interpretative and constructive vision of the phenomena. It is possible, through this kind of interaction, to ask questions to the interviewee on representations, feelings, and experiences. (Creswell 2003)

This method allows for new questions to be brought up during the interview as a result of what the interviewee says (Lindof & Taylor, 2002, p. 180). The use of open-ended questions and training of interviewers, enables to bring up relevant topics that may stray from the interview guide, moreover, they provide the opportunity for identifying new ways of seeing and understanding the topic at hand (Cohen & Crabtree, 2006 para. 5). The interviewer in a semi-structured interview generally has a framework of themes to be explored.

Semi-structured interviews are selected as the means of data collection because of two primary considerations. First they are well suited for the exploration of the perceptions and opinions of respondents regarding traditional production processes and the application of rapid prototyping into jewellery. Secondly, the different practices, experiences, and specialisations of each participant precluded the use of a standardised interview schedule.

4.3.1 Interviewees - The interviewees for these semi-structured discussions are three professional jewellers; and particularly they work or prefer to work using traditional techniques, by hand. The criteria of selection include people from different specialisations and years of experience in the field of jewellery making in order to portray a vaster group of jewellery professionals. The sample selected for this part of the study is contacted directly by the researcher by phone or in person.

The interviewees have been selected through purposive sampling, both males and females. For ethical reasons the participants must be older than eighteen years old, and in order to take part of the study, they have to sign and agree a consent form (annexe 1). The consent forms are provided to inform the participants on the matter of the study as well as their participation in it. The interviewees are addressed with their initial, as it is not required for them to reveal their identity.

4.3.2 Themes and Questions - The interview's questions are divided into 4 general themes: general information, practice, applied technologies and design. These 4 themes have been generated to frame the content of the interviews.

4.3.2.1 General information - The interviews inquire general information about the jeweller's business, years of experiences and the educational background. These first few questions are useful to frame and understand the type of practice of the jeweller. These questions are also used to introduce the argument and put at ease the participant by letting them introduce themselves, their background and work.

4.3.2.2 Practice - This theme aims to better define what constitutes the jeweller practice - who are their clients and what are their usual tools. The answers to these questions will provide a more specific idea on how the jeweller works and what the tools and materials are. The questions posed for this theme will help introduce the next: applied technologies.

4.3.2.3 Technologies - This theme is the most valuable. All the questions are centred on technologies used in the practice. Firstly, questions like 'What kind of technology do you use?' will be asked to understand how the jeweller makes his or her pieces.

Afterwards, more specific questions will be asked concerning the use of lost wax casting techniques and related tools and technologies used. These questions will lead to the subject of the use of RP and to understand what their experience with it is and how they consider the technology to be.

4.3.2.4 Design - This last theme focuses on the design process and decisions. A few questions will be asked about sources of inspiration and design changes during the production process.

4.3.3 Data collection and Analysis

All 3 interviews are recorded in the order to be reported through a prose description of the conversation between the interviewees and the researcher. In order to identify recurrent and emergent arguments about jewellers' experiences and knowledge on traditional process and technologic contribution. The data that the interviews will generate will be analysed to identify convergences and divergences in answers between the interviews. Common answers will be

drawn out in order to build a potential profile for the ‘traditional jeweller’. Diverging answers will be taken into account and analysed according to the interviewee’s experiences.

Also, the data collected in regards to technologies will be examined to understand if RP is changing the traditional practice and its outcomes.

4.4 Focus Groups

A focus group is a form of qualitative research in which a group of people are asked about their perceptions, opinions, beliefs, and attitudes towards a product, service, concept, advertisement or idea. (Belk 2006, p.146). This research method has been identified as a suitable means to answer the second research question, as it is used to identify convergent and divergent viewpoints around a subject and understand the reasons behind them (Morgan 1997). The primary aim of a focus group is to describe and understand meanings and interpretations of a select group of people to gain an understanding of a specific issue from the perspective of the participants of the group (Liamputtong, 2011).

The hallmark of focus groups is their explicit use of group interaction to produce data and insights that would be less accessible without this synergy. Participants stimulate each other. The main advantage of using a focus group as a method of research is the opportunity to observe a wide range of interactions about a specific topic in a limited time frame.

The objective of organising these focus groups in this study is to assess the influence of RP technology concerning potential consumer perceptions of the value of jewellery. In order to do so the group discussions are organised to show participants the two production methods (handmade and machine made) to assess the different perceptions regarding the value of jewellery. The two group discussions are developed around two rings, which are supposed to be equal in shape, their foremost difference between each other is their production process. The production methods are not revealed to the participants right away, to assess the first impression of the object without being influenced by the way the object is made. After the first parts of the discussion, the video documentation process is shown to the two groups (one each)

with the intention to assess if there is a difference in the value perceived and in the opinions expressed.

4.4.1 The Objects - The two groups will observe and react to two rings, designed personally by the researcher during work experience at 123 Proto. These pieces are made with the same materials and have the same formal features (material, stone and shape), the only thing that differs is their production method. The first object will be made by hand and the second one is produced with rapid prototyping technology. The choice of having two rings with the same physical features is an attempt to neutralise other aspects, such as shape and finishes. Therefore, since the two groups will substantially discuss the same object, it will be possible to conclude how production processes influence the appreciation of jewellery.

The physical difference between the two objects can be explained partly because of two different production processes but also because of two different main creators in the making: the researcher/designer, who designed the 3D model, and a professional jeweller, who copied the design of the ring following a technical drawing. Therefore the handmade version came out as slightly different, according to the jeweller interpretation of the drawing.

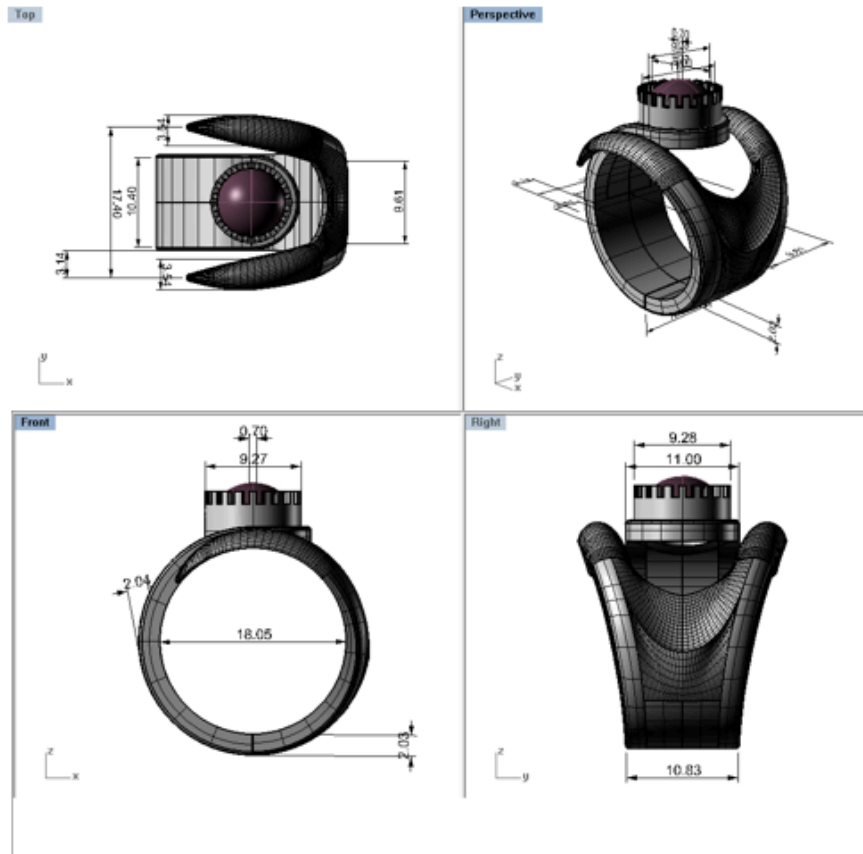


Figure 20: Technical drawing of the machine made ring.

The shape of the rings has been thought to be a modern looking ring with the inclusion of an opal. It has been designed to be an open form in order to be adjustable. The form of the ring reflects two characters: one softer and lighter, given by the light blue colour of the stone and the other one bolder and more aggressive, given by the two sharp ends on the either side.

4.4.2 The Videos of Documentation

The use of props or external stimuli was first introduced in focus groups dynamics, regarding social science, to assess people's reactions to certain products or advertising campaigns. The 'focusing' component of focus group research refers to the boundaries of the discussion in relation to a particular stimulus object, event or situation (Brewerton & Milward, 2001, p. 80).

The video is in this case used to focus the groups attention (Bianco, 2014, para 5), to show the participants the production processes of the two rings (Annexe 5), with the aim to provide the participants with useful information that generates meaning making.

Since what we experience is tied to our understanding of how we express what we experience in terms of meaning, we can attribute that meaning to objects and things (Poldma and Vasilevich, 2013, p 103)

The images and footage of these videos has been recorded during and after the internship at 123Proto. The first video portrays the hand made ring process and the second one portrays the rapid prototyping making process of the ring. Both videos are about the same length (6-7 minutes).

4.4.3 Participants

It is intended that each focus group be populated by 5 or 6 people, females being 18 years of age and older. The sampling of participants is being done through social network and through newspaper ads. The prerequisite of participants is to already have purchased jewellery for themselves or for a gift for someone else. This is so that the participants base their responses on previous experience and knowledge of the discussed topic. Jewellery is also known to be one of the favourite indulgence items for women and is an important fashion accessory (Danziger 2004). From a traditional, and still very current standpoints, jewellery, like many other modes of fashion, has been attributed to women and the realms of femininity. It became evident in the initial part of planning the experiment that a group of women would be the ideal demographic to work with. With a purchase incidence of 61 per cent, women are more likely than men (39 per cent) to purchase jewellery (Danziger, 2004, p. 220). Women's experience of wearing jewellery could very well exceed that of men's, whom, if had been included in the research, would have altered the female feminine standpoint of the research questions.

In the attendance of these group discussions, all participants are referred to with a pseudonym of their choice, since the revelation of their identity is not a requirement for the research.

Participants have to sign a consent form in which explains the nature of the research, the objectives and the information about their participation in the study (annexe 2).

4.4.4 Organisation - At the beginning of each focus group, there will be an introduction of the topic as well as an explanation of how the discussion will be structured.

The participants will be aware that a video on the production process of the ring will be shown before the discussion begins. With the help of a collaborator a false problem will be staged to stop the video and delay its viewing. With this pretext, the researcher will start the focus group discussion; meanwhile a collaborator will pretend to fix the problem. Midway through the discussion the collaborator will interrupt by saying that the video is finally ready to be watched.

The purpose of intentionally staging a delay in the participant's viewing of the video is to allow the researcher to ask the participants precise questions regarding their perception of the ring and its relative values. Just by looking at the object itself, without being influenced by the knowledge of the way it was made. To facilitate this experiment, a set of questions will be initially posed before the video is shown. After the video, the same issues will be raised once again, but with questions that are phrased so as not to resemble the previous ones. This will allow for the measurement of how the fabrication method influenced the perceived value of the ring.

The structure of the focus group is to allow for the participants to react honestly and openly. By creating the pretense that the showing of the video has been delayed, the participants will not suspect that the intention of the experiment is to measure their reaction to the production process.

Since the main purpose of the focus group is to understand how the production methods influence the product's perceived value, the aims of these group discussions are to refer participants to a stimulus, or an influencer, without them realizing it. Focus group is an

artificial situation created by the researcher to witness natural interactions (Demant, 2012, p. 1). The use of staging of a problem with the video is a tool that helps build a credible scenario in that encourages a range of responses, which provides a greater understanding of the attitudes, behaviour, opinions or perceptions of participants on the research issues (Hennink 2007, p. 3).

The aim is not to «trick» or deceive the participants, but rather to make the comparison less obvious. By utilizing this methodology, the researcher is encouraging the participants to provide feedback without the fear of contradicting their previous statements. The success of focus group discussion relies heavily on ‘the development of a permissive, non-threatening environment within the group’ where the participants can feel comfortable to discuss their opinions and experiences without fear that they will be judged or ridiculed by others in the group (Hennink 2007, p. 3).

4.4.5 Questions - Both focus groups will be asked the same questions.

The interview’s structure is divided in two parts. The first part of the interview will primarily introduce the object into the focus group, to have participants familiarise themselves with the ring and concentrate on the physical features and the appearance of the object. More questions are posed about the perceived value of the ring, through questions regarding the occasion to wear the piece and its potential price.

After these questions, a video is presented to the group concerning the production process (one video for each focus group). The video shows and explains step by step how the rings are designed, created and finished.

After the video is shown, more questions are posed to the groups in regards to the ring’s value. These questions are conceptually very similar to the previous ones; however, the fact that they are formulated in a different way is done to get a more spontaneous reaction, as well as to avoid group members’ fear of contradicting themselves after the video. The answers to these types of questions will help clarify if and why the production process influences the users’ appreciation.

4.3.5 Data Collection and Analysis

The analysis of focus group data seeks to find meaning in the nature of participants' verbal responses to the questions in the discussion guide (Stewart and Shamdasani,, 2006). Both focus group discussions are recorded and transcribed to identify those sections of the conversations that are relevant to the research questions. First off each focus group is analyzed individually through a semantical content analysis, to classify signs according to their meaning. This analysis takes form more specifically in the designation analysis, which determines the frequency with what certain concepts are mentioned during the discussion. (Janis 1965, p.55)

For each group discussion concordances and discordances between the first part of the discourse and the second one will be analysed. This analysis will provide a clearer view on how the two production process provoke different reactions in potential users.

The second part of the analysis will focus on the different data generated between the two focus groups. This data will be compared to understand how the values identified in the two production processes differ from each other, and why.

4.5 Conclusion

In this chapter we have presented a detailed account of the research methodology according to which we shall conduct this research, aiming to answer the two main research questions:

1. 'How does rapid prototyping technology influence the practice of jewellery making and its outcome? In which way?'
2. 'How does the use of rapid prototyping technology influence potential users's appreciation of jewellery? In which way?'

