Aesthetic experience & innovation culture : the aesthetic experience in an R&D department through design and for innovation culture

Ioana Cristina Ocnarescu

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AESTHETIC EXPERIENCE & INNOVATION CULTURE: THE AESTHETIC EXPERIENCE IN AN R&D DEPARTMENT THROUGH DESIGN AND FOR INNOVATION CULTURE

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GENERAL INTRODUCTION

I. Aims and objectives

This thesis explores the concept of **Experience** and **the Aesthetic quality of living Experiences**. Going in the same direction as recent studies that tackle these notions from a users' perspective – *User eXperience (UX), experience design, product experience* etc., our investigation proposes a study of **long-term experiences in real settings**. *The target population* of our study is not the final user, but the research-engineer in an R&D department.

Due to the terrain specificity and the nature of this *industrial PhD*, we are also sensible to organisational and contextual variables that impact the *working experience* in an R&D department. As **design practitioners**, our aim is to understand the *relation between design and innovation* and the influence of design on the organizational culture of R&D teams.

With these in mind, this thesis has the following objectives:

→ **to framework the concept of Experience and the Aesthetic quality of living Experiences** in real live situations in order *to observe, describe* and finally *generate* memorable and meaningful experiences;

→ to **investigate the influence of design culture** on **the working experience** of research-engineers in an R&D department;

→ **to explore the role of design** and its relation to the **innovation culture** in a Techno-centred department.

II. Research question

Given that *aesthetic and subjective experience* are topics of growing interest in the design community, several studies investigate these concepts **to measure and predict rich users' experiences** with products or to understand the development of **the aesthetic appreciation** in art-related environments. However, lots of these studies in design research, focus on *information-processing models* of the aesthetic perception, while others, that take into account the holist nature of aesthetic experience, usually *build theoretical frameworks coming from philosophy* and do not study aesthetic experiences **in real settings**. Even fewer of these studies discuss *the temporal evolution of aesthetic experience*.

Therefore there has been a research gap in understanding *the conditions and dimensions of aesthetic experience*, from **a holistic perspective**, **in real settings** and environments that are **not related to artworks and museum contexts**. Thus, it is necessary to develop a

descriptive framework to observe the aesthetic quality of living an experience over time. Moreover the several studies from management science interested in the psychology of work feelings, suggest that *studying aesthetic experiences in organizations opens for new experiences and attitudes in this environment*, while other pretend that the interest in **feelings of work** is *critical for organisations that rely on motivation* such as research institutions and laboratories.

Therefore our research question is related to **the aesthetic experience of research-engineers in an R&D department** and **the relation of this subjective experience with innovation and performance**. Furthermore, due to the cultural difference between the design and the Techno-centred culture of R&D departments, we also question **the role of design to influence people's experiences** and to transform the organisational culture.

III. Research methodology

In order to conduct our research, we use an Action-Research approach. The industrial nature of this PhD, and the experience as a design practitioner in the Application Research Domain (APPRD) of Alcatel-Lucent Bell Labs France, brings to this thesis a rich experimentation terrain.

The first cycle of the Action-Research, called Pre-Experimentation, lasts between 12 and 18 months. During this exploration phase, in which we get immersed in our field, we identify relations between the working experience of Bell Labs researchers and the influence of the design culture in this department. From the theoretical point of view, this phase consists in two directions: a specific field-related state of the art to solve design problems while participating in APPRD projects, and a more general state of the art related to concepts of Experience and Aesthetic Experience (see **Figure 1**). The empirical and theoretical knowledge acquired during this first phase allow us to build the research question and the hypotheses of the thesis.

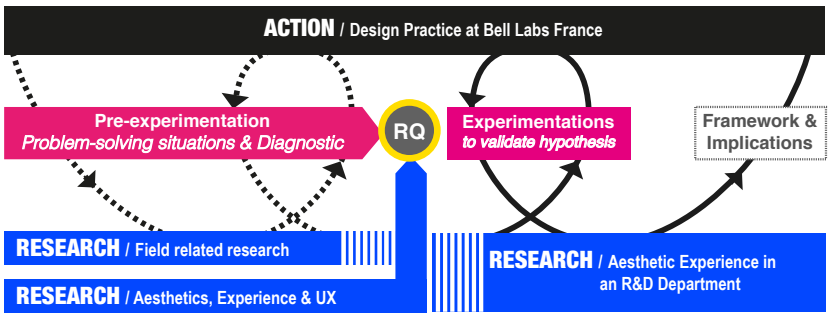


Figure 1 Thesis research methodology

The second cycle of Research-Action consists in testing hypotheses, building the theoretical framework of the study and proposing first implications for design to craft aesthetic experiences through design and for innovation culture.

IV. Research Contributions & Originality

We briefly present the **methodological, theoretical and practical** *key contributions* of the study as following:

1. A holistic framework of Aesthetic Experience

From a theoretical point of view, we **propose a descriptive framework of Aesthetic Experiences** in an unconventional environment: an R&D department. Our framework revalidates the dimensions of aesthetic experience coming from literature and shows specificities of these dimensions in a working environment in comparison with museum or art-related environments. Moreover our study describes new experiential aspects like *the collective experience*, *the experience of makers* and *the organisational* and shows the importance of these elements for the success of a rich and memorable experience in an R&D department. Finally we also propose **first implications for design** that operationalize the dimensions found in our study on three directions: *working environments, intermediary objects and guidelines for the design process.*

2. A sequential methodology to study experiences in real settings

From a methodological point of view, our research proposes a sequential procedure to study long-term experiences developed in real settings. As it is shown in the State of the Art, the measurement of long-term experience is a topic of interest for the design research community. We use **a three-step structure to framework aesthetic experiences in real settings**: *Research-Action*, *Qualitative study and Quantitative study.* Additionally this proposition is built during the investigation of a new concept, the Aesthetic Experience of an R&D department. This concept creates a transition between **UX** – *User Experience* and **CX** – *Concepteurs Experience.*

3. Design artefacts – cultural vehicles and the aesthetic quality

Another theoretical contribution is the quality of design artefacts as **cultural vehicles** in a Techno-centred environment. Due to their cultural difference, these artefacts transform the actors of innovation and inspire them to generate new usages and adaptions in their work. From this point of view they are *extra-ordinary, unique* and therefore *aesthetic* - their force and visibility lays in their cultural difference with the technical background of R&D departments.

4. Aesthetics, design and innovation culture – directions for new measurements

A practical contribution of this thesis is the operationalization of several aspects we find in our study into directions for **new measurements of innovation culture, design and subjective judgments in R&D departments**. We discuss the relation between **design tools & practices and innovation culture** and we propose **new directions to measure the influence of significant, memorable and desirable projects** in R&D departments.

V. Thesis Structure

Section 1. Context

Section 1 presents the industrial and the academic context of this thesis and introduces the major topics of this research. From the organisational point of view, this research project is an *industrial or professional PhD* (*thèse CIFRE* in French). In this section, we thus explain both the industrial demand and its inscription in a larger industrial context of the today Telecommunications industry (§1.1). Further on, we discuss the role and definition of design, its social and industrial impact as a vector of change for companies and people (§1.2). Finally, we draw an evolution of design research from design-solution methodologies to more complex tools and methods that consider human's subjectivity and experience in the design process (§1.3).

Section 2. State of the art

Section 2 provides the state of the art of concepts as **Aesthetics, Experience, Aesthetic Experience** and the corresponding theories coming from *Design Research, Psychology, Philosophy, and Management science*. This chapter is divided into three parts. The first part focuses on normative and judgmental models that describe the aesthetic features and principles in design (§2.1). The second part draws a global view on holistic perspective of User Experience and proposes definitions and a theoretical tool to study Aesthetic Experience (§2.2). In the third part, we introduce the notion of Aesthetics in working environments and we focus on the design culture impact for organizations and innovation culture. Moreover we underline the attributes of design tools and methods for collaboration and cooperation (§2.3). This section is concluded with a synthesis of findings and limitations from scientific literature that leads, in Section 3, to the formulation of research questions and the development of hypotheses.

Section 3. Research question and hypotheses

Section 3 formulates a research question and develops the hypotheses of this thesis. The core research question explored in this thesis is related to the concept of **Aesthetic Experience of an R&D department and the relation between this subjective experience and the design and innovation culture**. Two main hypothesis are explored: **Hypothesis 1** suggests that there exist an aesthetic experience in an R&D department and it can be frameworked; **Hypothesis 2** proposes that there are strong correlations between the aesthetic experience, the innovation indicators and the design culture elements created in an R&D department.