This qualitative research methodology is structured according to a mixed approach that will use different methods to answer the two research questions.

First, semi-structured interviews will be conducted with jewellers who work in a traditional way. These interviews will investigate the traditional practice to see how rapid prototyping is perceived and used in the sector compared to traditional techniques.

Secondly, two focus groups will be conducted to assess potential consumer's appreciation and influence on the fabrication processes.

This research seeks to gain a better understanding on how production techniques influence the value perceived by potential consumers in jewellery, as well as realizing how technology is changing the practice and its future.

Chapter 5: Data Collection

This chapter reports the details of the two main experiments: three semi structured interviews and two focus groups. The following subsets will report the questions and the content of the interviews to jewellers and the questions and content of the group discussions with potential consumers.

5.1 Semi Structured Interviews

This section focuses on industry professionals' experience, perceptions and opinions regarding production processes and technologies in jewellery making.

The following key research question has been posed:

- 'How does rapid prototyping technology influence the practice of jewellery making and its outcome? In what way?'

Three interviews were organized with three jewellers. Initials were used to refer to them in the report, due to privacy reasons. All the interviews were done in their workshop/atelier with an average duration of 80 minutes each.

Each professional interviewed belongs to a different generation; therefore the three interviewees are likely to represent a broad span of different experiences and specializations.

The main objectives through this field approach are to document and understand the influence of RP technology on jewellery making through the experiences of professionals. This report aims to document jewellers' points of view and experiences on the application of RP technology into jewellery.

The interviews will clarify what professionals know about the technology and its application, if they used it or had experience with it and, what they think about it. Their opinion will show

how the technology is perceived, used and valued in this sector. These interviews will also clarify whether and how RP is considered a valuable tool for the practice.

These interviews will also focus on identifying strengths and weaknesses of the technology as compared to traditional processes.

5.1.1 Questions Guide line

The following set of fifteen questions are divided into four themes: general information, practice, technologies used and design.

General information:

1. Name or code
2. Years of experiences
3. Previous technical/practical formation - year of completion

Practice:

4. In what does consist the practice in your business?
5. What kind of clients do you have?
6. What kind of means/tools do you use to create your pieces of jewellery?

Technologies used:

7. What kind of technology do you use?
8. Do you use lost wax casting process? yes/no

If answered yes to question 8 - go to 9 otherwise skip to question 12

9. How do you make your wax models? by hand or other means?
10. How long does it take to build a wax model?
11. Do you consider lost wax casting process that suits well the jewellery making process?
12. Have you ever heard of rapid prototyping technology for jewellery? yes/no what do you think about it?
13. Have you ever used rapid prototyping to produce your models? If so, describe your experience
14. Do you think this technology is an added value? yes/no explain

Design:

15. How do you come up with your design?

16. What is your inspiration?

15. Do you change your design during the making process? If so why?

5.1.2 First Interview

The first interview was done with A.M. and U.P. for their jewellery making activity. Both of them work as creators and managers of their own business with 29 and 27 years, respectively, of experience in the industry.

A.M. and U.P. mostly make jewellery by hand or with mixed (subtractive and additive) methods; they use additive manufacturing processes, which imply the stacking of different layers of metal obtained by laser-technology; they also apply a traditional subtractive process which involves wax sculpting for the lost wax casting process. The traditional tools handled for jewellery bench work are very similar or, in some cases, the same as the instruments found in the dental industry.

The jewellers incorporate a hybrid process, combining the lost wax casting process with a mixed approach: part of the object is originally sculpted into wax and after the metal casting, more components are welded directly onto the metal.

A few interesting points came out about preparing and sculpting waxes for lost wax casting process: wax hand sculpting doesn't allow 100% precision, that is in effect reached afterwards through the finishing of the object in metal. There is a small reduction of the object during the casting (3% - 4% of the volume). Jewellery that is created through wax sculpting remains a bit thicker than jewellery done directly in precious metal, because the physical properties of wax make it hard to do very finely crafted objects. This is the reason wax sculpting is mostly used to create rings. This feature of wax-sculpted objects is something of a weakness nowadays since the gold crisis brought the price up to \$1,721 a troy ounce (Kelpie 2013, para. 3). The more mass and weight the object holds, the more it is going to cost and consequently it is

harder to sell, explains U.P. The metal of jewellery created with lost wax casting remains more porous and with impurity inclusions, due to the process of infusion, than metal worked directly by hand.

In the small-scale reality of this workshop, wax carving and lost wax casting suits well the creative needs to produce our pieces (U.P.)

Despite the few defects this process has, it still remains a fast and flexible way to produce, since wax is ductile and removed with ease.

A.M and U.P. have already used external rapid prototyping services to produce their waxes. Initially they were not satisfied with the outcome that this service had provided to them, due to a lack of aesthetic sense by the people who provided the services, A.M. said. After a few attempts where they were getting objects back that were not quite as they imagined or designed it, they finally changed their approach to overcome the lack of communication. They found a solution that signalled exactly what they wanted by creating the very first prototype by hand. This prototype is given to the company with specific instructions such as 'make it lighter' or 'make the wall of this ring 0.2 mm thick' or 'I want this object with this design with the wall 0.3 mm thinner'.

Through their experience U.P and A.M consider the contribution of this technology to add value to the extent that it allows certain pieces of jewellery to have a lighter weight and therefore to be easier to sell and more suitable for the market. On the other hand, the use of an external rapid prototyping service can constitute a risk regarding intellectual property. The service provider does not give the guarantee that their design would not be copied or worse, sold to third parties.

Another observation that constitutes a weakness according to U.P. is the fact that the mere possibility of having a piece of jewellery mass-produced implies the risk it loses its sentimental value, its uniqueness. In a series production, the object's value lies mostly in its precious material and monetary value.

As for their design, A.M. and U.P. find inspirations observing the social environment that surrounds them including fashion, art and architecture. They sometimes create legacy-jewellery, by repeating a style that has not been around for two or three decades.

5.1.3 Second Interview

This interview was held with M.T., a jeweller and a setter with 44 years of practice and experience. He deals with both private clients and retailers. His creations are entirely made by hand, mostly made directly into metal and in some cases through wax.

As far as the different technologies and processes that he uses, M.T. says that there is generally more mass and weight in objects done through the wax sculpting process. In finer traditional jewellery the product is created directly from precious materials and is more a matter of assembling parts together through different layers. The feature of this kind of manufacturing is a much finer result compared to objects made with hand wax carving. The strength of wax, according to M.T., is that it is a kind of material that is very soft and easy to carve compared to metal. On the other hand wax doesn't enable perfect control on the wall thickness of the model, which is why to keep the walls a constant thickness in an object they often use metal sheets instead of wax carving.

M.T. explained that there is a specific relationship between the weight of the wax and that of the precious material. For example 1.5 grams of wax is equivalent to 10 grams of gold. The use of traditional jewellery making directly into metal allows, generally, making lighter objects. M.T. made the comparison between having a ring made with wax and one, with the same geometry, made directly into metal. The result of this comparison is that the ring made directly into metal ends up being 3-4 grams lighter than the one made in wax. However in traditional jewellery making, making directly into precious metal always has a loss of 5%-6% of material due to filing and finishing.

Regarding rapid prototyping technology, he is aware of the existence and the application of the technology to jewellery but he has never had the chance to use it.

I think it is a fantastic innovation but I still think that traditional jewellery making is done by hand and I still think that by hand it's possible to make things that are not possible to make by machine (M.T.)

He also established that, through years of experience, he mastered manual dexterity in jewellery making so fully that he would never forgo such deeply personal satisfaction:

If I can create by hand I would rather make things myself. (M.T.)

He remarked that he would probably consider using this kind of technology if someone ever asked to remake a copy of an object that he previously made. M.T. always worked on unique pieces of jewellery so, until now, he did not have the necessity to use or explore this technology.

Working with wax requires less time and less experience, since the material is inexpensive and it allows making mistakes without a significant loss. That is the reason why young generation jewellers use this technique according to MT, since it turns out to be more complex and expensive to work directly into metal. Objects sculpted in wax are also easier to “empty” or remove material to be more lightweight.

Since M.T. works a lot as a setter he doesn't always work on his designs, in approximately 50% of the cases he works on jewellery pieces that were not created by him. The remaining 50% are works commissioned by clients who trust his inventiveness. He also mentions that it is hard sometimes to get clients to visualize his ideas.

Regarding his inspirations, M.T values a lot of his experience in this sector, he bases most of his inspiration on what he has already done in the past and he tries to create forms that are already established in his mind.

5.1.4 Third Interview

This last interview was held with jewellery maker M.P., with 8 years of experience in jewellery design and making. She works entirely by hand and prefers the use of silver 925 for most of her creations, although she has experience in costume jewellery as well, made with non-precious material. For her silver creations she uses mostly wax hand carving, lost wax casting and drill-cut metal.

In her self-made business she hand carves waxes and uses an external service to cast them or she works directly into metal with the piercing of metal plates. She only works with unique pieces that her clients commission.

I make everything by hand in my workshop, at the moment I do not use other technologies. There are not very many professionals or companies that provide this kind of service to private clients and that is why I like doing it. It's either people go to have personalized pieces to professional and established jewellers, who charge much more (expensive) than I do, or people buy jewellery that they already find on the market. (M.P)

She finds wax a very comfortable medium to work with, it is a very ductile material and it just requires a few tools and some manual dexterity to come up with interesting outcomes. She also shares that the volume shrinking of cast jewels is not a problem for her, since she tends to have a quite solid and bold style, so that the shrinking doesn't affect her creation's appearance in a visible way.

M.P. states that traditional jewellery making consists, mostly, of working directly with precious metal sheets and wires, and it is a lot harder and requires more experience than wax carving.

Regarding rapid prototyping technology she had no experience using this technology, even though during her academic and professional formation she had the chance to learn about it and its function.

I am definitely curious and attracted to this technology but I do not think it could become a usual instrument in my practice. My hands work well and I am able to do everything successfully by hand. It is also why I really enjoy doing what I am doing, it is because of the 'hands-on' dimension, which is what fascinates me about an object. (M.P).

M.P. also thinks that rapid prototyping technology applied to jewellery making finds its *raison d'être* for people who have ideas and want to make jewellery but are not trained jewellers. This technology could indeed provide a new means of expression for creative minds in general.

I think this kind of machinery has a lot of potential but I think I do not need it at the moment. If I will ever find myself not being capable of making what I have in mind then I will find my way to do it with the help of technology (M.P.)

A great potential use for this technology would be also to produce those parts or details that would be very time consuming to do by hand and that people would not value as much or would not perceive how much human effort and time there is in producing them; hinges and carabineers for example. M.P. relates a previous experience, where she had to figure out how to make a hinge by hand for a ring from her collection. A lot of people loved the piece of jewellery and were interested in buying it. But since so much effort and time was put in such a small detail she could not make a realistic fair price for it:

I would have to charge a lot for this ring and people would probably not understand the reason. I think that these kind of parts should be made industrially or with the use of machinery. Even chains for instance, represent a very long work to do by hand. Only in antique jewellery the chains were made by hand, now it is all done with machines, that is proof that there are things that have almost no point in being made by hand anymore (M.P)

Regarding the design process of her jewels she follows the request of clients: they usually give her a subject to work on, so she can start to hand sketch her ideas to show them for approval, and then she starts the production process.

As for inspirations regarding techniques, she consults and reads a lot of contemporary jewellery books, not so much for the style but more for new ways to assemble materials, proportions, wearability, type of closures etc.

As for the style I try not to get contaminated too much by others work, I try to keep the look and the style of my work as much as possible true to myself. (M.P.)

Generally art, fashion and accessories inspire her.

In particular street culture inspires me a lot, as much as the world of body art and tattoos. (M.P.).

5.2 Focus Groups

The following section describes the happening of the two focus group discussions, regarding the second research question:

- ‘How does the use of rapid prototyping technology influence potential users’ appreciation of a piece of jewellery? In what ways?’

Both discussions are reported with the question integrated in the dialogue.

These experiments were designed to test the different perceptions of value attributed to the two rings, which differed mostly in the production process used in their fabrication, as well as to understand the reasons for this differentiation. As explained in the Methodology chapter, the focus group’s experiments were designed to assess opinions and perceptions and how they were affected by the manufacturing processes also, how they differed for potential users. Two videos documenting both production processes were made to clearly illustrate the techniques to the participants.

The viewing of the video was shown halfway into the discussion. This was done to collect responses before and after participants were made aware of the means of production and thus be able to compare and analyze them.

5.2.1 The Rings

The two rings were intended to have the same physical features, material and type of stone. The metal used is silver 925 and the stones are opals. As the production processes of the two rings were different, the two outcomes ended up having slight differences.

5.2.1.1 The Production Processes

In both processes lost wax casting was used. The models of the rings were thus realized initially in wax. The hand made ring was hand sculpted from a solid block of wax by a jeweller. The machine made ring was designed using the Rhinoceros 3D modelling program

and later printed with a Solidscape 3D printer. The ring was printed and cast in two separate pieces: the crown for the stone and then the rest of the ring.



Figures 21 and 22: Handmade wax (left) and 3D printed wax (right).

Figures 23 and 24: Hand sculpting wax model (left) and Solidscape 3D printer printing the model (right).

Subsequently both wax models underwent the same steps for the lost wax casting process. The wax models were installed at the base of a cylinder (one for each piece) into which plaster was poured. Then the cylinders containing the models were placed in an oven to melt the wax, to create the space to cast the metal afterwards.

After the metal casting, the cylinders were put in a cold-water bath to provoke fracture of the plaster from heat shock, allowing the parts to be extracted from their plaster coating. Once the parts were extracted from the plaster, they underwent numerous processes of cleaning and polishing, both manually with files and by machine. During this stage, the two parts of the machine-made ring were finally welded together. In the last formal step, stone setting, the opals were set into the two rings. Finally, a final polishing was done after the setting to remove tool marks.

The substantial difference between the processes and their outcomes lies in the first part of the process: creating the wax model. Indeed creating the wax model by hand requires experience, dexterity and effort; it is usually more time consuming and the outcome ends up with less fine detailing than a wax model made by machine. Using a 3D printer to print wax does not require physical effort, but on the other hand requires a good knowledge of the 3D modelling software. It is typically seen as a faster way to make waxes since the production process can be made to function beyond business hours, even overnight, permitting work to be done without human labour.

5.2.2 Focus Group 1: Hand Made Ring

For the first focus group 6 participants were gathered with ages ranging between 25 to 40 years.

The group discussion lasted 52 minutes.

5.2.2.1 Hand Made Ring



Figure 25: Hand made ring. Materials: silver 925 and opal.

5.2.2.2 Description: Part 1

The first part of the group discussion was centred on the general appreciation of the ring. The first few questions were intended to get participants comfortable with the group conversation, therefore questions were aimed at their personal opinions, appreciation, and what feature most captured their attention.

Questions:

- 1- How do you like this ring?....
- 2- How would you describe it? With few (3 or 4) adjectives....
- 3- What do you think characterises this ring? What is the main feature? What catches your attention? (shape, finish, inclusions, etc...)

Most members of the group seemed to have a good appreciation of the object, pointing out as interesting features the shape, the weight and the colour of the stone.

I like the way the ring doesn't have a closed shape, that it is not 'round'. I also like the fact that has a good weight to it, is not too delicate and it is sort of massive in a way but not too gaudy. (Sabrina, 40)

For me, personally, the weight would be too much, but I really like the shape and the bright colour of the stone. (Myriam, 29)

I really like the shape, it does not resemble any shape I have seen around. I feel you cannot find another ring like this, it is unique. (Camilla, 28)

The adjectives that were used to describe the jewellery illustrate different reactions.

Heavy. (Alexa, 35)

Interesting, nice, pretty. (Sabrina, 40)

If I could use nouns I would say summer, it reminds me of that season. Flow is another word that this ring makes me think of and clarity also. (Gaba, 25)

I find it bright. (Camilla, 29)

I like a lot this ring, even if it is massive and solid, It is really my kind of ring. Regarding the stone it looks somewhat fake, I think it is the colour of the stone, there are a lot of brilliant reflections, it almost makes me think of magic stones in fantasy movies. (Marie, 29)

I do have an issue with the stone, she said it is 'fluid', and I agree with her, but I find that the shape embraces the stone and at the same time it is not closed. It gives a sense of freedom in a way but then the stone looks trapped, so I find it a bit contradictory. (Alexa, 35)

The main features pointed out by participants were the shape and size of the ring and the stone.

I would say the shape, it reminds me of a claw. (Myriam, 29)

The following questions were structured as multiple-choice questions to measure the value attributed to the object without any explicit factor that could bias the answers.

For the question “Where would you wear this ring?” there were similar answers as to the kind of occasions for which participants could wear the ring.(Question 4, Appendix 4)

I could picture myself wearing it for a gallery opening or at the opera, or even a wedding, those kind of events. (Gaba, 25)

Something nice and fancy (Myriam, 29)

I could even wear it everyday, not with my current job, but if I had an office job I probably would. (Camilla, 29)

I could also wear it anywhere. For me it would not be so important the occasion but the style, it would really depend on what I wear. (Sabrina, 40)

Regarding both the hypothetical market price and the creator of the jewel the answers were very much alike. (Question 5 and 6, Appendix 4)

I could see this ring being sold for \$350, even though I do not know the value of the stone. (Sabrina, 40)

I would say around \$300, though depends as well where you buy it. (Alexa, 35)

\$250 I would say. (Camilla, 29)

I think the ring was made by a professional jeweller. (Alexa, 35)

Artisan, I would say. (Camilla, 29)

After the question regarding who made the ring, a video of the actual production process was shown to the participants.

5.2.2.3 Video

The video was designed as a small documentary to show the entire process of making the ring by an artist using traditional artisanal techniques. It had a duration of 6 m 50 s.



Figures 26: Images taken from the video showing the handmade making process.

5.2.2.4 Description: Part 2

After watching the video, the participants were asked more questions regarding the perceived value of the jewel, again with the same multiple-choice structure. For the question "For what occasion would you give this ring?" (Question 7, Appendix 4) here are some of the responses given by the participants.

If it's for a friend of mine, that I know very well and I know that this kind of ring is something that she is going to wear, I would see it as a birthday gift. (Camilla, 28)

I could see it as an anniversary gift. Something that a husband would give to his wife for a special occasion. (Gaba, 25)

I could even see it as a self purchase, as something that you fall in love for yourself. (Sabrina, 40)

Or for instance, if you were to be travelling somewhere and you saw this ring and maybe buy it for someone special. (Gaba, 25)

For me it would not be so much the occasion but the person I am giving it to, that matches her style or her personality, because it is very particular. (Sabrina, 40)

For the next question "where would you expect to find this ring? Le Chateau/ Le Baie/ Holt Renfrew/ Birks" (Question 8, Appendix 4) the answers given started to resemble each other more.

I could see it more in a small jewellery store but with a designer in it, or maybe in a nice online shop like a 'net a porter' or something like that, something at a designer level. Definitely not La Baie, somewhere more high end because it is artisanal. (Sabrina, 40)

It is an object that shows its beauty, it is obvious that is precious so I think that it should be shown in a nice store. (Marie, 29)

Probably in a gallery - jewellery store. I do not think you could see something like this at Tiffany's, she used the word unique, so it is very particular, it is something that you would not find in a main stream store. (Alexa, 35)

The last question of the multiple choice-structured questions regarded the uniqueness of the jewel: "Do you expect this ring to be ... A part of a collection (few identical pieces)/ an only

exemplar/ Produced in large quantities”(Question 9, Appendix 4) Here again we find similar answers.

As the video shows we can exclude the ‘large quantities.’ I see it as a unique piece or maybe few samples. (Sabrina, 40)

I could see it as a piece of a collection, maybe as a variation with different stones. (Gaba, 25)

The last set of questions were structured in a more open format, in order to assess in a more general way the influence of the video on the point of view of participants.

Question 10: “Do you think that the video helped you answer the previous question?”

Just for the fact that it is hand made it shows that it is not produced in large quantities, that it is not industrially made. (Sabrina, 40)

The video was really fascinating, it gives the impression that it is not mass market at all. It raises the level of its uniqueness in my head. (Gaba, 25)

Question 11: “Do you think that knowing the production process changes the way you are looking at the object / perceiving the object?”

In my opinion, seeing the actual production process, it gives it more value, because of the peculiar design, but also because it is something more personal, you see in the video the jeweller carving the ring by hand. (Alexa, 35)

Not for me no, if I like the ring I like it. It was very interesting to see how it was made but it would not influence me whether to buy it or not. If I really like it and it was not handmade I would still buy it. (Sabrina, 40)

For me it was fascinating to see how much care and number of processes there are between the raw material and the finished product, regardless of the fact that is hand made or made on an industrial scale. It was incredible to observe the care for the particular and the numerous step of the process. (Camilla, 28)

Watching the video makes it feel even more unique. (Myriam, 29)

Question 12 and 12a: “Do you feel you would value the ring differently if it was made in a different way? For example: Do you think you would value this object less if it was made by a machine and not by hand?”

Yes, but it could be positive too, I did see that you are doing your research on 3D printing as well and I was expecting to see something 3D printed. At the same time the video that we saw makes it feel very human, like there was care put into it by a human so that also gives it value. (Myriam, 29)

For me if it were the first 3D printed ring it would have been very interesting, because everything went in to it. After, when you get a mass production, the energy spreads somehow and it would probably make me lose interest to see so many copies. But I also think that if you put a machine in the process and if you have the possibility to produce a piece many times it loses value. (Alexa, 35)

If the ring had been made by machine I would not mind, there is something about machines that is really precise and measured, it is all about math you know...But then when I saw the video it is really great, but at the same time you see all this 'dirty work': the work environment, how he uses his tools...It is something that you do not think about it, you know. (Gaba, 25)

I think that it is really cool that it is not clean and sort of a messy environment. In a way, I would probably like it more now that I am thinking about it; there is something very cool about having it done by hand. (Sabrina, 40)

Yes, when you are creative you are kind of untidy, it reminds me a little bit of my lab..." (Camilla, 28)

At the end of the focus group, the second ring, made with rapid prototyping technology, was presented to participants. This action was not originally planned in the research methodology, but it emerged from the intention of the research to have participants compare the two different outcomes and explain which one they prefer and for what reason.

Now that I see the other one I prefer the handmade a lot, it has more personality, even if in the printed ring you have certain details that are different from the handmade one. In the printed ring I like this little surface on the side, but I definitely prefer the crown that holds the stone in the ring made by hand. (Sabrina, 40)

I agree with her, I like the hand made ring better, it has more personality I find, but on the other side I like better the stone on the other ring. (Alexa, 35)

Maybe if we had seen the printed ring first it would be different, but we talked about the hand made ring so much, we looked at it a lot that we bond with it. (Sabrina, 40)

I find that the other one looks too perfect. (Alexa, 35)

I feel that the hand made ring, because it is heavier, it is more precious. (Gaba, 25)

5.2.3 Focus Group 2: Machine Made Ring

The participants for this group discussion were supposed to be 5 in number but due to an unexpected event only 4 took part in the discussion.

The group discussion lasted 66 minutes.

5.2.3.1 Machine Made Ring



Figure 27: Machine made ring. Silver 925 and opal.

5.2.3.2 Description: Part 1

This group discussion was structured to follow the same questions as the previous one. In the beginning of the discussion questions were centred on a general appreciation of the piece (Questions 1, 2 and 3, Appendix 4). Here are some of the answers given.

I find the ring precious, cute and original. I think you will not find a second one like this, will you? (Jacqueline, 70)

I think it is very nice, If I was to criticise it, it is that I do not like is the symmetry, it is too perfect. (Maya, 61)

The shape reminds me of a fork, sort of aggressive, on the other side I really like the stone, it is not used often. (Kim, 25)

Here are the adjectives picked by the participants to describe the ring:

I find it a bit confusing because it gives two different impressions: on one side it is soft and nice and at the same time aggressive, and edgy, it is a clash. (Maya,61)

Yes!... on one side it is really round and geometrical and on the other side it is animal. (Kim, 25)

It reminds me of water, the sea. Cool, refreshing, liquid. (Cat, 66)

It also reminds me of claws of an eagle. (Maya, 61)

The main features that participants pointed out were the stone and the finishing.

I think the stone is the most important feature, because it is the detail that catches the eye, not the mount. (Jacqueline, 70)

For me it is the finish, the nice, soft and polished finish, that is what I saw first. (Maya, 61)

I would say the stone and the shine, both of them. (Cat, 66)

Again, as a multiple-choice question, the participants had to explain for what occasion they could see themselves wearing the ring (Question 4, Appendix 4).

In a wedding or a big reception, when you go out in a nice place, or even in a fancy restaurant, depends also on who you are with. I certainly would not wear it to do the dishes. (Jacqueline, 70)

It would probably be the opposite for me, I would wear it everyday, because it is large, for a reception I would see something more fine, where everything is more calculated... (Kim, 25)

For the perceived monetary value all the participants' guesses were from \$250 to \$350. (Question 5, Appendix 4)

I have no idea, just by looking at it I would say \$250. (Jacqueline, 70)

I agree with her, I would say it is between \$250 and \$350. (Maya, 61)

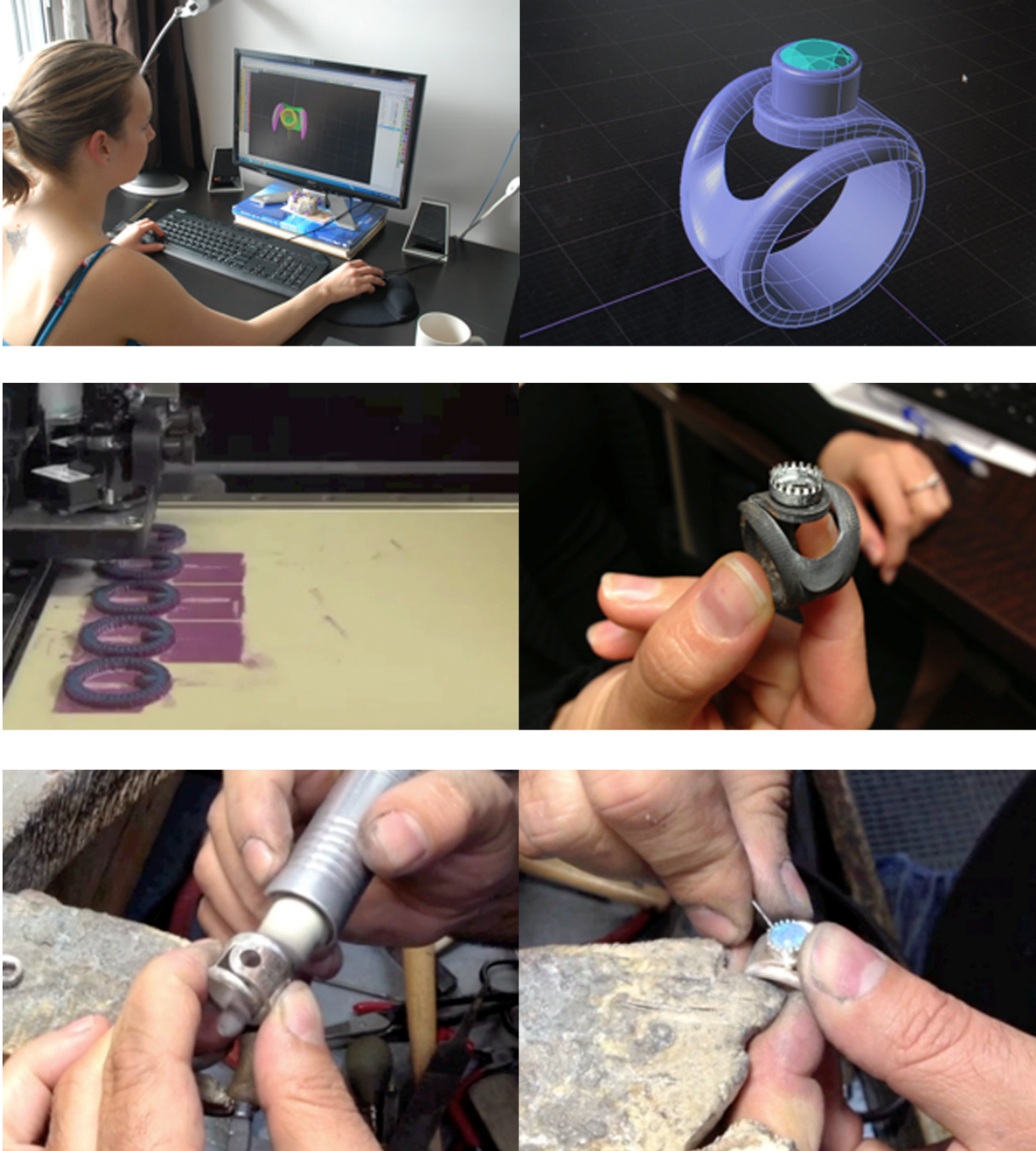
350 I think, 500 would be a very big price, but probably it would be better to sell it at \$500 because it looks very expensive to make, considering that the opal would be something around \$80 and the sterling it is probably around \$90, also who made it needs to make profit out of it as well. (Kim, 25)

For question 6: ‘Who do you think made this ring?’ participants gave different answers. Two of them stated that in their opinion the piece was made by a professional jeweller, one of them said an artisan, and the last opted for ‘an amateur’.