Section 4. Empirical study

In Section 4, we present the experimental methodology and the experimentations of this thesis. In order to validate the hypotheses presented in Section 3, we perform an Action-Research approach in two cycles. **In a first cycle,** Pre-experimentation, we present our design contributions in the Applications Research Domain (APPRD) projects, and the role of design on the working experience and outcomes of projects at Bell Labs (§4.1).

In the second cycle, Experimentations, we present two separate investigations, which aim to validate the two hypotheses developed in Section3. Through a qualitative study conducted on 31 Bell Labs research-engineers, Experimentation 1 frameworks the aesthetic quality of the working experience in the R&D department during four years (§4.2). Experimentation 2 is a quantitative study that revalidates the Aesthetic experience conditions extracted from Experimentation 1. It aims to find relations between these conditions and Bell Labs innovation indicators. It also tests the influence of design to trigger such subjective experience in a Techno-centred environment (§4.3). Each sub-section includes results, limitations and discussions. Finally, this section is concluded with the partially validation of our hypotheses.

Section 5. Thesis Contributions & Design Implications

In Section 5 we present the key contributions based on the results from the empirical studies conducted in Section 4. From a methodological point of view, our research proposes a sequential methodology to study long-term experiences in real settings, and formulates of a new concept: the Aesthetic Experience in R&D departments. From a theoretical point of view, we propose a descriptive framework of Aesthetic Experience and we address its similitudes and differences with Aesthetic Experience in other

contexts. Moreover we propose first implications of this theoretical framework for design and design management. Additionally we discus new features for design artefacts in Techno-centred environments as cultural vehicles and transformative, extra-ordinary and therefore aesthetic elements in the organizational culture. Finally, we suggest **several directions to measure the design impact in organizations and the influence of significant, memorable and desirable projects** in R&D departments.

Section 6. Conclusions and perspectives

Section 6 presents general conclusions by recapitulating the thesis (§6.1) and then discusses possible directions for further studies as following (§6.2):

- the validation of the design implications of the aesthetic experience dimensions proposed in Section 5;
- the investigation of the relation between a rich experience in the process and the user experience resulting from such a process and the introduction of a new concept: 'Experience Triggers' as a generative method for UX;
- the relation between Aesthetic experience and human needs;
- the matching between the temporal phases of aesthetic experience and the aesthetic experience conditions found in this thesis.

MOTIVATIONS

Before discussing the research and industrial frameworks of this PhD, I will briefly present my motivations for this research project. *'The Cup', 'Blue & Paper'* and *'Meeting Mona'* are three stories that ask questions rather than explain concepts. Some of them are born before starting this PhD. Others, more specific and subtle, come along the three years of this thesis.

Ceci n'est pas une tasse! At least, not anymore

On August 2008, Tim Brown writes on his blog *Design Thinking* a post called "Is this a product or an experience?" He receives a new cup, a Bodum coffee cup that looks like any other coffee cups. As Tim tries this new product next morning, the long-lasting heat of the coffee in this new recipient profoundly surprised him. From an unwanted gift, this product reveals to be a fantastic coffee drinking experience. Since 2008, this blog post intrigues me. And when in March 2013 I finally got my Bodum cup some questions still remain unanswered. Tim's story made me live an experience even before I taste the first coffee from my own. As a designer, I am interested to find out influence of these induced experiences on personal experiences with products. As a researcher, I ask myself how this experience is evolving over time. Is Tim experience over? He surely drinks coffee each morning from Bodum coffee cup, but is he feeling the same surprise and reflective attitude towards this product? |

Figure 2 Image of Tim Brown's Bodum coffee cup (designthinking.ideo.com)

Blue & Paper

In the corporate world of Alcatel-Lucent a blue tape film was forgotten on the ceiling near the coffee corner. Somebody stack a paper boat on the blue film. The result is amazingly simple and beautiful. I call this the aesthetic attitude and I tend to think that designers are also taught to look for opportunities to bring such moments in people's life and craft situations in which we suddenly feel 'higher' than before. They can make people change perspective and find new ways to perceive their environments.|

Figure 3 The coffee corner ALU Bell Labs France

Meeting Mona

In the urge to understand and talk about aesthetic experiences, I found myself in the Louvre on February 2012 to look for Mona Lisa and for people watching her. Dozen of cameras gleamed all over the place. I met people that saw the painting for the first time, some that came to watch this painting very often and others that took care of it everyday – security guards. All their stories are very different. If in my first story I ask how experience is evolving over time, here I ask how to create a personal experience with Mona Lisa. Is it about preparation, intellectual questioning, and connection with a personal situation? Is it about the understanding of this painting or the fact that the "more I know, the more I like"? Could I connect with such objects from home or do I need the museum context and the original artwork? Thinking about all these questions and having this reflective process engages me even more with the artwork. The will to understand, my attitude and consciousness seem to have a big influence on the experience. |

Figure 4 People looking at Mona Lisa (Feb 2012)

1 Context

1 Context

From the organizational point of view, this research project is a professional PhD (*thèse CIFRE* in French). The goal of a professional PhD is to contribute both to theory and practice in the field of design: to develop strategies and solutions useful for the professional practice and to build knowledge within the community of design science (Murray, 2006). The industrial support is provided by *Alcatel-Lucent Bell Labs France*, the academic support by *the Product Design and Innovation Laboratory* (LCPI, EA 3927) from *Arts et Métiers ParisTech. Strate Collège* (design school) is also a partner of this research project.

The following section is divided in three parts. It has the goal to draw an overview of the context of this PhD and general observations concerning the topic of this research.

The first part explains the industrial context of this doctorate and the industrial demand. It presents an analysis of the telecommunication industry evolution and, from the experience of a designer practitioner in a techno-push environment, it underlines some of the design challenges encountered during the 3 years of this professional activity in an R&D department. From a PhD focusing on User eXperience (UX) with telecommunication technologies, the goal of this research project changes towards the *working experience of researchers* due to the design culture entering the department.

The second part shows the evolution of design since the last half of the XX century and the role and definition of this discipline in the today society. Going beyond the execution of an industrial demand, design creates its own responsibility and ethics as a vector of change both for companies and for people.

The third part draws an overview on design research and the challenge of this academic field to have a general methodology. Within this academic context, I present the research topics of CPI laboratory and the approach used in this research project, Action Research. I explain how this approach coming from Human Sciences is used within this PhD.

Figure 5 Badges of the three institutions contributing to the PhD: **Alcatel-Lucent Bell Labs France, CPI Laboratory** Arts et Métiers ParisTech and **Strate Collège**.

1.1 Industrial context

> Reliance on technology is hugely risky. Relatively few technical innovations bring an immediate economic benefit that will justify the investments of time and resources they require. This may explain the steady decline of the large corporate R&D labs such as Xerox PARC and Bell Labs that were such powerful incubators in the 1960s and '70s.
>
> **Tim Brown** (2009) – Change by design

The history of Bell Labs is complex. Many books are written to understand the factors that made Bell Labs and AT&T the leaders of telecommunication systems and many books are written to understand its collapse. Technical discoveries, inventions, economic monopolies, political regulations, Nobel prizes, disinvestments, and fusions – all these factors built the history of this laboratory. Besides this history, there are also stories and Bell Labs image is still glowing in today telecommunications through its research culture and scientific recognition. In 2007 when Alcatel and Lucent merge, Bell Labs becomes the research laboratory of two R&D laboratories: Lucent Bell Labs and Alcatel R&I (Research & Innovation). In the same year a new department is created, *Applications Research Domain* (APPRD). Its mission is to create end-user applications, build technologies and discover scientific facts. Within a Techno-Push environment, new profiles like designers, sociologists and ergonomists bring new ways to approach innovation. This section draws an overview of the mission of this research department at different scales and the challenge of a PhD within this industrial context.

Figure 6 Old logo of Bell Labs present in one of the researchers desks – Alcatel Lucent Bell Labs France.