It could even be an amateur using a casting service or a machine, using rapid prototyping technology.” (Kim, 25)

5.2.3.3 Video

A video with a documentation process was shown to participants. It had a duration of 7m 30s.



Figures 28: Images extracted from the video showing the process. Machine made ring.

5.2.3.4 Description: Part 2

Right after viewing the video a participant was curious and asked questions about the production process.

Was it made here in Montreal? How long did it take to make the ring? (Cat, 66)

For the question 7 ‘for what occasion would you give this ring?’ most of the answers were similar:

Does not matter the occasion, any celebration really. (Jacqueline, 70)

Maybe if the opal represents a month, it would be a good birthday present. (Cat, 66)

I do not think that this ring says ‘birthday’ or ‘graduation’, you can offer it to anyone who likes big jewellery. (Maya, 61)

As for the question 8 ‘where would you expect to find this ring? Le Chateau / La Baie / Holt Renfrew / Birks’.

Definitely not La Baie or Le Chateau, not at all. (Maya, 61)

Maybe Holt Renfrew. (Jacqueline, 70)

I do not see it in a main store, I feel it is a one of a kind piece, so I would expect to find it in a “one of a kind store”. (Maya, 61)

Or probably on line, there is this site that is called ‘one of kind’. Where you can find a lot of nice jewellery and it is for promoting new designers and artisans. This ring makes me think of this site. (Kim, 25)

...or in a gift shop in a museum. (Maya, 61)

Yes! Definitely, somewhere like the contemporary art museum. (Kim, 25)

For the question 9: ‘Do you expect this ring to be a part of a collection, a only exemplar or produced in large quantities?’

I would not see it as a unique piece but probably a small production or part of a collection as you said. (Kim, 25.)

It will be hard to find the same opal anyway. (Maya, 61)

I would say a small production. (Jacqueline, 70)

‘Do you find that the video helped you answer the previous questions?’ (Question 10, Appendix 4)

I was surprised, to discovered the machine to start with. I heard about it but I did not know what it looked like. (Maya, 61)

I never studied to do jewellery so I had no idea of all the processes. But I do think that if you have that made by hand it is better, because it is exclusive, nobody else would have the same piece. It is like having a tailored suit, all the others do not have it. (Jacqueline, 70)

‘Do you feel that knowing the production process changes the way you are looking at the object?’ (Question 11, Appendix 4):

Definitely, I was very impressed by the ring but then when I saw the way it was made I thought: oh...it is a fake. Although I know that is the way things are made differently now, but I am from that generation where only plastic comes out of machines, not something beautiful like this, but I am open minded enough to know that new techniques exist; it is probably what it is used now. (Maya, 61)

For very personal jewellery could be interesting to use that process, it could go against the fact that could look cheap, because you can choose what ever shape you want, with rapid prototyping; you can make jewellery very particular and unique design. (Kim, 25)

I think that if you get to design your own pieces of jewellery it could be very interesting, because you have the power to personalize your object, but if someone else uses it to sell more it has a much lower value, because it is easier to do. (Kim, 25)

If it was written ‘made by rapid prototyping machinery’ it would have a lower value in my opinion. (Kim, 25)

Basically, no pain no gain. (Maya,61)

Because it is machine made. It is the idea that, if the machine made a jewel, it does not have the same value as if a person made it. From a creative side there is someone that designed it but there is always the use of the computer to make the object. (Kim, 25)

Yes but I think it is good too, this technology allows to make more. (Cat, 66)

Yes, I agree but I think that because of that it loses its value. There is a side to it that says 'there is not only one like this'. (Kim, 25)

I am not talking about making more items in production, but to enable to move on to other things faster, maybe new designs. I think that using this technology it is easier to have more variety. (Cat, 66)

Is this technology actually cheaper? (Maya, 61)

'Do you think you would value the ring differently if it was made in a different way? Do you think you would value this object more if it was made by hand and not by machine?' (Question 12 and 12b, Appendix 4)

I think so, because a jeweller probably spent more time and care making it. And it would be more exclusive too. (Jacqueline, 70)

Once again I think that it is because we grew up with the idea that what is made by hand is necessarily better. But I do not think it should be any cheaper if made with a rapid prototyping machine. (Maya, 61)

Yes but if it is done in series... (Jacqueline, 70)

Well, not necessarily... (Maya, 61)

I do not think I would value the ring differently. For me it is the end result that counts. Maybe it is tedious to make waxes by hand so if it is possible to make them by machine it is a good thing too. (Cat, 66)

But once again it is because when we think that a piece of jewellery is made by hand for us, it is made for us! As we expect the jeweller to have some kind of feelings conveyed to us through the object. I think that these kinds of feelings are going to be hard to fade. But, once again, in my case we grew up with this idea; that if you make your bread by hand it tastes better than if you make it by a machine, which is not always necessarily true. It is about being nostalgic of something that is disappearing. It is a lot beyond the jewellery. (Maya, 61)

It is really about the emotional durability of an object and the personalization. If I make a present for someone, even if it is not that fine it is something that is made for them, personalized for them, so it is an aspect that has a lot of value. (Kim, 25)

At the end of the focus group the same experiment as in the previous group discussion was made: showing the hand made version of the ring to gauge the reactions.

It is very interesting that you made both to see the differences. (Kim, 25)

It is interesting to see that in handmade ring it was cast in a single piece while the machine made ring was made in two pieces. (stated by the research assistant who helped the realization of both discussions.)

I would have said the opposite, I would have imagined the ring made by hand to be smaller and more refined than the one made by the rapid prototyping machinery, not the other way around. (Jacqueline, 70)

I think I like the small one better. (Maya, 61 talking about the machine made ring.)

For me it is the opposite, I like the big one better I think. (Cat, 66 talking about the hand made ring)

I like the big 'griffes' of the handmade ring, I find that they work well with the design but personally I like the finer details more. (Kim, 25)

I think that the hand made one is less pretty because I find it coarse, massive. (Jacqueline, 70)

The focus group assistant expressed her point of view as well on the two objects:

Personally I do like the fact that it is big. I can see that the mood changes in the two rings, in the machine made one there is a classy touch, the other one is more bold.

I find it more 'wise'. (Maya, 61, referring to the machine made jewel)

5.3 Summary

This section refers the execution of the two research methods applied in this study: three semi structured interviews with professional jewellers and two focus groups discussions with potential consumers. It presents the content of the interviews through a prose description and the content of the group discussions through direct quotations of the participants. The data this experiment has generated will be analyzed and discussed in the next chapter.

Chapter 6: Analysis and Discussion

This section analyses and discusses the data gathered in the previous section with the objective to answer the two main research questions.

The data generated during the three interviews was analysed by comparing the content of each experience to the others, in order to find patterns in the data and ideas that help to explain the existence of the patterns.

The data generated during the groups discussions was first analysed singularly based on the content and after was compared to each other for understanding how potential consumers react to RP, as a production method, for jewellery making.

The findings of the analysis are disclosed into a discussion mainly divided in the description of the effects of RP in the jewellery making practice, and the perceived value of jewellery when the technology is involved.

6.1 Analysis

6.1.1 Interviews Analysis

Although all the jewellers interviewed have different specializations and years of experience, there are some interesting observations that came out during the discussions that these artisans have in common. Regarding hand techniques, they talked mostly about wax hand sculpting and about production directly in precious metals. Both these techniques showed to have some strengths and weaknesses.

Wax hand sculpting is perceived as a very ductile and flexible means through which to make jewellery. It does not require expensive tools and it represents a good technique to learn for jewellery making, since wax is not a precious material it allows you to make mistakes without precious material losses. On the other hand wax sculpting does not allow 100% precision (precision is reached with the finishing of the jewel afterwards). Jewels made through this

execution shrink from 3% to 5% after the fusion in metal. Also, objects handmade in wax tend to be more solid and heavy than objects made directly from precious metals.

Traditional jewellery making made directly in precious metal allows finer and lighter pieces of jewellery to be made compared to wax sculpting, since it is a technique that works through different levels of material subsequently welded together. It usually requires more experience and dexterity with the material since there is an average loss of 5%-6% precious material during the process.

Regarding rapid prototyping, only one of our interviewees had direct experience with it, therefore opinions and points of view were more various and with different depths.

The jeweller who had already used rapid prototyping technology recognizes this technology as an added value, used as a way to create shapes not feasible otherwise and to make precious metal parts lighter and therefore more marketable. On the other side there is still distance between the approach, as a maker, of a jeweller and a rapid prototyping service. The RP service seems to have a more technical approach, where it values more the producibility of the product even at the risk of compromising the aesthetic value of the object. Jewellers instead give more importance to the aesthetics of the jewel.

The other two jewellers never had experienced using rapid prototyping and stated that they prefer the hand making process, as they are capable of successfully working with their own hands. One of them expressed his opinion on RP by saying that he would use it only if he had the need to reproduce a piece a second time, and that he would never forgo the satisfaction to do it himself. Artistic satisfaction seems to represent a very important factor for the jeweller. Similar aspects also emerged in Dewey's Aesthetic theory regarding the artistic experience: the craftsman cares deeply for the subject matter upon which skill is executed he also embodies himself in the perceiver while he works.

The same jeweller stated that he believes RP is a great innovation in the jewellery sector but he still believes that traditional jewellery should be made by hand, moreover that he believes

that the hand still surpasses the machine in the possibility of production. Such a statement could reflect a lack of knowledge about the technology.

I think it is a fantastic innovation but I still think that traditional jewellery making is done by hand and I still think that by hand it's possible to make things that are not possible to make by machine (M.T.)

This statement also reflects a certain detachment from technology, as well as recognizing the hand as the true and authentic means through which to make traditional jewellery. This point of view gives a significant perspective about some misconception about the technology, it indicates that there are still serious prejudices to be overcome before RP becomes widely accepted.

During the last two interviews what also emerged was the importance of the closeness between the matter and the artist. In the first case M.T. mentioned the 'deep personal satisfaction' that hand making represents for him, and that if he could create by hand he would rather do it himself, contemplating the possibility of using RP technology only in the case he had to remake a piece already done by hand. A similar answer was given by the third interviewee:

I really enjoy doing what I am doing it is because of the 'hands-on' dimension, that is what fascinates me about an object. (M.P)

Both statements reflect the high value they give to material understanding in their practice.

Another threat posed by this technology for the jewellery industry concerns intellectual property, either to guarantee that an object will stay unique or that reproductions pay the due royalty to the owner of the property rights. That is because when a jeweller uses this kind of services there is never the certainty that the design is not sold to third parties. Moreover the possibility to make more copies (in series) of an object makes it less valuable.

Other interesting insights came from the third jeweller interviewed who stated that the use of technology in general could be used to make some jewellery parts, in particular those details that are time consuming and require a lot of effort to do by hand. The use of technology could provide a more optimized production for those parts and details that rarely capture the attention of the final consumer for their “human touch”. This point brought up another topic, not answered before, the economic argument about the price of jewellery and marketability. This subject could also be brought forward and eventually developed for further research.

The use of RP technology in the jewellery industry could represent a means of opening up jewellery making to a wider population. For instance, with this technology, not only established jewellers could express their creativity through these kinds of objects, but ultimately anybody who has an idea; a kind of democratization of craftsmanship.

6.1.1.1 Interviews Outcome

		Interviewees		
		U.P. - A. M.	M.T.	M.P.
Themes	General Info	-Jewellers with 29 and 27 years of experience -Works for privates	- Jeweller and setter with 44 years of experience. - Works for privates and retailers	- 8 years of experience in jewellery design and making. -Works for private costumers
	Practice	-Work mostly by hand Wax sculpting and metal working.	-Works entirely by hand. -Works mostly into metal. + light weight - 5%-6% loss of material -Works sometimes into wax + Easy to carve - weight & shape	-Works entirely by hand, mostly in silver but also with unprecious material (costume jewellery) -Wax sculpting -Drill cut metal
	Tech.	-Lost wax casting process -Hot and cold connections Had Experience with RP + -Lighter weight -Aesthetic result -Easier to sell -Intellectual property -reproducibility	-Lost wax casting process -Hot and cold connections NEVER had experience with RP + innovation - Not comparable with handmade process. Hand still over come the machine	- Lost wax casting process - Cold connections knows about it but NEVER had experience with RP + curiosity - unfit, enjoys hand making
	Design	-Inspirations: -Social environment, fashion, architecture, Legacy design	50% own design 50% commissioned by clients	Own design and commissioned -Inspiration: art, fashion accessories, street culture, body art, tattoo

Figure 29: Chart summary of the three semi-structured interviews.

All three interviews for this research provided a better understanding on what the jewellery practice of today consists. They provided a deeper understanding on strengths and weaknesses for different jewellery making techniques. These interviews also gave a clearer view on how the rapid prototyping technology is perceived, used and valued in the traditional jewellery making industry.

Regarding the influence that this technology is having on the industry, it is indeed perceived as having big potential for the future, as a technology that will probably change the industry. At the moment it is a reality that does not apply so much in small jewellery workshops.

RP is used by jewellers to escape formal constraints, to have more freedom and control of geometry, but most of all it is used to make pieces of jewellery lighter and therefore more saleable. This technology also gives the ability to make jewellery not only to trained jewellers, but to everyone. On the other hand, it is also perceived by some of the jewellers interviewed as a less authentic means than the hand to produce jewellery.

In general, we could say that even if the RP technology is breaking through the traditional sector of jewellery making and it is slowly changing and evolving it, the actual practice is still very tied to the “hand made” way of producing. Experience and manual dexterity are still a very important part of the jewellery making practice.

6.1.2 Focus groups Analysis

6.1.2.1 Focus Group 1

In the first part of the focus group, in the first range of questions about the general appreciation of the ring, the adjective “unique” emerged to refer to the piece.

This implies that even before getting to know the production process some of the participants already perceived the object as valuable, presumably due to its appearance.

In the second round of questions, the multiple choice round, regarding the context in which participants would wear the ring, there were two different areas of thoughts. Around half of the participants stated that they would wear it for a more fancy occasion.

The other participants asserted that the occasion would not matter, and instead they could see themselves wearing it everyday.

I could even wear it everyday, not with my current job, but if I had an office job I probably would. (Camilla, 29)

I could also wear it anywhere. For me it would not be so important the occasion but the style, it would really depend on what I wear. (Sabrina, 40)

These responses illustrate how people choose what they wear for different reasons; some wear jewellery for appearance, especially during important events, while others wear it to communicate something or to express themselves. These two levels of communication are quite different, but they can apparently be expressed by the same piece of jewellery.

As for the assumptions of the monetary value of the jewel, answers were similar among all the participants. They guessed that the retail value was between \$250 and \$350, quite close to the real cost of the object which is \$350.

During the viewing of the video there were interesting reactions from some participants. One expressed astonishment when the documentary was showing the hand sculpting of the wax.

Wow, that is amazing! (Sabrina, 40)

The non-verbal reaction of another was to pick up the ring in her hands and look at it, almost as if to compare it with the images in the video.

These reactions reflect astonishment at witnessing the production process, as it was mentioned at the beginning of the discussion that a video of the production process was going to be shown, but it was not revealed how the ring was made.

For the second set of multiple choice questions, answers to the question “For what occasion would you give this ring” were more varied: a Christmas gift, birthday present or self purchase, or a travelling souvenir for someone special. Another response:

For me it would not be so much the occasion but the person I am giving it to, to match her style or her personality, because it is very particular. (Sabrina, 40)

Most answered that the value of the jewellery would be suitable either for a special or semi-special occasion, or if it particularly matched the personality of the receiver.

To the question “Where would you find this ring?”, answers from participants were fairly similar. All excluded the options “Le Chateau” and “La Baie”, as they were too commercial and not up to standards for the piece. Instead they could see the ring being found in a gallery or in a small designer jewellery store.

The fact that all participants chose a more ‘high end’ location reflected well the value that they perceived in the object, as well as expressing the ‘non-mainstream’ nature, also stressed by the words ‘designer’, ‘unique’ and ‘artisanal’.

For the last multiple choice structured question, “Do you expect this ring to be a part of a collection, an only exemplar or produced in large quantities?”, answers were very alike.

As the video shows we can exclude the ‘large quantities.’ I see it as a unique piece or maybe few samples. (Sabrina, 40)

All participants thought that, because it was made in an artisanal way, the ring was most likely to be a unique piece or a part of a small production. None of them pictured the jewellery as a mass-market piece.

In the final part of the group interview, when the questions were more focused, participants had the chance to express themselves more openly on their perceptions and opinions.

The participants were asked how the video helped them to answer the previous question. Some of the responses showed that the video raised the perceived value, by demonstrating that the ring is hand made and not mass-market.

The video was really fascinating it gives the impression that it is not mass market at all. It rise the level of its uniqueness in my head. (Gaba, 25)

For the previous question as to whether knowing if the production process changed the way potential consumers perceive the jewellery, all participants had a positive reaction to the video documentation. For some of them it represented an added value to see how the ring was fabricated:

In my opinion, seeing the actual production process, it gives it more value, because of the peculiar design but also because it is something more personal, you see in the video the jeweller carving the ring by hand. (Alexa, 35)

For me it was fascinating to see how much care and number of processes there are between the raw material and the finished product, regardless of the fact that is hand made or made on a industrial scale. It was incredible to observe the care for the particular and the numerous step of the process. (Camilla, 28)

Watching the video makes it feel even more unique. (Myriam, 29)

For others even if they find it interesting to know the production process, they explicitly stated that it would not be an influencing factor in purchase.

The responses to this question show that knowing the production process of a handmade jewel solicits more appreciation for the object. Particularly because it was hand carved by a human being who put care into making the ring, this is also asserted in Dewey's Theory on the aesthetic experience. Another factor that affected the participants' perceptions was the awareness of the multiple stages required in the making of the object.

Regarding the question whether the awareness of the manufacturing technique had changed their value perception of the ring, many interesting answers came out relating to traditional and rapid prototyping technology.

Yes, but it could be positive too, I did see that you are doing your research on 3D printing as well and I was expecting to see something 3D printed. But at the same time

the video that we saw makes it feel very human, like there was care put into it by a human, so that also gives it value. (Myriam, 29)

Participants were aware of the nature of the research due to the consent form, where the title, description and objective of the research had to be clearly stated in order to explain the nature of the investigation and its experiments. Ideally the participants of the group discussion should not have been exposed to this in order to elicit more spontaneous and ‘pure’ reactions. On the other hand it was not possible to hide this information due to ethical requirements. The fact that some of the participants were already influenced by the knowledge of the subject of enquiry represents a limitation and a weakness in the experiment, although on the other hand it brought up some interesting clues as to what potential buyers think about the technology applied to jewellery without necessarily having experience with it.

For me if it were the first 3D printed ring it would have been very interesting, because everything went in to it. Afterwards, when you get a mass production, the energy spreads somehow and it would probably make me lose interest to see so many copies. But I also think that if you put a machine in the process and if you have to possibility to produce a piece many times it loses value. (Alexa, 35)

In these answers it is possible to note a certain curiosity and excitement about a potential piece of jewellery made with rapid prototyping. Through the second answer, we see how the idea of technology and machinery is automatically bound to the idea of mass production, even if that may not reflect the reality of the case. At the same time the use of the expression “the energy spreads somehow” to refer to the value is very striking. The hypothetical first printed piece has a certain value; as the process of making more copies progresses, the value does not disappear, but it is divided by the number of copies, and so decreases.

Another interesting clue given by a participant’s answer was regarding the precision of machines versus the handiwork of the jeweller:

If the ring would have been made by a machine I would not mind, there is something about machines that it is really precise and measured, it is all about math you know...But then when I saw the video it is really great, but at the same time you see all this ‘dirty work’: the work environment, how he uses his tools...It is something that you do not think about it, you know. (Gaba, 25)

This statement affirms that the video revealed a side of jewellery making that probably most of the participants didn’t expect, the working environment. The fact that the environment is not clean and tidy seemed to have the power to build character surrounding the maker and the ring. As well as showing a more human side of the work, it demonstrated the capability of making beautiful objects in an imperfect and messy environment. This made some of the participants feel more involved and bound to the object:

I think that it is really cool that it is not clean and sort of a messy environment. In a way, I would probably like it more now that I am thinking about it there is something very cool about having it done by hand. (Sabrina, 40)

In the comparison with the 3D printed ring at the end of the focus group, all six participants preferred the hand made version, even if they appreciated some of the details in the shape and the colour of the stone of the printed one. Some of the reasons were because they found that the ring made by hand “had more personality” or they felt a “bond with it”.

Now that I see the other one I prefer the handmade a lot, it has more personality, even if in the printed ring you have certain details that are different in the handmade one. In the printed ring I like this little surface on the side, but I definitely prefer the crown that holds the stone in the ring made by hand. (Sabrina, 40)

I agree with her, I like the hand made ring better, it has more personality I find, but on the other side I like better the stone on the other ring. (Alexa, 35)

Maybe if we had seen the printed ring first it would be different, but we talked about the hand made ring so much, we looked at it a lot that we bond with it. (Sabrina, 40)

The fact that some of the participants felt emotionally linked to the object is interesting. It is almost as if they felt as a witness of the making process, or knowledgeable about it, and that made them connect to the object even more. Another comment about the machine-made ring was that it looked “too perfect”, a statement that underlines how the imperfection of the human is sometimes considered more valuable than the perfect symmetry of machine-made objects. The last comment of comparison between the two rings was:

I feel that the hand made ring, because it is heavier, it is more precious. (Gaba, 25.)

The fact that the hand made ring is heavier than the machine made one is indeed a symbol of the difference between these two manufacturing processes. In the case of rapid prototyping technology for jewellery making, the possibility to make lighter and finer jewellery embodies a great advantage, making jewellery more affordable. This last comment shows that participants were also aware that the weight loss had somewhat lowered the intrinsic value of the item.

6.1.2.2 Focus group 2

In the first part of the second discussion adjectives emerged regarding the ring such as: cute, nice, original and unique.

Other commentaries were made regarding symmetry, considered by someone ‘too perfect’ and the shape. The ring seemed to have a good communicative value since participants were able to recognize it and link to things and object that they had already knowledge about:

Yes!... on one side it is really round and geometrical and on the other side it is animal” (Kim, 25)

It also reminds me of claws of an eagle (Maya, 61)

The ring was also found somewhat contradictory: the form was described as ‘aggressive’ whereas the stone was described in the opposite way.

I find it a bit confusing because it gives two different impression: on one side it is soft and nice and at the same time aggressive and edgy, it is a clash. (Maya,61)

It reminds me of water, the sea. Cool, refreshing, liquid. (Cat, 66)

The features that attracted the most attention seemed to be both the stone and the polished finish of the ring.

For the first set of multiple-choice questions about the occasion where participants would wear the ring to, there were two main opinions: some of the participants saw it as a ring to wear at an important and elegant occasion, such as a wedding or reception. Other participants saw the ring as a piece of jewellery that would even fit daily use, since they considered it a big and solid ring.

As far as the guess for the price the answer from the participants remained in the same price range, between \$250 and \$350.

When the participants were asked who, in their opinion, made the ring, two of them thought that the ring was made by a jeweller, one said that it was an artisan and another said that it could be even an amateur:

It could even be an amateur using a casting service or a machine, using rapid prototyping technology. (Kim, 25)

This last guess showed that at least one of the participants was aware of the use of rapid prototyping technology in the jewellery industry; this might have been personal knowledge or something suggested by the title of the research itself.

Right after viewing the video a participant asked a few questions about the making of the ring and the provenience of the process. This attitude showed curiosity toward the use the technology, its effectiveness, and its availability.

When the participants were asked for what occasion they would wear the jewel, different answers were given. There was no significant majority among the response options. These answers were not especially helpful in assessing the possible change of perceived value due to the video, because there is no majority view that would allow a particular model to be highlighted.

For the question regarding the possible place where the participants expected to the buy the jewellery, the answers tended to converge towards similar ideas: pointing out more high end options for the possible location. Interestingly the idea again came out that the ring would probably find its place in a 'one of a kind' store and not in a mainstream store. This suggests that despite the fact that the ring is not entirely hand made, it should still be displayed as a handmade product or in the same kind of environment where a handmade silver jewellery item would be displayed.

Participants were asked whether they could see the ring being more a unique piece, a part of a collection or produced in large quantities. Most of the answers converged to the option, 'be part of a small collection (few pieces)'. These answers showed that even if the jewellery was made with the use of an automated machine it does not mean that the object is mass-produced. Although, no participants mentioned the possibility of the ring being a unique piece.

The answers to the last set of questions were more relevant to assess the change of the perceived value, since they were open questions and participants had the opportunity to explain their reasoning.

When the participants were asked if the video helped them to answer the previous questions, most of them expressed surprise to find out all the process of the making and the technology involved.

I was surprised to discover the machine to start with. I heard about it but I did not know what it looked like. (Maya, 61)

Another participant expressed her point of view on the use of the rapid prototyping machinery: that in her opinion, it takes away the aura of exclusivity that a piece of jewellery should have. She drew a parallel with custom-made suits to express the idea that ‘something that is made by hand has a certain value due to its uniqueness’.

I never studied to do jewellery so I had no idea of all the processes. But I do think that if you have that made by hand it is better, because it is exclusive, nobody else would have the same piece. It is like having a tailored suit, all the others do not have it. (Jacqueline, 70)

When the group was also asked how knowing the production process influenced their perception of the object or its perceived value, some interesting answers came out, such as:

Definitely, I was very impressed by the ring but then when I saw the way it was made I thought: oh...it is a fake. Although I know that is the way things are made differently now, but I am from that generation where only plastic comes out of machines, not something beautiful like this, but I am open minded enough to know that new techniques exist; it is probably what it is used now. (Maya, 61)

This answer shows how for this participant, the use of machinery to make jewellery does not represent an authentic means of creating these kinds of objects. As the comment raises the question of authenticity it, also brings up the idea of an object’s ‘pedigree.’ This statement also shows how the idea of the use of machines to make things is still very bound to an industrial production system, and still far from a connection to custom made use.