1.1.1 Telecommunication in XXI century

Telecommunications live a global and multiform mutation, a "creative destruction" as Pierre Musso describes the evolution of this sector in 2006. Due to the technological Big Bang brought by the process of deregulation and digitalization even the term "telecommunication" is questioned. The evolution of telegraph, telephone, telecommunications to Internet and mobile communications creates new communication paradigms. The important thing today is to be contacted in order not to feel abandoned ((Musso, 2008), p. 104) and in a context of *connected presence* "communication is not opposed to absence but to silence" (Christian Licoppe in (Musso, 2008), p. 104).

Figure 7 101 Gadgets That Changed the World © JAMIE CHUNG (2011)

On a population of 6.5 millions people in 2006, 1.1 millions are using Internet and in 2013 this number doubles. The fixed telephone subscriptions are stable, but the number of mobile broadband

subscriptions has largely escalated over the past few years – if in 2006 there were 268 millions in 2013 the estimated number is ten times bigger. The indicators of the ITU (International Telecommunication Union) presented in **Table 1**, show what Lévy and Jouyet call the *transition from an industrial economy to an immaterial economy*. This transition brings ambiguity for the actors that enhance the macro-system of telecommunications – i.e. *the operators, the industry, the state policies and the users* (Musso, 2008), but in the same time it brings an economy of knowledge, of systems working in networks and challenges industry and people behaviours (Lévy & Jouyet, 2006).

Table 1 ITU April 2013 statistics on Internet and mobile communications evolutions (www.itu.int)

	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012***	**2013***
Individuals using the internet (millions)									
World	1,024	1,151	1,365	1,556	1,747	2,023	2,273	2,497	2,749
Fixed-telephone subscriptions (millions)									
World	1,243	1,261	1,254	1,249	1,253	1,228	1,204	1,186	1,171
Active mobile-broadband subscriptions (millions)									
World	N/A	N/A	268	422	615	778	1,155	1,556	2,096
Percentage of individuals using the internet (% per country)									
France	42.87	46.87	66.09	70.68	71.58	80.10	79.58	N/A	N/A
USA	67.97	68.93	75.00	74.00	71.00	74.00	77.86	N/A	N/A
Germany	68.71	72.16	75.16	78.00	79.00	82.00	83.00	N/A	N/A
China	8.52	10.52	16.00	22.60	28.90	34.30	38.30	N/A	N/A
Japan	66.92	68.69	74.30	75.40	78.00	78.21	79.53	N/A	N/A

** : estimations; N/A : not available.*

Within this context in 2005-2006, the race for innovation drives industries to *concentration procedures and mergers* (for example Nokia-Siemens and Alcatel-Lucent), and reduction of the R&D investments. All these evolutions and transformations also impact the R&D structures and their research and innovation process. From a *Techno-Push* nature, the industrial laboratories switch to a *market-pull* approach that brings within these structures new profiles from **marketing, innovation services and design**. Focusing more on the development of the demand and on anticipation, it is time for *the fourth generation of R&D* ((Musso, 2008), p.98). The next part presents how Alcatel-Lucent explores the fourth generation of R&D and how innovation is perceived in this environment through a new perspective, that of the **User** (Guern, 2013)**.** The understanding of this context brings clarity to how design enters an R&D department and how its role is defined in this environment.

Figure 8 Bell Labs ages: technic, client, user - adapted from (Guern, 2013).

1.1.2 Innovation at Bell Labs and Applications Research Domain (APPRD)

Following the main trend of investing in R&D departments to bring innovation, Bell Labs becomes in 2008 the innovation centre of Alcatel-Lucent. Bell Labs mission is to create substantial growth opportunities and competitive market advantage for Alcatel-Lucent through a *disruptive innovation and a clear technical vision*. These two directions, on innovation and technical development, are both supported by the research culture of Bell Labs. The difference with the traditional research culture - mainly techno centred, is that the new framework also includes the **User**. The new direction on Applications brings to Bell Labs what Guern calls *the Age of User at Bell Labs* (Guern, (2013)) (see **Figure 8**). Indeed, besides the seven departments that are entirely technological, Bell Labs opens in 2008 a multidisciplinary domain, ***Applications Research Domain*** (APPRD)[1]. This PhD is conducted in this department.

In 2008 APPRD at Alcatel-Lucent Bell Labs is constituted of 82 research engineers, 2 sociologists, 1 design manager and 1 designer, a total of 86 research engineers working in France, Belgium, India and USA. The department focuses on three interdependent directions: ***applications***[2], ***web 2.0*** and ***user needs***. Due to the technical history of this research centre, testing the technological functionality is one of the most important aspects in the design process. Therefore most of the projects created overtime in our laboratory are not final applications but **technical demonstrators**. A demonstrator role in an industrial context is described by Bouchard et al. as to emphasize *the proposals of new performances*, to *make a synthesis of all the innovative work in the company*, to *consolidate consumer and user centred design methods* and to *provide a support for the diffusion of knowledge and the evaluation of the synthesis* (Bouchard, Camous, & Aoussat, 2005).

Besides the Techno-Push context new factors are introduced in innovation process of APPRD, the **Pull factors.** The *Pull factors* are external factors like the socio-cultural or the political values, norms and tendencies and the user's behaviours, needs and cognitive limits (Gotzsch, 2003; Hetzel, 2002). On the other hand, the *Push factors* are internal aspects like management and human resources, technology and company values. In APPRD the projects are technology driven projects and

[1] The mission of APPRD is to develop technologies, intellectual properties, paradigms and product concepts that serve the users in their needs for information, communication and entertainment. Applications Domain deals with any software that intends to serve directly the end-users' needs (Bruno Aïdan, Head of APPRD Alcatel-Lucent Bell Labs in 2008).

[2] An application is a complete and direct answer to a specific user need in a context in which the world is getting more and more digital and communication pervades most applications (Bruno Aïdan, Head of APPRD Alcatel-Lucent Bell Labs in 2008).

consequently they follow a Techno-Push product development. Therefore the challenge in these projects is to adapt and use technology for a particular situation, context, and environment, and to include more cultural and social factors - the Pull factors in the design process. In order to achieve this goal, new profiles are mixed in the innovation process of APPRD. Psychologists, sociologists and designers bring a new culture in the telecommunication department (see **Figure 9**). The next part explains the mission of the design team in APPRD and the focus of this PhD.

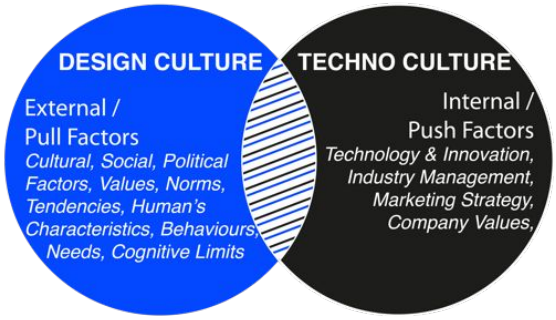


Figure 9 Push & Pull Factors, the encounter of two cultures - adapted from (Gotzsch, 2003; Hetzel, 2002).

1.1.3 User Experience at Bell Labs

PhD Industrial Context: Within the mission of APPRD, the user and the user's needs are the focus of all research themes. Almost all the missions of this group are written as following: "*Empower users to …*", "*Enable users to …*", "*Build a dynamic network of persons related to users…*". In order to achieve these goals and to create desirable, usable and useful applications a transversal team is built in 2009, ***User Experience Design (UXD)***. The UXD team is lead by Frédérique Pain, the industrial tutor of this PhD. The goal of this team is to create *user interface design* (through usability techniques, web design, storyboard, graphics), *user centric design* (functioning demos, lifestyle-evoked universe) and *to innovate through design thinking approaches and design research methods*. The **User Experience** concept enters this department as a key element to innovation and value creation for the company.

PhD Focus: My PhD starts in this context in June 2010 as a member of UXD team. At the encounter of telecommunications technologies and users' subjectivity, the need of Bell Labs is to understand *the concept of User Experience*. This direction lines up with a new paradigm in design that focuses on *experiences with products* and not on products per-se: "although industrial design has long been concerned … on the physical structures of the devices, the forms and shapes, the materials, and the manufacturing process to be followed …today the focus has shifted **from**

objects to experiences that result from interaction"(Don Norman in (Hekkert & Leder, 2008), p.xix). Following this direction and interest, the industrial demand of this research project is related to *the potential of telecommunication technology to create experiences in users' life*. More precisely the focus of the PhD is related to the **aesthetic quality of these experiences,** on models and processes to observe, analyse and generate such experience for users with Bell Labs technologies and applications.