On the other hand, another participant saw a potential strength in the use of the technology as a means through which to design customized personal jewellery. This could be a means for the users themselves to be able to make their own jewellery.

I think that if you get to design your own pieces of jewellery it could be very interesting, because you have the power to personalize your object, but if someone else uses it to sell more it has a much lower value, because it is easier to do. (Kim, 25)

The previous statements seem to encapsulate what, for some, the use of rapid prototyping technology for jewellery represents: it is a very democratic means for those who wish to make their own design; but from the other side, since the making does not require experience or human effort, it is automatically perceived as having less value than something made by hand.

Because, it is a machine that makes it. It is the idea that the machine made the jewel does not have the same value as if someone would have made it. From a creative side there is someone that designed it but there is always the use of the computer to make the object (Kim, 25)

Another point underlined in the conversation was the ability of the machine to deliver more with more variety; but since this characteristic is not something related to crafts, but conversely a feature bound to faster production, it brings back the idea of mass market and therefore implies a less valuable object.

For the last question participants were asked if they would have valued the jewellery differently if it were made in a different way, by hand for instance. Three out of four participants stated that there would be a difference in the way they perceive its value due to its production method. The reasons cited were the time and personal care that the jeweller put into the object, which make the piece more exclusive, as well as the notion of hand made item simply being 'better'.

Once again I think that it is because we grew up with the idea that what is made by hand is necessarily better. But I do not think it should be any cheaper if made with a rapid prototyping machine. (Maya, 61)

The one participant that said that she would not value the ring differently because of its process affirmed that it is the final result that counts, regardless of the manufacturing process. It was also suggested that the use of the machine could be a significant help in the process instead of a weakness.

Another participant affirmed that jewels made by hand have emotional value because the object itself it is the symbol and result of the care and effort of another human being. As well as the idea that handmade is perceived as something more valuable that comes from the idea of the contact that exists between the hands of the jeweller and metal during construction jewel gives more importance to it. (Marzari 2007).

But once again it is because when we think that a piece of jewellery is made by hand for us, it is made for us! As we expect the jeweller to have some kind of feelings to convey to us through the object. I think that these kinds of feelings are going to be hard to fade. But, once again, in my case we grew up with this idea; that if you make your bread by hand it tastes better than if you make it by a machine, which is not always necessarily true. It is about being nostalgic of something that is disappearing. It is a lot beyond the jewellery. (Maya, 61)

In this statement the participant mentions as well the nostalgia tied to the hand making process. The presence of crafts represents the beauty that survives. Craft are significant for us because they symbolize something of the past that we wish we still had (Becvar, 2006, p.31).

A point raised by another participant regarded the emotional durability and the personalization of the object, an aspect that increases the value when it is present.

It is really about the emotional durability of an object and the personalization. If I make a present for someone, even if it is not that fine it is something that is made for them, personalized for them, so it is an aspect that has a lot of value. (Kim, 25)

At the end of the discussion when the handmade ring was shown to the group, participants expressed their preference. Three out of four participants preferred the machine made ring, some of the reason given being for the size, judging it more 'fine' than the hand made ring.

6.1.2.3 Comparative Analysis

6.1.2.3.1 Participants

Both the group discussions were supposed to host the same number of participants. In the first group there were six participants with an average age of 31. The second group was originally supposed to be five people with an average age of 40, but due to unexpected events only four persons took part in the discussion, raising the average age up to 55.

Even if the number of participants in the discussion was slightly uneven, the duration, interventions of the participants, and the contents were shown to be balanced enough for a comparison.

The large difference in average age between the two groups represents an element of inequality not planned for in the research, and therefore represents a limit to this experiment and somewhat reduces the applicability of the results. A tighter control over the homogeneous nature of the focus groups would increase the validity of such a research project.

6.1.2.3.2 Rings

The rings were designed to look and be as similar as possible. Although all natural stones are different from each other, both opals were very close to the same size, but with slightly different colour reflection. The most striking difference between the two rings is definitely the size, the handmade ring being bigger than the machine-made one.



Figure 30: Comparison of the rings: hand made (left) and machine made (right).

A detail that attracted attention in the first discussion was the crown that holds the stone in the handmade ring. A detail that was well appreciated in the machine made ring was the side surface, the part of the band antecedent to division into claws. This side surface is not present in the handmade ring.

The physical differences between the rings led to different responses during and after the discussions, especially when, at the end of each focus group, both rings were displayed simultaneously.

6.1.2.3.3 Result and interpretation

In the first part of the focus groups there were a lot of similar adjectives that came out in both discussions to describe the rings and point out their features, such as ‘different’ and ‘original’ or, evoked by the shape, ‘claw’ - ‘fork’ - ‘aggressive’ or ‘contradictory’ - ‘confusing’. Other adjectives and nouns used to describe the rings were not synonyms but were related to each other: ‘flow’ - ‘liquid’, ‘summer’ - ‘the sea’, ‘clarity and bright’ - ‘cool and refreshing’.

Different physical features came out as salient for the rings. In the handmade ring the weight, size and the light colour of the stone that was defined as ‘fake’ were pointed out. On the other

hand for the machine-made ring the main features were the symmetry, defined as ‘too perfect’ by a participant, and the polish and sleek finish of the metal.

The different main features underlined in the discussions are attributable to the physical differences between the two rings.

As far as the occasion for which the participants would wear the rings, two areas of thought emerged common to both discussions: the idea for some that the ring could be worn for elegant and important occasions, and for others that it could be jewellery to wear everyday and even to go to work. These are two different and almost opposite ways to wear, perceive, and value jewellery.

The price range mentioned in both discussions was between \$250 and \$350, which is a good estimated cost. The real cost of the handmade ring was \$350 and that of the machine-made was \$270. The fact that participants were able to guess correctly shows that the jewels communicate their monetary value.

For the next question asking who had created the ring, nine out of ten participants stated that it was either a professional jeweller or an artisan, only one participant (in the second group focus group) mentioning the possibility that it could have been done by an amateur using a rapid prototyping service. This answer shows that at least one of the participants was aware of the use of rapid prototyping technology in jewellery, albeit that the answer she gave may have been influenced by the title of the research and the description content in the consent form. It is even possible that she was actually able to see the ‘touch’ of the machine through the symmetric appearance and materiality of the jewellery.

During the first part of both discussions, most of the answers tended to resemble each other or at least have a lot in common, which seems to indicate that the participants were not influenced by characteristics emanating from methods of production in their appreciation of the rings. Most of the differences in the answers are due to the shape differences between the two rings and the participant’s personal knowledge about jewellery-making and new technology.

During the viewing of the video and right after there were reactions from participants in both cases. During the first video of the handmade process, one participant picked up the ring in her

hands to take a closer look at the details, as if to verify and assess the result; another stated her appreciation. In the second focus group, a participant asked a question about the technology showed in the video. The question regarded the operation, the timing and the availability of the technology in the local area. These reactions showed that in the first case some participants were impressed by what they saw in the video, while the participant in the second group showed signs of curiosity toward the technology used.

In the second part of the discussions other questions were asked, such as; Was for what occasion participant would give the rings to another person? The answers to this question were varied and yet similar. In both the discussions two sets of responses came out: that the rings could fit any kind of celebration, or that rather than the occasion it would depend more on the person it was given to. Another answer common to both discussions was 'birthday gift'. In the first discussion the options also arose of 'Christmas gift', 'Self-purchase' and 'Purchase made while travelling'. In the other discussion, the options of 'graduation gift' and 'anniversary' were given. The answers to this question suggest that the question itself was not particularly relevant to evaluate the changes in the perceived value.

Regarding the question on where participants would expect to find the ring, the common idea shared between the two groups was that the rings were not expected to be found in a main store but more likely in a small jewellery store with a designer in it or eventually online.

In the first focus group participants stated that the ring was most likely to be found in a high end boutique or in a gallery, in the second focus group the possibility of 'La Baie' (suggested answer of the questionnaire) and 'a museum gift shop' came up instead. Comparing answers between the two focus groups, it is possible to note that the hand made jewel was associated with more high-end sites compared to the machine made one. The answer to this question was the first to show a difference in the perceived value.

As to the uniqueness or the repeatability of the piece, the idea emerged in both discussions of the rings being a part of a collection with few identical pieces. Only in the first focus group, concerning the hand made ring, someone expressed the idea of the ring being a unique piece.

6.1.2.3.1 Values and Perceptions

In the last open questions it was possible to probe more deeply into the difference between the answers given in the two group discussions. Participants answered more completely, expressing their reasoning on the object and the production process.

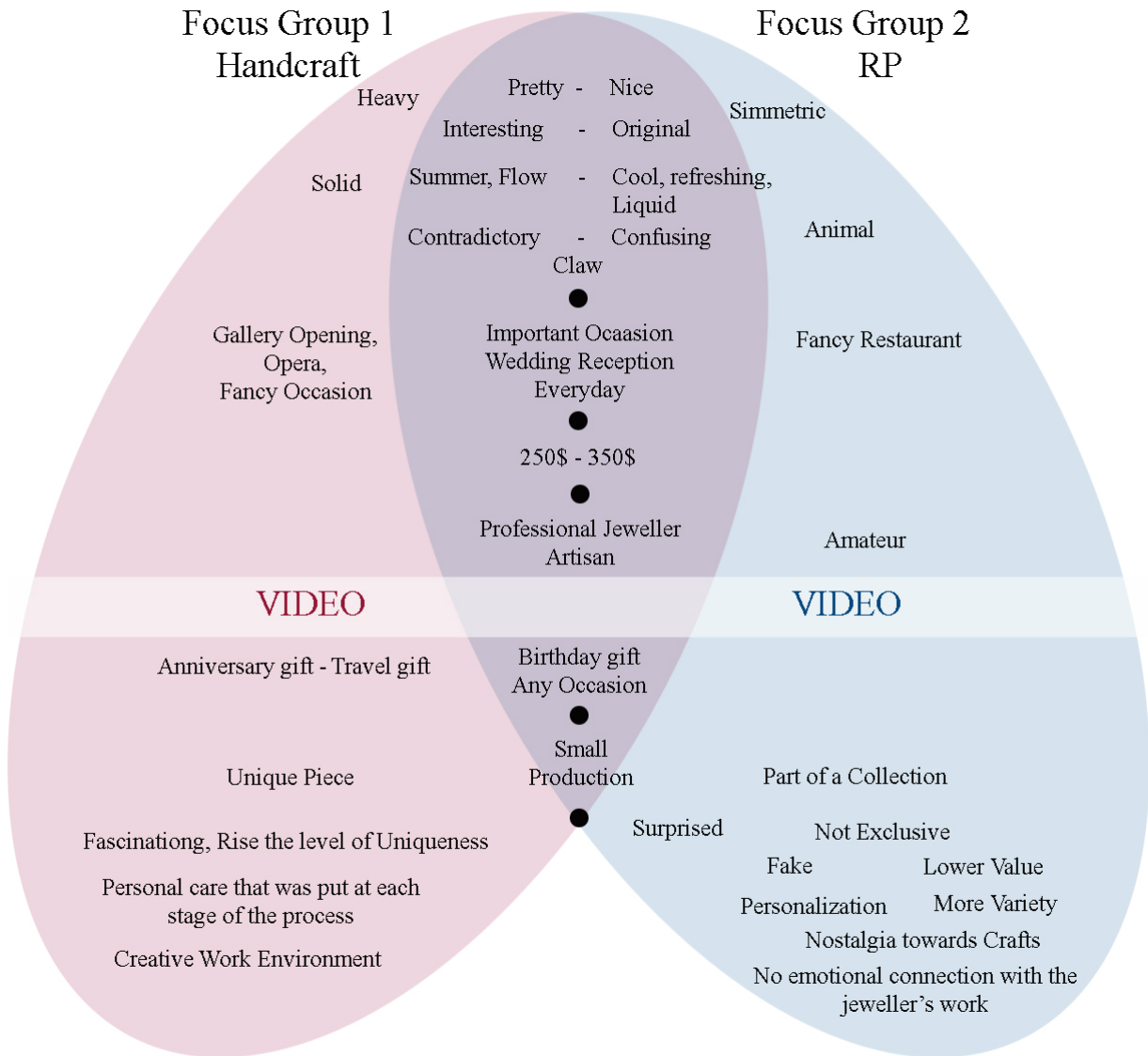


Figure 31: Focus groups summarization outline.

Concerning the explicit reactions to the video there was a common reaction of fascination and surprise between the two discussions as for different reasons. In the first, participants found that witnessing the process itself was fascinating and showed the uniqueness of the ring. In the second group some participants were surprised to discover a machine was used, but at the same time they stated it would have been more exclusive and therefore more valuable if done by hand.

As for the question on how the production process changes the way participants perceive the object, there were substantial differences between the answers given in the two discussions. In the first group it was remarked that the hand carving of the wax gives it a “personal” value, as well as the treatment and care put into it by a human being. In the second focus group the fact the object came out of a machine represented a somewhat less authentic, less meaningful means through which to fabricate jewellery, thereby diminishing value. It was even characterized as ‘fake’ by one of the participants. The connection of machines to mass-production materials and products was also stressed.

In the last question where participants were asked whether they would value the ring differently if it was made in a different way, the majority of participants stated that it would make a substantial difference. In the handmade ring focus group, it was pointed out how the environment in which the jeweller made the ring, the fact that it was disorderly and dirty, lent the ring an appreciable ‘character’. On the other hand, if the object was made by a rapid prototyping machine there would be interest and excitement for the new technology used for the first ring produced, but it would ‘lose its energy’ if replicated.

In the second focus group it was stated that time, care and exclusivity augment the value of handmade jewellery. It was also stressed how people see themselves reflected in their jewellery, this revisits the need of self-projection and social affiliation, as in the ‘Maslow pyramid of basic needs’. If it is handmade, it has even more personal value as it reflects one’s personality, and more deeply, the nature of a human being, through its uniqueness.

It also came out that hand made objects are considered ‘better’ and more valuable due to a greater emotional content, with the jewel being the medium and the evidence through which the jeweller and the user are connected.