PhD Refocus: Following a Research-Action approach that we present in detail in the third part of this section, the first year of this PhD followed two directions. The first is *theoretical*, focusing on the understanding of the User Experience (UX) and Aesthetic Experience (AE) concept and frameworks. The second is *practical* and is related to the industrial character of this PhD. Within the projects of APPRD due to **the complexity of technology**, the **Techno-Push vision** of the department we encounter difficulties to directly test and validate knowledge coming from the literature on UX and AE. Technologies are too young, and the technical demonstrators are rarely applications to be tested with users. Rather than working on aspects that improve or generate **users** experiences with Bell Labs technologies and applications (i.e. **Figure 10** - *Left*), we observe the design influence at a larger perspective. Besides building use-case scenarios for technologies, designers also bring a culture, design tools and methods for the multidisciplinary department. The creation of these tools and methods in the Techno-Push environment brought a mixed culture at Bell Labs (see **Figure 10** - *Right*). It is this observation that repositions the focus of this PhD and raises questions on **design influence in this R&D department**.

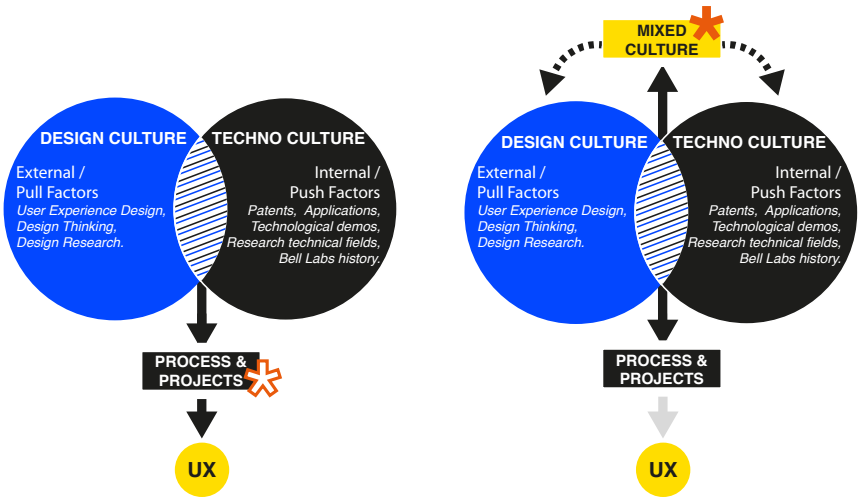


Figure 10 The Push & Pull Factors at Bell Labs and the positioning of the industrial demand; *Left*: The first industrial demand; *Right*: The final industrial demand.

The UXD team introduces new ways of understanding innovation, creates tools for the people around them, and brings within the technical context of this laboratory a user-centric perspectives. These tools and methods change research-engineers process. From a culture of Power Point presentations and technical-demonstrators, engineers learn other ways of working and presenting their results. Moreover different engineers reconvert to design and acquire new skills and knowledge (see the evolution of profiles in **Table 2**). Focusing on both the User Experience and Aesthetic Experience concepts and on the design influence in this department, **this PhD aims to understand the outcomes of the mixed culture for both the industry as for the people working in this department**. More globally this thesis redefines the Push methods towards a new way of designing together in a mixed culture.

Table 2 Distribution of profiles in APPRD from 2008 to end of 2011

2008	2009	2010	2011
Techno: 82	Techno: 83	Techno: 83 + (1)	Techno: 75 + (20)
Human Science: 2	Human Science: 2	Human Science: 4 +1*	Human Science: 4 + 1* + (4)
Design: 2	Design: 2 + (2)	Design: 5 + 1*+ (2)	Design: 5 + 6* + (4) + (3*)

* Reconversions from technical profile to other profiles like Human Science and Design; () interns.

From the macro-economic view, European Commission report (EU Report, 2009) on "Design as a driver of user-centered innovation" discusses the link between design, R&D and innovation and shows that design activities are included in the definition of R&D. Specifically, *the prototyping and industrial design required during R&D should be included in R&D for statistical purposes.* Design for production processes and less technical design activities are however not considered as R&D. This report concludes that design **is considered a driver, input, or tool for innovation rather than the innovation itself** but in the same time can have other roles and "preparations for product and process design" (EUReport, 2009).

Beyond its role in industry to foster innovation, design is also a vector of cultural change and social responsibility. In order to understand designers' role in the today society and the positioning of this discipline among the other academic disciplines, the next part draws an overview on different challenges and aspects of design and design research.

1.2 Design discussing design

Figure 11 Tawaraya boxing ring designed by Masanori Umeda. This furniture is used by the members of the *Memphis collective* (1981) to challenge the modernist design codes and vision (image©designboom).

> Design "is a way of discussing society, politics, eroticism, food and even design. At the end, it is a way of building up a possible figurative utopia or metaphor about life."
>
> **Ettore Sottsass** cited in *Design since 1945* by Peter Dormer

Over the past half-century people live dramatic changes in their experience in time, space, matter and identity (Aldersey-Williams, Hall, Sargent, & Antonelli, 2008). Design is following these changes whether as an influencer or a concrete manifestation of these societal transformations. The first part of this section shows the industrial context of this PhD. Within this part we draw an overview of how design evolved in the last century and what are its implications for both industries and society. The elastic tendency of design, to go further the classic "form follows function" principle towards the social, the political and the ethical, brings new roles and new responsibilities to this discipline.

1.2.1 Design and its turns

Design is about making things and making things that bring change. The designer, through concreteness acts, brings to life not only solutions that help us to solve problems, but also things that open spaces for reflection. In France, design, as architecture and engineering, is part of the discipline called "conception" en French (from the Latin *conceptare* – to conceive) situated between *the creation of the unknown from something known* (Hatchuel, 2006). And if an engineer role is to bring *a radical unknown* to people - the invention of the car, the train, the spaceship that goes to the moon, Hatchuel describes design as the practice that creates *an acceptable unknown* by **an object that seduces and surprises without any confusing.** He also identifies two types of design:

Figure 12 Example of design of parure – 'Soft washbowl' by Droog design (Material: soft polyurethane, pink) www.droog.com

- *design of parure,* that plays with different attributes of objects, losing their identity to gain appearance (see example in **Figure 12**) and

- *design of wit,* that disturbs objects identity to provoke a feeling of discovery, of freedom and finally to create new entities that bring subjectivity between the user and the object and personal experiences (see example in **Figure 13**).

These design classifications emphasize the complexity of fields and professions, the myriad of choices and concerns to take into account in order to create a design artefact. The age of Raymond Loewy aesthetics and symbolic representations that define design is overtaken by a complexity of domains and disciplines - psychology, philosophy, anthropology, contribute to the creation of artefacts in the today society.

A variety of choices go into the design of any given artefact: functionality, aesthetics, practicability, motivations for making, capabilities and identities of the future users and socio-political concerns (B. Gaver & Bowers, 2012). From **product design,** that focuses on *form and function*, to **interaction design** that gives a global view *both on the product but also on the quality of the human interaction* and finally to **experience design** in which *the product disappears to give place to life experiences*, the complexity and richness of the design object[3] growth substantially.

Figure 13 Example of design wit – 'Concrete Stereo' by Ron Arad, 1983. V&A Museum www.vam.ac.uk

In order to represent the design evolution, (Crampton Smith, 2006) describes the 3 design ages of the XX century:

I. **First Age** (before 1950) or the "heroic" period, represents a concretization of speed: cars, trains, planes and the preparation for the space conquest.

II. **Second Age** (1950 to 1990) or the age of "domestic electronics" is represented by technologic advancement and the introduction in homes of domesticated machines. These machines become "ingredients of their daily experience" as they change people behaviour and their relation with each other. The fridge for example gave people free time and therefore this object becomes a symbol of this emancipation.

III. **Third Machine Age** (from 1990) or the age of electronic devices is characterized by computers and communication technologies – e-mail, chat and finally html were created to share and collaborate with information on the World Wide Web. Internet, the "mechanical, collective brain" and computers enter offices and then invade homes.

Within this context, design roles and responsibilities are enlarged. If in the first two ages machines are responding to *functional requirements* and product design, the third ages brings new relationship with the work and firstly through interaction design, this age brings also experience design: "electronic machines can extend our minds, ... our active relationship with other people" (Crampton Smith, 2006). This subjectivity and significant relationships between people and designed objects are important notions for experience design.

Moreover design is no longer giving only responses of form and function, but also *questions the possibilities of electronic technologies.* (Dunne, 2008) argues that the artefacts people interact with have an enormous impact of how people think. These questions started through the post-modern critics on the modern material culture brought a new

[3] **Design object** refers to all types of products, artefacts, services and situations crafted by designers.

Figure 14 Fan heater by Winfried Scheuer - semiotics and semantics used to express implicit meanings: the flow of air in this fan heater ((Dunne 2008), p. 28).

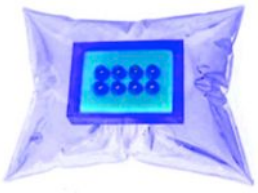


Figure 15 The Pillow by Anthony Dunne is an abstract that broadcasts mobile phones, pagers, walkie-talkies etc. that are in the neighborhood of the device. It questions notions of privacy as a social invader. www.dunneandraby.co.uk

Figure 16 Radio in a bag by Daniel Weil (1953)

turn in how design artefacts are created and interpreted. Aesthetics is not anymore related to friendliness and expressing of implicit meaning but brings in subjectivity and interpretation (Dunne, 2008) – **Figure 14**. This perspective studies the quality of the relation that people have with objects at different levels of the social, psychological and cultural experiences that they mediated (**Figure 15**).

Subsequent to this idea, (Vial, 2010) is talking about the schizophrenic character of design. On one side design is intended to create something useful, desirable etc. for the market and the final user - i.e. the user-friendliness notion that Dunne criticizes that comes from the *capitalist* demand. On the other side, the demand coming from the *social revolution* fights industrialisation. In order to dodge these two paradoxical perspectives, Vial proposes two *design laws of morality*:

> 1: Act in such a way that you treat the market whether in your own designer personality or in the projects that you give to users; make your design be always a mean and never a final purpose. ((Vial, 2010), p. 50)
>
> 2: Act so that the effects of your action are compatible with the permanence of genuine human life (Hans Jonas cited in (Vial, 2010), p. 110)

Moreover Vial argues **the role of the designer** is *to objectify people subjectivity* within a project with three directions:

- to project people existences and the society within the future – *design as a utopian motor*;
- to project an idea that has a place into reality and that makes industrials, engineers and politics re-present themselves – *design as a federator*;
- and all these through a visual projection, *a representation*.

This design project goes from a product perspective to a larger scale within organisations and politics. The second part of this section presents the relation between design and innovation and news roles of design born with XXI century in industrial technological corporations.

1.2.2 Innovation & design

The designer is more than a packager of technology says Daniel Weil, post-modernist artist and designer that create manifest objects like the *Radio in a Bag* (**Figure 16**). Weil is anticipating the technological conglomeration, the Baudrillard's "crisis of functionalism" criticized by Dunne:

> (T)here is something unreal and almost surreal in the fact of reducing an object to its function: and it suffices to push this principle of functionality to the limit to make its absurdity emerge. ((Dunne, 2008), p. 49 quoting Baudrillard)

Dunne's critique gives an alternative to this perspective as he opposes functionality to aesthetics of use and new experiences for daily experience; he militates for *the exploration of poetic dimensions of new technologies rather than their practicality and functionality that can be taken from granted* (**Figure 17**). What Weil is questioning through his work is also the role of the designer in technical environments that is generally used at the end of the project to give a form to the technological concept.

However from an industrial and economic point of view in industrial corporations, **technology is not taken for granted**. Technological demonstrations and techno-push environments represent the context of today innovation. From this innovation perspective, Tim Brown challenges companies to incorporate design within their organisational DNA as "reliance on technology is hugely risky" (Brown, 2009). In the same time, he challenges designers to adapt themselves to technological contexts and to today the "tool to improve the quality of life at every level, as opposed to creating the signature objects that grace the pedestals of art museums and the covers of lifestyle magazines" (Brown, 2009).

In 2011 the report of European Design Leadership Board shows the *evolution of design influence in companies* through a tool - **The Design Ladder** created by National Agency for Enterprise, Copenhagen. This tool (see **Figure 18**) enables companies and organisations to identify where they are on a scale of design competence ranging from 'no design' to 'design as strategy'. It shows a new tendency of design to become a new strategic actor and the importance of this disciplines nowadays.

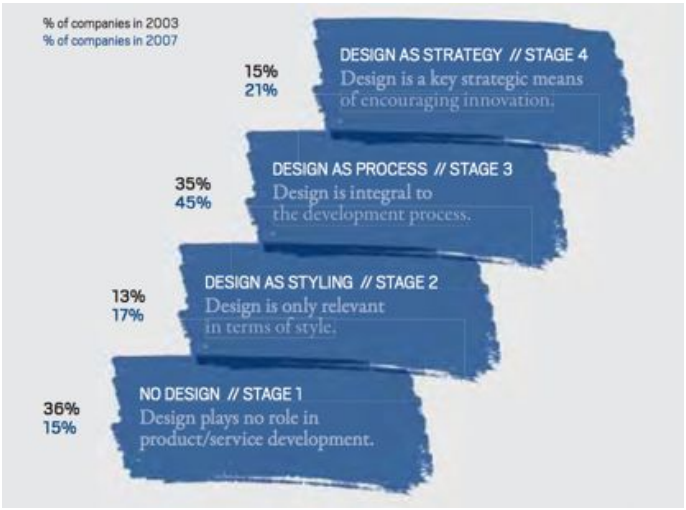


Figure 18 The Design Ladder and the evolution of design in companies.

Both Dunne's perspective that militates for design responsibility to *overpass the industrial* demand and Brown's discussion on *the designers' role in organizational context* are important. As Vial is suggesting, it is time

Figure 17 GPS on an ordinary phone (*Top*); Compass Phone by Hayeon Yoo (*Bottom*). It measures the distance between two people and converts it to the time it takes for them to meet each other. The centre of the compass indicates the user's position and its needle indicates the other person's direction (hayeonyoo.com)

for design to stop fighting *against* or *for* something and start working with the today constraints:

> The future of the industrial world will not be made without the industrial world. It is time for design to stop being reborn. It is time for design to completely assume the principles of an industrial society even for a consumerist society. It is time for design to think that it can do with this society. And to make us are dream within. ((Vial, 2010), p. 52)

To bring a change today, **design has to understand the principles of an industrial society and to start designing from that particular point**. To achieve this goal and also to dilute the schizophrenic nature of design (between industrial demand and societal responsibility), one can change **perspective**. Looking at the cultural and social aspects while designing for the process means *not focusing only on the process*. We saw in the first part of this section that, traditionally, the designer's role is related to the design process and to its optimization for industrial productivity. However *each time designers enter industrial companies, they also bring in a design culture*, designerly way of doing and thinking, in which *subjectivity and questioning* are new values. Design is a vector of change, of critical through and intellectual exploration. We believe that these aspects influence the industrial culture and bring in new ways of doing and thinking innovation.

But what are these ways of doing and thinking of design and design research? This young discipline still needs justifications. Discussions on *Design Research* or *Design Science* in the design community are still effervescent. Both a personal experience as a designer at Bell Labs and as a PhD student in the design community suggest that design and design research are still exotic disciplines for both the industrial as the academic. To understand the today epistemological challenges and the research approach of this PhD, the next section presents the general events in the history of design research and its major evolutions in methodology and educational frameworks.

1.3 Academic context

> Those ideas which take the form of scientific knowledge would belong to Science. The historical, philosophical and critical ideas would belong to the Humanities. What is left is the artefacts themselves and the experience, sensibility and skill that goes into their production and use.
>
> **Bruce Archer (1979)** – Design Studies, Volume 1, No 1

In 2006, Design Research Society celebrates 40 years from its founding. Nigel Cross writes on this occasion an editorial in which he explains the evolution of design research since the '60s until today. During these years, design research keeps on evolving and enlarging its scope, redefining its nature and specificity. The first part of this section describes the different definitions, ages and approaches of this discipline and what is specific in being a design researcher. What is today design research between the objectivity of first design methods and the evolution towards more subjective methodologies? The second part the different research fields design science in France focusing on the LCPI (Product Design and Innovation Laboratory) of Arts et Métiers ParisTech.