... it is because when we think that a piece of jewellery is made by hand for us, it is made for us! As we expect the jeweller to have some kind of feelings to convey to us through the object. I think that these kinds of feelings are going to be hard to fade. (Maya, 61)

Another interesting point brought up in the last group discussion was about a nostalgic perspective about handmade jewellery making, and about crafts in general, that are slowly disappearing or being taken over by technology.

Emotional sustainability was also something that came out as a factor that increases the value of the object through the resilience of relationships established between consumers and products (Chapman, 2009, pp.29-35).

From the comparison of the rings at the end of the discussions, it turned out that, out of ten participants, seven liked the handmade ring more. The three remaining preferred the finer result of the machine-made ring. All six participants of the first focus group preferred the handmade piece. One of the participants also mentioned a bond created with the object:

Maybe if we had seen the printed ring first it would be different, but we talked about the handmade ring so much, we looked at it a lot that we bond with it. (Sabrina, 40)

It seems that just the fact of taking time to linger and talk about the jewellery created a deeper connection, and knowing its production process made the participants relate better to the ring.

In the second group three out of four participants liked the machine-made ring, because of its finer appearance, deeming it “wiser” and “classy”. When the hand made ring was presented to the second focus group, some participants seemed to be surprised to find that it was a thicker and bigger jewel as they expected the contrary.

In the second group only one participant favoured the handmade ring even if she did not have any knowledge of its making process.

Though nobody in the two groups watched both videos or was influenced on the perception of the ring in the same way, it was interesting to see how everybody in the first group showed more appreciation for the hand made ring that they had examined during the discussion. On the contrary, in the second group there was not the same consensus. One participant preferred the handmade jewel, the remaining three still favoured the machine-made ring.

6.1.2.4 Focus Groups Outcomes

In these group discussions, it appears that two pieces of jewellery with similar physical features are valued somewhat differently due to their differing production processes. It was also learnt which factors account for this difference.

The handmade manufacturing process is valued more because of the fact that a human being personally made an object. This makes it unique and unrepeatable, as well as a way through which feelings, personal memories and meanings are conveyed.

The hand carving of the material and the care from the jeweller in each step of the process increases the level of uniqueness perceived by potential consumers. Seeing the environment and the tools that the jeweller uses to create the object was pointed out as something that potential users are typically not aware of, and which gives more appreciation for the jewellery itself. A handmade piece of jewellery is also valued more because it connects two parties, the maker and the user.

The making process that involved the use of a rapid prototyping machine was assessed as a less authentic means through which to make jewellery. Even if during the discussions, statements of surprise and excitement for the use of this new technology came out, the idea of the use of the machine made potential consumers think immediately of mass production. This also led to the idea of repeatability, a strong factor that made participants have a lower value of the object, because it excludes the possibility of uniqueness.

The use of rapid prototyping machines into jewellery-making evoked a sense of nostalgia for handcrafts, as something that is perceived will fade and be taken over by technology.

On the other hand, rapid prototyping technology seemed to acquire value as a manufacturing process when it is used directly by a consumer, since it gives the freedom and the power to personally design an object that is invested with personal meaning.

The use of rapid prototyping for jewellery influences appreciation as it is still perceived as something that is not authentically connected to the way jewellery is made. The idea of a machine taking the place of a human hand in the making process is an association that gives a lower value to a piece of jewellery, not because it is less precious but because it is less meaningful.

6.2 Discussion

Both actors of these experiments, jewellers and potential consumers, had distinctive reactions and perceptions between rapid prototyping technology and the traditional making process.

As it was discovered from the jewellers interviews there are relevant issues regarding the use of RP in jewellery making concerning the changes in the practice and in the outcome compared to the traditional practice.

During the focus groups discussion it emerged that potential consumer recognises the machine as a less authentic mean to make jewellery.

6.2.1 The Effects of RP on Jewellery Making Practice

‘How does rapid prototyping technology influence the practice of jewellery making and its outcome? In what way?’

6.2.1.1 Changes in the Practice

From a practical point of view, the application of rapid prototyping has transformed the jewellery production process by making it faster, cheaper and more precise. The result of this application to jewellery practice has revolutionized the sector, from the way jewellery is conceived to the way it is created.

6.2.1.1.1 Flexibility of RP and the Application of Creativity in the Process

The rapid prototyping process was found to be both more flexible and more rigid than the handmade process. Flexible, because it permits changes to the form of the model before committing to the production, rigid because it does not allow changes during the production process. This latter feature is unique to the handmade making process and it is this feature that allows the artisan to make choices and change his mind on details during the production, applying creativity to practical problems that arise. With RP it is the opposite: there is great flexibility in the ideation phase of the design process, but no possibility of changes during the printing process. In the handmade process, the making is the most important phase for the artisan to apply his inventiveness to the object. With the use of RP, creativity is applied during the ideation phase, in the 3d modelling. One can therefore state that the two processes find their creative phase in different stages: RP in the ideation, and traditional hand making during the process of creation itself. These differences represent one of the main points of differentiation between the craft and the use of the technology in this sector.

Another observation concerning RP and creativity is that it does not reward the knowledge and experience in hand making, but instead rewards creativity, the capability of having new ideas. It raises the question of how and what will be valued more in the future. Until now experience and artisanal capacity has always been recognized as more valuable, but since the application of technology is growing exponentially, will the value of creativity overshadow the value of manual capacity? Or in other words, will creativity applied to 3D modelling produce results more valuable than creativity expressed through manual dexterity?

6.2.1.1.2 The Distance Between the Hands of the Artisan and the Material

The RP process has been found to represent a less authentic means through which to make jewellery compared to the hand. It has been highlighted, during the interviews, how the practical, hands-on dimension of jewellery production is very significant to jewellers.

My hands work well and I am able do everything successfully by hand. It is also the reason why I really enjoy doing what I am doing it is because of the ‘hands-on’ dimension, that is what fascinates me about an object. (Interviewed jeweller.)

The contact with the material, either carving waxes or metalworking, is the central part of their practice. The use of RP to make jewellery denaturalizes the practice as it creates a gap between the hand of the jeweller and the object. When RP is used, it replaces hand work and the contact with the material almost completely. This leads to a sort of ‘depersonalization’ of the object from the maker. The feature of using the hands to create is the main feature of craftsmanship, and it becomes a problem for the artisan to change such a thing by turning the practice virtual.

Through the testimonies of the interviewees, how the application of rapid prototyping into jewellery is a profitable technology for craft workers who have the capacity and the will to adapt to it emerged. Because RP was not initially designed specifically for the jewellery sector but applied to it afterwards, the production methods of the artisanal practice and the use of the technology are characterized by an enormous difference, which is ultimately between physical and virtual reality. The distance between these two ways of making represent a challenge to overcome to improve the interface of the technology by making it more suitable for artisans and ultimately everybody.

6.2.1.1.3 Reproducibility of a Piece of Jewellery

What also emerged, was that rapid prototyping technology is perceived by professionals as a tool whose strength lies in the faculty of producing more than one if needed, or making copies. It seems that the interest of jewellers who work by hand lies in the opportunity to work with unique pieces, therefore there is less enthusiasm involved in producing a piece of jewellery a second time. As the jewellers learn from the making process and master the technique, there seems to be less challenge and zest in repeating something already learned. The reproducibility of jewellery also influences the sentimental value of the object from the maker’s perspective:

The fact is that the mere possibility of having a jewel producible in a series implies the risk it loses its sentimental value, its uniqueness. Instead, in a series production, the object's value lies mostly in its precious material and monetary value. (Interviewed jeweller)

A similar insight was presented during the focus group discussions, where it was stated that RP could represent a way to 'move on' with things faster in order to generate new designs and more variety.

I am not talking about making more items in production, but enabling to move on to other things faster, maybe new designs. I think that using this technology it is easier to have more variety. (Focus group member)

6.2.1.2. Changes in the Outcome

From a practical point of view, the use of rapid prototyping in jewellery making has been shown to be a useful and valuable tool to respond to the needs of the market of today: reducing time in production, giving more control over the geometry of the piece of jewellery, and opening up the possibility to make lighter, and therefore more marketable pieces. Rapid prototyping also allows professionals to create jewellery with geometry not feasible otherwise. This feature adds value by expanding the possibility compared to the handmade.

Regarding how the technology influences the final outcome, it has been observed that jewellery made with rapid prototyping is characterized by a more generic and a less precious look, especially when the piece of jewellery holds stones. The technology allows perfectly symmetrical pieces that ultimately can have a 'too perfect' appearance, which does not reflect the human touch.

I find that the rapid prototyping ring looks too perfect. (Focus group member)

6.2.2 The Perceived Value of Jewellery

‘How does the use of rapid prototyping technology influence potential users’ appreciation of a piece of jewellery? In what ways?’

In the focus group experiments, how the different production processes prompted different potential consumers’ reactions when the production process was shown was highlighted. In the initial part, both the focus groups generated similar results, concerning the adjectives that came out to describe the rings, occasions to wear them and price range. These common answers suggested the idea that potential consumers showed to have almost the same appreciations for the two pieces of jewellery without knowing the way they are made. After showing the production processes, the results showed a relevant differentiation of answers between the two rings, which ultimately proved that there is a different appreciation due to knowledge of the processes.

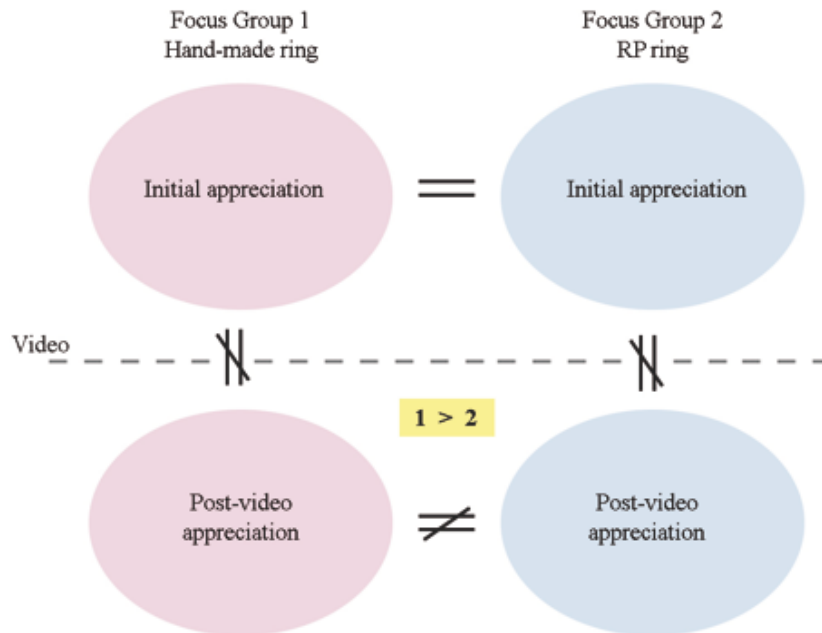


Figure 32: Diagram showing the focus groups results.

6.2.2.1 RP: a Less Authentic Means to Make Jewellery

Through the analysis of the focus group sessions, it has been shown that potential consumers were surprised to discover the application of RP technology in the field, as it was perceived as an unconventional way to make jewellery.

Definitely, I was very impressed by the ring but then when I saw the way it was made I thought: oh...it is a fake. Although I know that is the way things are made differently now, but I am from that generation where only plastic comes out of machines, not something beautiful like this, but I am open minded enough to know that new techniques exist; it is probably what it is used now. (Focus group member)

6.2.2.1.1 Use of the Machine

The image of the use of a machine caused potential consumers to link this technology to mass production, a hint that diminished the perceived value of a machine made piece of jewellery compared to the hand made one. The idea that the piece of jewellery that came out of a machine made potential consumers assume the jewellery was treated the same way as a mass product, and therefore had less value.

This analogy was the strongest factor that made the use of RP technology be perceived as a less authentic and less meaningful way to produce jewellery, due also to other reasons linked to the use of the machine: the repeatability of the machine made, the aseptic character of the machine and the nostalgia raised for crafts.

6.2.2.1.1.1 Repeatability

Other points stressed during the discussions, regarding the handmade piece compared to the machine made one, related to the uniqueness and the repeatability of a piece of jewellery.

With the use of rapid prototyping there is the possibility of re-printing a wax and recreating the exact same piece of jewellery a second time, as opposed to the hand making process. Repeatability is perceived as a feature that decreases the value of jewellery.

6.2.2.1.1.2 Aseptic Means Compared to the hand

It was also pointed out by potential consumers, that being able to see the jewellery workshop environment, in the case of the hand made ring, lent an appreciable ‘character’ to the piece of jewellery itself. As the video documentation acted as a gap filler between the imaginative experience and the real experience, it gave a clearer understanding of the object being in line with Dewey’s Theory regarding the aesthetic experience. On the contrary, there were not any particular remarks on the rapid prototyping environment.

I think that it is really cool that it is not clean and sort of a messy environment. In a way, I would probably like it more now that I am thinking about it; there is something very cool about having it done by hand. (Focus group member)

This hints that the rapid prototyping machinery and process is perceived as aseptic relative to the handmade one. Potential consumers showed more appreciation viewing the hand made ring process, almost as if they could better understand the process as they felt themselves reflected in the artisan. Rapid prototyping was perceived as a less familiar method compared to the hands of a human being.

6.2.2.1.1.3 Nostalgia for Crafts

Discussion of the use of rapid prototyping to make jewellery provoked a certain nostalgia towards the world of handicrafts, with a perception that technology is taking over and replacing a valuable practice. This nostalgic perspective about handcrafted jewellery starting to disappear raises the appreciation for and the value of the handmade jewellery even more.

RP does indeed represent an important innovation in the jewellery-making sector today and as jewellery’s history has witnessed the democratization of the materials, the use of RP could indeed represent an attempt at democratizing the means. At the same time the use of this application seems to have moved the industry in two opposite ways: forward concerning the

optimization of the resources such as time, material and overall costs and backward concerning the perceived value of the final product.