1.3.1 Design as a discipline

1.3.1.1 A historical overview of Design and Science

Several scholars write about the relationship between Design and Science and how design research emerges and evolves over time (Bayazit, 1999; Bonsiepe, 2007; Cross, 2001, 2007a, 2007b). Since 1920 when Bauhaus introduces the modernist approach to design and teach design: "in order to construct a new object we need a method, that is to say, an objective system" (Theo van Doesburg in (Cross, 2001)), passing through the 60's when the first conference on Design Methods is held and the 70's when design methodology is rejected for "becoming an intellectual game" (Christopher Alexander in (Bayazit, 1999)) different contexts, events and actions brings design and science closer to form design as a discipline. **Figure 19** shows this temporal evolution and specific periods and gives an overview of important journals, conferences, books that are the pillars of design research. The focus of this figure is mostly oriented to events contexts that launch the foundations of design research, mostly between 1960 and 1990, due to the difficulty to represent the outnumbered conferences and journals that appear in the last 10 years.

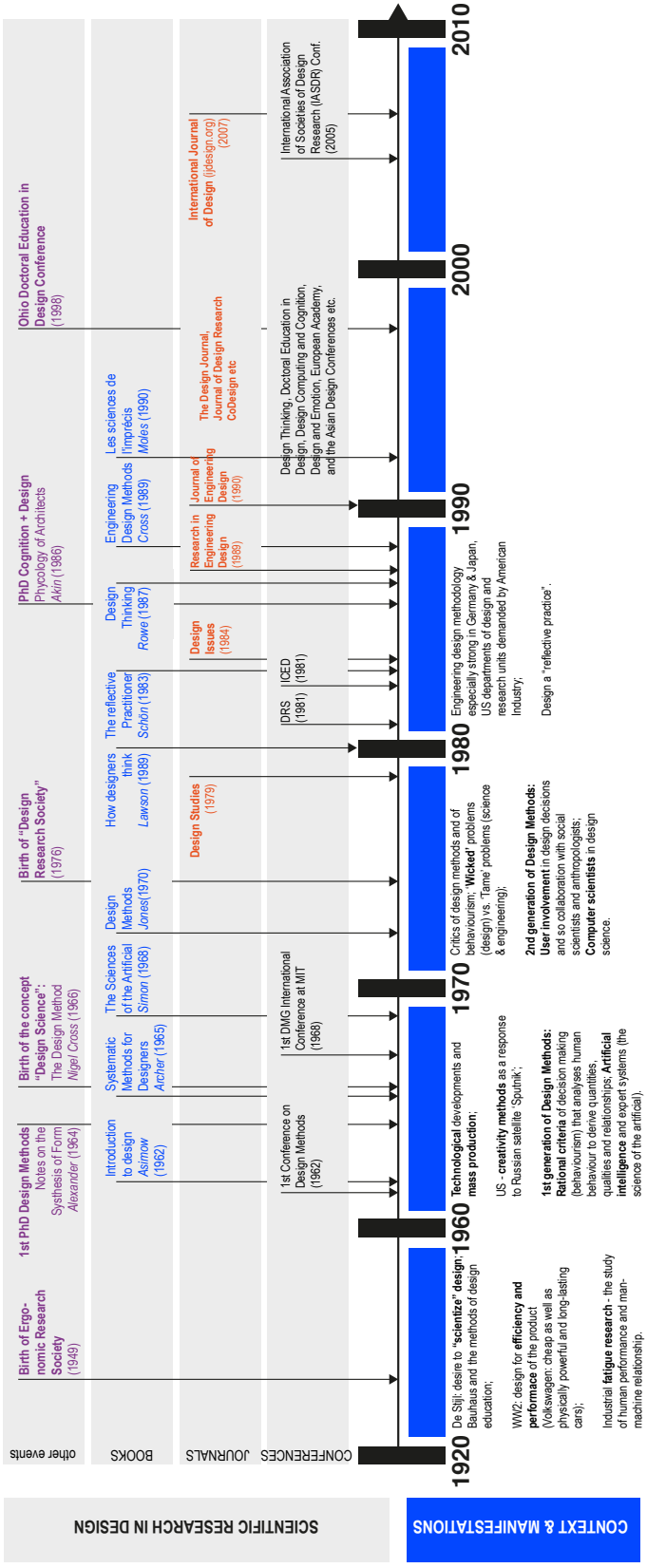


Figure 19 Design and Science evolutions - towards *Design as a discipline* (a synthesis of (Bayazit, 1999; Bonsiepe, 2007; Cross, 2001, 2007a, 2007b)

(Cross, 2001) describes four encounters of Design and Science as following that correspond to the different contexts that influence this discipline:

- ***Scientific Design*** is born with the mechanization of industrial design in the '60s and substitutes intuitive methods of the pre-industrial design to decision-making methods that use rational criteria to understand and optimize human behaviour.
- ***Design Science*** (1965) is the rationalization of the design process and activity - "an explicitly organized, rational; and wholly systematic approach to design". Starting with the '70s, this perspective is criticized.
- ***Science of Design*** has the same technical-rationality as Design Science. It studies of the nature of design, i.e. how designers and design-researchers think and act – their cognitive process, through systematic reliable methods of investigation. Design activity is "a body of intellectual tough, analytic, partly formatizable, partly empirical, teachable doctrine about the design process" (H. Simon in (Cross, 2001)). This rationalistic character opens design knowledge to other disciplines involved in the activity of creating the artificial world.
- ***Design as a Discipline*** emerges in opposition with the positivist approaches brought by *Science of Design*. Donald Schön names design a *reflective practice*: "an epistemology of practise implicit in the artistic, intuitive processes which some practitioners do bring to situations of uncertainty, instability, uniqueness, and value conflict" ((Schon, 1984), p.). In the '90s the design community embraces this new approach to design through numerous conferences and publications.

In another book on the subject, (Cross, 2007a) proposes to complement Schön and Simon's perspective to "construct a way of conversing about design that is at the same time interdisciplinary and disciplined". As Gui Bonsiepe underlines, today the research in design comes to assume great significance: firstly, due to *the complex design problems that can no longer be solved without prior or parallel interdisciplinary research* and secondly, due to *the consolidation of design education at universities that creates a pressure to adapt this new discipline to academic structures and traditions* (Bonsiepe, 2007). But what is the definition of such discipline and finally what are its characteristics and specificities?

1.3.1.2 Definitions & approaches – design as a discipline

> We have come to realize that we do not have to turn design into an imitation of science; neither do we have to treat design as a mysterious, ineffable art. We recognise that design has its own distinct intellectual culture.
>
> **Nigel Cross (2007)** – Design Research Now

The difficulty to establish a clear definition on what is design research and what is the specificity of its intellectual culture has been a challenge for the design academic community since the first design journal, Design Studies appears in 1979. Bruce Archer, professor of Design at Royal College of Art – one of the first institutions that granted academic degrees in design, explains in Volume 1, No 1 of Design Studies what is specific to design practise and methodology. He shows that there is a vacant plot in between Humanities and Science, a new discipline that has "the ability *to understand, appreciate and value those ideas which are expressed through* ***the medium of making and doing***" that comes with acute need for transmission and understanding. Archer shows how this new discipline is related to the other two (see **Figure 20**) and underlines the specificity of this discipline to adapt our surroundings in *the light of our material and spiritual needs* (Archer, 1979).

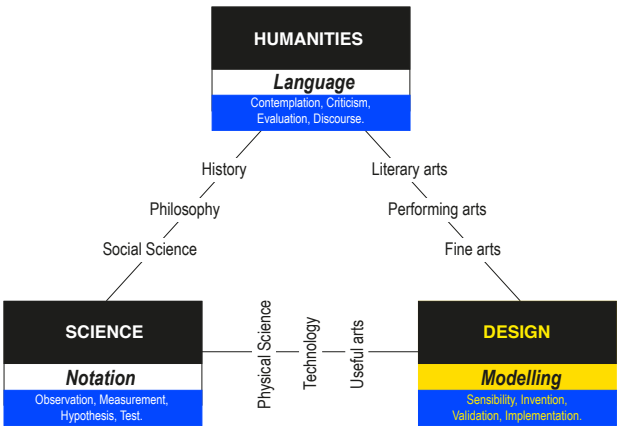


Figure 20 The new three R's of Archer (1979): Reading & Writing (**Humanities**), Reckoning & Figuring (**Science**) and Wroughting & Wrighting (**Design**)

Other different design scholars since Archer's definition analyse the specificity of doing research in design and its distinction with design practice. Like any other type of research design research should be research is a **systematic enquiry, based on previous knowledge whose goal is to acquire communicable knowledge** (Archer, 1995; Cross, 2007a).

The tight connection between **Design Research** and **Design Practice** show the challenge of defining this discipline. In 1993 and 1995 two papers (Archer, 1995; Frayling, 1993) set up terms and methodologies that design research embraces since then: Research *about, for* and *through* Design (**Figure 21**).

Figure 21 Design Research and Design Practice relations: *Research for Design Practice, Research about Design Practice* and *Research Through Design Practice*

Research about Design Practice is performed by other disciplines, usually Social Sciences, to bring knowledge on the practice of design. This type of research is less relevant for Design Practice, as it contributes to the knowledge corpus of the science that studies design – anthropology, history, cognitive psychology, management etc. (Findeli, Brouillet, Martin, Moineau, & Tarrago, 2008). However looking at how Design Council describes the design practice – as only *to solve a problem but also having a transformative power to society* (Burns, Cottam, Vanstone, & Winhall, 2006), this perspective could show the design influence in industries and in our society.

Research for Design Practice is situation specific. It focuses in bringing relevant information on the variables used in the design practice. (Archer, 1995) believes that this approach not only advances practice but it could also provide generalizable knowledge for later. However (Findeli et al., 2008) observes that this methodology usually is disappointing in regards to the scientific standards and it rarely brings knowledge to the research community as the results are mostly tacit or confidential.

Finally, *Research through Design* or **Action-Research** (Archer, 1995) or *Project-grounded research* (Findeli et al., 2008) is a situation-specific research approach in which the investigator is explicitly taking action in and on the real world in order to devise or test or shed light upon something. If most Human Science approaches are planned to only observe the world with the perspective of cognition, *Action Research observers the world with the eye of designability* (Bonsiepe, 2007).

Action-Research comes from Social Sciences. The term is coined by Kurt Lewin as "a comparative research on the conditions and effects of various forms of social action and research leading to social action" that uses "a spiral of steps, each of which is composed of a circle of planning, action and fact-finding about the result of the action" (Lewin, 1946). (Liu, 1992, 1997) describes how Action Research progresses over time in cycles in order for research to be acceptable and efficient.

Figure 22 shows the two cycles of this methodology between the two entities: Action and Research and regroups seamlessly the reflection through practise of the nature of design research. It also fits perfectly to a professional / industrial PhD. Through the round exploration between knowledge and practical demands, this approach refines a research question that is both linked to industrial reality and theory.

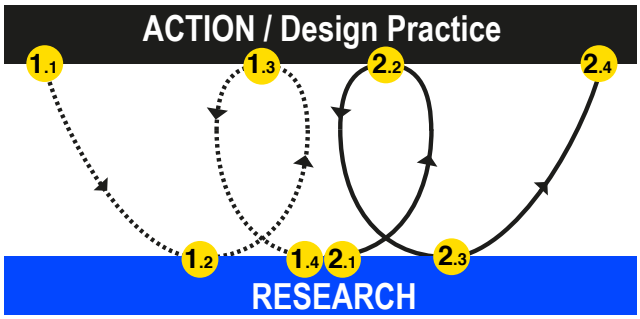


Figure 22 The Action-Research in two cycles

The two cycles consists in four steps as following:

1.1. Diagnostic of an initial situation (in action, within the practice);

1.2. Creation of a research question and hypothesis to solve the initial situation;

1.3. Experimental actions to test hypothesis;

1.4. Diagnostic 1st cycle, evaluation, results & theory building to pass to 2nd cycle;

2.1. Review the research problem and hypothesis;

2.2. Experimental actions to test hypothesis;

2.3. Diagnostic of the 2nd cycle, evaluation of results and build theory from conclusions;

2.4. Finalisation of the project.

Following this line of thoughts, the design research approach of PhD is Action – Research. As Liu argues, Action-Research is also the tool to use for the *experimentation of knowledge in social environments where the nature of knowledge is progressively gathered and where lab experimentations are useless for studying such complex phenomenon* (Liu, 1997). Furthermore this research being a professional PhD, the first cycle starts in the company on specific projects where different concepts are explored. This step corresponds to the *intelligibility* level of Action-Research. We call this first cycle the Pre-experimentation. In order to attain the *prevision* and *feasibility* level of the research, in the second cycle the company is seen as experimentation field to test the hypothesis and thus the research question.

This part showed the evolution of design as an academic discipline. From a methodological point of view we show different perspectives on how a design research is developed. The next part focuses on design research topics and research directions and the positioning of CPI Laboratory in the community of design science.

1.3.2 Laboratory CPI

Laboratory CPI has been pioneering research towards the modelling and optimization of the design and innovation process (Aoussat, Christofol, & Coq, 2000; Aoussat, 1990). Looking at the actors, tools, methods and fields that collaborate within the design process, the research in this laboratory is focused on three directions:

A) **Tools and methods for the last part of the design project in order to improve the design decisions and innovation**. Through formalization of the design information process into informational cycles, Bouchard and Aoussat show how to build new tools for communication, decision-making and creativity for the different players in the design process. An informational cycle (**Figure 23**) contains an informative, a generative and a decision-making phase. Its outcome is an intermediary representation. This representation is a concrete informative mass that can be easily transported to other actors of the process. The cycle can be applied several times in the design process until the design problem will be transformed into a design solution. This formal representation of the design process and the use of CAD tools to its optimization, promise timesaving techniques, greater flexibility and considerable communication impact in the design process. Even if efficiency and rapid execution are first goals of this research other aspects are suggested for exploration by the authors *like freedom in creation and the sensorial relation between designers and physical representations* (Bouchard & Aoussat, 2002).

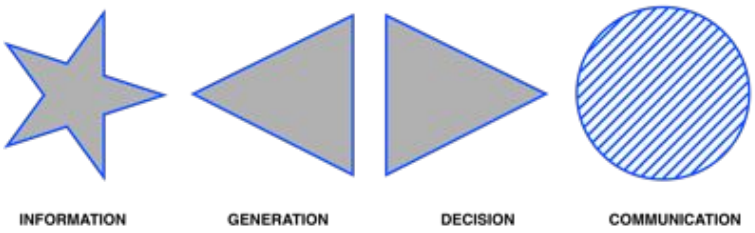


Figure 23 Description of an informational cycle (Bouchard & Aoussat, 2003).

B) Tool and methods for the integration of new professions – ergonomists, psychologists etc. and **new fields** – *emotional design, Kansei engineering and design* (Bouchard et al. 2008, 2009) and most recently *experience design*. The challenge is to identify how new professions could cooperate together even though their scientific maturity and methodology is different in order to respond to the rapid growth and complexity of design research in the new field. The majority of the studies in this track focus on *Kansei engineering, emotional design* and most recently *experience design*. These new fields raise new challenges for CPI laboratory to understand subjectivity and emotion in regards to **Kansei design** – i.e. understanding how the three levels information (*high-level*: sociological

values, semantic descriptors and style, *middle-level*: sector name, texture, patterns, matter and *low-level*: colour, form, shape) influence the perception of a product (Bouchard, Kim, & Aoussat, 2009) and **human values and cultural differences** (Bouchard, Mantelet, et al., 2009). Finally this makes *a transition from an engineering approach, which militates for automatized design tools to create future products, towards frameworks coming from psychology, phenomenology and philosophy* that help designers understand human values and emotions (see **Figure 24**)

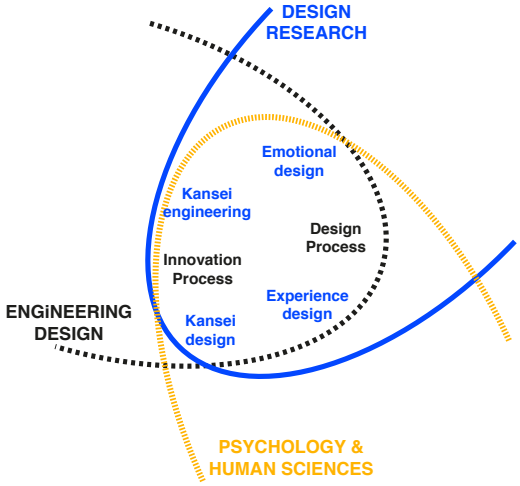


Figure 24 CPI Laboratory fields and topics

Figure 25 The multidisciplinary environment and intermediary objects created by designers.