Whether RP represents yet another technology that threatens the artisanal jewellery making practice or that serves as a new starting point for the industry is uncertain. What does seem clear is that RP provides a new medium through which to explore the field of jewellery and inspire new forms of creativity.

Ultimately, what has clearly emerged is that neither potential consumers nor professional jewellers react to RP in the same way as to hand production. The difference in the use and in the perception of these two means of production remains fundamental. At the same time the use of rapid prototyping seems to include a problem of 'image', as the mean of production does not reflect the object properly. Future developments of this subject could address how the technology could improve and differentiate this point of view in traditional jewellery making beyond just being a more marketable way of making. For instance it finds higher value when used at its potential, by pushing forward the boundaries of the makeable and, moreover, of imagination.

Chapter 7: Conclusion

This research has explored the application of rapid prototyping technology to jewellery making.

Rapid prototyping is emerging as an important technique with the potential to revolutionize the world of manufacturing thanks to its characteristics of mass customization, freedom from design limitation, lower manufacturing costs, reduced waste material and logistic costs. (UBS, 2013) Over and above its multiple applications, it has also entered the field of jewellery making which traditionally fell into the domain of handicraft.

Jewellery manufacture represents one of the crucial factors through which its value and perception are built. Craftsmanship remains the key image of jewellery, which is inextricably tied to the concept of authenticity. It is perceived as a meaningful and significant production method as it can trigger emotional connection with users, even more in the case of jewellery, since it is a kind of object that enjoys a close relationship with the human body and which is often invested with personal meanings.

This thesis has discuss the influence and implications of RP in jewellery making compared to the traditional hand crafted process, with the formulation of two research questions:

- ‘How does rapid prototyping technology influence the practice of jewellery making and its outcome? In what way?’
- ‘How does the use of rapid prototyping technology influence potential users’ appreciation of a piece of jewellery? In what ways?’

Through a mixed methodology approach that included; three interviews with professional jewellers, and two group discussions with potential consumers, emerged that rapid prototyping changes the experience of making and the way jewellery is perceived radically.

RP has had an impact on the practice of jewellery making as the technology allows lighter, more marketable, perfectly symmetrical pieces with complex geometries that were previously not possible. On the other hand, the use of the technology represents a dramatic change from manual practice: as reported by professional jewellers, the technology creates a gap between

the hand of the artisan and the piece of jewellery, completely changing the artistic experience of making. Ultimately, RP has been perceived as a less authentic means for the manufacture of jewellery. What also emerged was how creativity is located in different stages of the production cycle: with the use of RP technology it occurs during the ideation and design stage; with the handmade process, it is concentrated in the stage of physical creation.

As perceived by potential users, RP machines are seen as a less authentic, less meaningful way to make jewellery since the use of machinery symbolizes mass production, which diminishes the value of jewellery compared to the handmade. The notion of uniqueness and a lack of repeatability was something that caused handmade jewellery to be perceived as more valuable than machine made. A sense of nostalgia attributed to traditional handmade practice compared to the use of technology also emerged.

The use of rapid prototyping in jewellery making has numerous benefits as well as limitations, as the technology allows the artist to overcome the limitations of handmade techniques regarding geometry, but is perceived both by craftspeople and consumers as less authentic and meaningful than the human hand. Even if technology is evolving to perfectly emulate the human hand and even surpass it, there is still a notable respect and appreciation for handcraft practices with all their limits, which are perhaps even considered as features that give value to the practice itself.

Understanding and comparing the application of RP technology to an area traditionally associated with hand crafts brought up some important differences between the processes and stressed how manufacturing processes can have significant influence on the products and their perceived value.

This research will hopefully inspire new developments in the application of RP to jewellery making, in a way that will better integrate the use of technology with the manual practice, making the experience more authentic and the outcome more valuable.

7.1 Research Limitations

As mentioned in the previous sections, there were some shortcomings in the organization of the research, specifically the age inequality between the two focus groups. A more rigorous selection of participants might have improved the accuracy of the results. It would be interesting to set up groups of different ages and see if there is a generational change in the perception of the technology, for instance, whether younger people are more receptive to the technology compared to older generations.

Because of some ethical requirements, participants were alert to aspects related to the nature of the investigation that, in retrospect, may have been better kept secret until after the focus group meetings. For instance, the mandatory consent form that was read and signed by each participant, somehow influenced their responses. Ideally, this form and other information provided to them should not have altered their viewpoint.

7.2 Further Research

Regarding the potential future development of this research, the first step would be to improve and expand the experiments already made in this investigation. As to the organization of the group discussions, expanding the range of participants, such as by repeating the focus group with a mixed group or a group with only male participants could improve the validity of the results.

As for the interviews, to better understand the pros and cons of the use of RP technology in jewellery production, the research could be extended beyond the area of artisans' workshops by involving bigger companies who already use rapid prototyping technology as an integrated part of their process in the interviews. This extension would provide a broader understanding of the application of the technology today.

Another interesting issue brought up during one of the interviews with the jewellers, was regarding the personal satisfaction of the artist. Further development of the research could be to enquire into how the use of rapid prototyping influences artist satisfaction. The response to the inquiry could clarify how the technology could be improved to better satisfy the artist's sense of aesthetics and tactility as compared to the hand. As previously described, haptic

technology could indeed be more appealing to traditional minded practitioners, since it reduces the distance between the hand and the material and is behaviourally more similar to hand practice. One improvement to the technology could be an even better interface, more similar to manual practice, with the design of a haptic system that provides simulated physical contact with the object with both hands instead of only one. The technology could also include virtual versions of jewellery tools used in traditional practice.

The results of this research could also inspire future development for the application of RP into jewellery making. For instance, the data that this research generated could be taken into account and used to design new tools and devices that bring the technology closer to handmade practice and make the experience of production more authentic.

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Appendices:

Appendix 1:

Consent Form for Semi-Structured Interviews

Title of the Research : Applying 3D Modelling Technology to Traditional Craftwork:
Rapid Prototyping in Artisanal Jewellery Making and its Impact on the Perceived Value of
Jewellery

Researcher : Cecilia Lico, student in M. Sc. A. DESCO,

Faculté de l'aménagement, Université de Montréal

Research director : Philippe Lalande, professeur agrégé, École de Design industriel,

Faculté de l'aménagement, Université de Montréal

A) INFORMATION TO PARTICIPANTS

1. Research objectives

This research aims to document the traditional ways of jewelry-making and the application of rapid prototyping technology within it. As the research will also look to identify strengths and weaknesses of both processes by comparing them to each other.

2. Participation in the research.

Participation in this research is to meet the researcher for an interview from 30 to 45 minutes at a time and place of your choice. This interview will focus on your personal working experiences with technology in the jewelry industry. The interview will be recorded.

3. Confidentiality.

The information you will be treated confidentially. The interviews will be recorded and analyzed afterward. Each research participant will decide whether to give or not their name and therefore their identity and business's name that they work for. This last detail could provide a better understanding of the kind of practice and technologies used. In addition, informations will be kept in a locked file located in a closed office. This personal information will be destroyed seven years after the end of the project.

4. Advantages and disadvantages.

By participating in this research, you can contribute to the advancement of knowledge and improvement proposals regarding technology, in the jewelry industry. Your participation in the research could eventually give new insights and ideas about future projects and creations as well as push you to explore new technologies' potentials.

5. Right of withdrawal.

Your participation is completely voluntary. You are free to withdraw at any time upon verbal notice, without notice, without prejudice and without having to justify your decision. If you decide to withdraw from the research, you may contact the researcher at the phone number listed below. If you withdraw from the research, the information that has been collected at the time of withdrawal will be destroyed.

6. Indemnity.

Participants will receive no financial compensation for their participation in the research.

B) CONSENT

I have read the above information, got the answers to my questions about my participation in the research and understood the purpose, nature, benefits, risks and limitations of this research.

I freely consent to participate in this research. I know that I can withdraw at any time without prejudice, upon a verbal notice and without having to justify my decision.

Signature :		Date :	
Surname :		Name :	

I declare that I explained the purpose, nature, benefits, risks and limitations of the study and have answered to the best of my knowledge the questions asked.

Researcher signature (or his/her representative) :		Date :	
Surname :	Lico	Name :	Cecilia

For any questions concerning the research or to withdraw from the project, you can contact the researcher at the phone number.

Any complaints about your participation in this research may be addressed to the Ombudsman of the University of Montreal, telephone number

Appendix 2:

Consent Form for Focus Groups

Research Title : Applying 3D Modelling Technology to Traditional Craftwork:
Rapid Prototyping in Artisanal Jewellery Making and its Impact on the Perceived Value of
Jewellery

Researcher : Cecilia Lico, student in M. Sc. A. DESCO,

Faculté de l'aménagement, Université de Montréal

Research director : Philippe Lalande, professeur agrégé, École de Design industriel,

Faculté de l'aménagement, Université de Montréal

A) INFORMATION TO PARTICIPANTS

1. Research objectives

This research aims to document potential consumer appreciations and reactions towards different making process in the jewelry industry. This research will seek to understand how making process influence the value of jewelry.

2. Participation in the research.

The participation in this research consist in taking part into a group discussion, or focus group, for a duration of 45 minutes. The time and place is choose by the researcher and communicated to participants 10 to 14 days in advance. The discussion will focus on a perceptions and opinions, given by participants, on a piece of jewelry proposed by the researcher.

3. Confidentiality.

The information you provide will kept confidential. The interviews will be recorded for afterward analysis. Each research participant will decide whether to use their first name or a pseudonym to be address with. Only the researcher will access to the name's list. Furthermore, all the information will be kept in a locked file located in a closed office. All the information that can

identify you will not be published. Personal information will be destroyed seven years after the end of the project.

4. Advantages and disadvantages.

By participating in this research you can contribute, to generate relevant data that could provide the jewelry sector with new ideas and improvements regarding production process. Sharing your buyer's experience and opinions could bring to understand better the consumer point of view and ultimately to more valuable products.

On the other hand this group discussion could also change or influence the way you perceive value on jewelry products.

5. Right of withdrawal.

Your participation is completely voluntary. You are free to withdraw at any time upon verbal notice, without notice, without prejudice and without having to justify your decision. If you decide to withdraw from the research, you may contact the researcher at the phone number listed below. If you withdraw from the research, the information that has been collected at the time of withdrawal will be destroyed.

6. Indemnity.

Participants will receive no financial compensation for their participation in the research.

B) CONSENT

I have read the above information, got the answers to my questions about my participation in the research and understood the purpose, nature, benefits, risks and limitations of this research.

I freely consent to participate in this research. I know that I can withdraw at any time without prejudice, upon a verbal notice and without having to justify my decision.

Signature :		Date :	
Surname :		Name :	

I declare that I explained the purpose, nature, benefits, risks and limitations of the study and have answered to the best of my knowledge the questions asked.

Researcher signature (or his/her representative) :		Date :	
Surname :	Lico	Name :	Cecilia

For any questions concerning the research or to withdraw from the project, you can contact the researcher at the phone number.

Any complaints about your participation in this research may be addressed to the Ombudsman of the University of Montreal, telephone number.

Appendix 3:

Semi-Structured Interviews' guide

Guide for semi-conducted interviews to jewellers.

This interview aims to give a better understanding on what jewellery making practice is from different professional's experiences.

RESEARCH QUESTION:

- How does rapid prototyping technology influence the practice of jewellery making and its outcome? In what way?

GENERAL INFORMATION

1. Name or code.....

2. Years of experiences.....

3. Previous technical/practical formation - year of completion.....

.....

.....

PRACTICE - concerning the manual practice.

4. In what does consist the practice in your business?.....

.....

5. What kind of clients do you have?.....

.....

6. What kind of means/tools do you use to create your pieces of jewellery?.....

.....

.....

TECHNOLOGIES USED

7. What kind of technology do you use?.....

.....

.....

8. Do you use lost wax casting process? yes/no

.....

If answered yes to question 8 - go to 9 otherwise skip to question 12.

9. How do you make your wax models? by hand or other means?.....

.....
.....

10. How long does it take to build a wax model?.....

.....
.....

11. Do you consider that lost wax casting process suits well the jewellery making process?

.....
.....

12. Have you ever heard of rapid prototyping technology for jewelry? yes/no what do you think about it?.....

.....

13. Have you ever used rapid prototyping to produce your models? If so, describe your experience

.....

14. Do you think this technology is an added value? yes/no explain.....

.....
.....

DESIGN

15. How do you come up with your design?.....

.....
.....

16. What is your inspiration?.....

.....

17. Do you change your design during the making process? If so why?.....

.....

Appendix 4:

FOCUS GROUPS QUESTION'S GUIDE

1- How do you like this ring?....

2- How would you describe it? With few (3 or 4) adjectives....

3- What do you think characterises this ring? What is the main feature? What catches your attention? (shape, finish, inclusions)

4- Would you wear this ring?

if so in which occasion would you wear it? Explain why....

-to go groceries shopping

-at the movie Theatre

-to a party

-at the opera / Theatre

-a wedding

5- How much do you think it costs? (range of price)

-25\$

-250\$

-2500\$

6- Who do you think made this ring?

-A professional jeweller

-An artisan

- An amateur

VIDEO / PRESENTATION - explains how the object is made and shows the process.

7- For what occasion would you give this ring?

-Christmas gift

-Birthday present

- Graduation

8- Where would you expect to find this ring?

-Le Chateau

-La Baie

-Holt Renfrew

-Birks

9- Do you expect this ring to be....

-A part of a collection (few identical pieces for each style)

-An only exemplar

-Produced in large quantities

10- Do you find that the video helped you answer the previous questions?

11- Do you feel that knowing the production process changes the way you are looking at the object / perceiving the object? yes/ no explain.....

12- Do you feel you would value the ring differently if it was made in a different way? For example:

12b- For focus group #1: Do you think you would value this object less if it was made by a machine and not by hand?

12a- For focus group #2: Do you think you would value this object more if it was made entirely by hand?

Appendix 5:

CDs with the videos documentation of the making processes of the rings