C) Intermediary representations and intermediary knowledge are tools and methods for interdisciplinary research in order to show a common representation of the design object. Different writings of CPI on the subject show how intermediary representations (IR) semiotics – each IR is a *sign* composed of a *signifier* and a *signified*, influence socially the design process. These social representations aim to organize, control the environment and build behaviours and communications to establish a common vision (Bouchard et al., 2005) – see **Figure 25**.

Beyond this social function, these tools affect human cognitive performance and sharing of a multidisciplinary knowledge. Moreover these representations and objects created by designers are tight related to the design culture. The pragmatic process of **making ideas concrete** (Mat Hunter, 2010) brings within the design process new ways of envision innovation, a new culture of making in which design team subjectivity influences the overall design experience. Looking on **new roles on intermediary representations** that goes beyond the optimization of the design process towards *the experience of a new culture within companies* could give new perspectives to approach innovation.

Moreover in the same direction with the new topics of **LCPI** on emotional design and experience design, and following also the industrial demand of **Alcatel-Lucent Bell Labs France** interested in User Experience and Aesthetic Experience, we identify key concepts to study the influence of design in industrial companies: *experience, aesthetic experience, subjectivity, innovation culture, design influence for the innovation process*.

In another trains of thought aesthetics, happiness, well-being and emotions are new trends in working experience and business creation. The last year issue (January-February 2012) of the Harvard Business Review shows the value of looking at *subjectivity in the work* rather than the usual cognitivist understanding of processes and guidelines (Fox, 2012). Other authors talk about Beautiful organizations (Brown, 2009). Tim Brown blog post (Brown, 2010) tackle the issue of *aesthetics in designing organisations* and asks lots of questions on how to relate innovation to simplicity of structure, clarity of purpose, thoughtfulness for every aspect of the experience or Google twenty per cent personal project time. Maybe a beautiful organization is one that succeeds in its domain and mission and that also bring a beautiful experience in the work. From user experience to how people work together "a customer experience that feels authentic, genuine, and compelling is likely to be delivered by employees operating within **an experience culture themselves**"(Brown, 2009).

Innovation refers to a much broader process that includes social, economic and technological dimensions, argues Norbert Alter in a recent review on innovation. It is not only a process, but also a culture of cooperation which allows for some degree of transgression and emotion, and, moreover, it is about the *"importance of sharing a reality"* (Norbert Alter, 2013). How workers feel about their work is critical for the organizations that rely on motivation such as research institutions and laboratories (Hackman & Oldham, 1976). Consequently this PhD in design looks at how the *concrete outcomes* of the design culture contribute to how people share a reality and how they are creative together.

1.4 Conclusions

This section looks at the different contexts of this PhD and emphasizes general directions that are detailed in the following chapters. Looking at design as a practice that has its own responsibility and ethics it is mandatory to understand its **societal role beyond an industrial demand** (Vial, 2010). In companies where the race to innovation is a daily constraint and in techno-push environments, **designers are challenged to bring a new culture as a tool to improve life at any level for better products and better working experiences** (Brown, 2009). In this context the **shift from products to experiences** (Pine & Gilmore, 1998) opens new opportunities for both industries and research. **Working with other fields like psychology, human sciences and philosophies**, we need to understand the nature of experience, its aspects and evolution. Moreover the **growing interest of subjectivity in working environments** and notions like **aesthetics, happiness etc.** question the concept of experience in a new perspective.

In this context, it is necessary to better understand the concept of experience and aesthetic experience in design research and then to revalidate it in **real settings and environments**. Consolidating this direction with the industrial demand, one could **question the role of design and design culture to influence the outcomes of the innovation process and the experience of people working together** in **Techno-Push environments**. What designers bring to an R&D culture? What tools and methods are created between the encounter of design with a techno-push environment? Moreover, the actual interest in **User Experience and the aesthetic quality of living experience** with products could lead us to understand how to create *memorable and meaningful experience* with future products and beyond. As we show in this section, the design influence grows in complexity and is no longer reduced to the design process. In order to understand these aspects from a theoretical perspective the next section present the State of the Art of this thesis.

2 State of the art

2 STATE OF THE ART

There has been a rapid growth in the number of studies related to **user experience** and the **aesthetic of this experience** in the recent years in design research. Therefore it is necessary to provide a critical analysis on these concepts and to capture how design builds knowledge coming from psychology and philosophy to create its own frameworks. While **experience design** is becoming a discipline per-se, it overtakes the frame of the user. Participatory design or multidisciplinary teams is also about designing together and living the experience of 'designing' together. When innovation is more than a process, the way people work and collaborate is becoming central. Our state of the art brings together these concepts and structures them as shown in **Figure 26**.

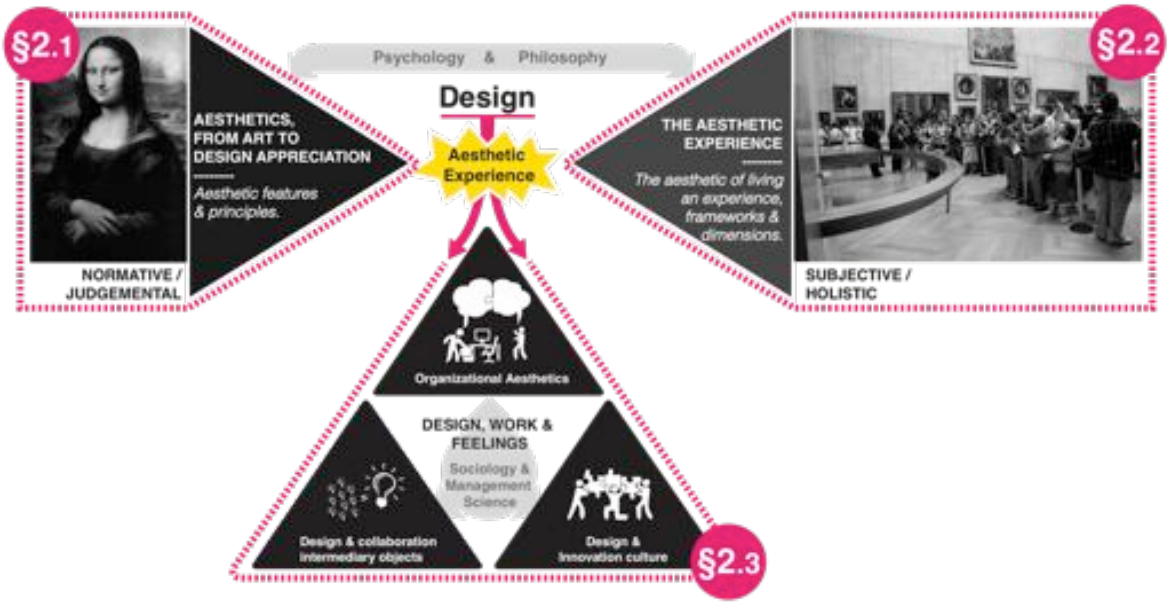


Figure 26 A graphical representation of the 'State of the Art' in three parts: §2.**1** – *Aesthetics, from art to design appreciation* shows the normative and judgmental perspectives on Aesthetics (*left image*: Mona Lisa painting), §2.**2** – *The aesthetic experience* presents the subjective and holistic approaches on Experience and the Aesthetic of living an Experience (*right image:* People looking at Mona Lisa - photo © J.P. Panter), §2.**3** – *Design, work & Feelings* draws an overview on organizational Aesthetics, design and innovation culture and their materialization through intermediary objects and tools for collaboration.

In the first part, **Aesthetics – from art to design appreciation** (**§2.1** in **Figure 26**) shows an overview of approaches coming from cognitive psychology adapted to design. These normative and judgemental models describe ***an aesthetic object*** as an object that can be analysed through its properties called *aesthetic features and principles*. The second part, **Aesthetic experiences or the aesthetic of living an Experience** (**§2.2** in **Figure 26**) draws a global view of frameworks that describe the concept of

Experience and Aesthetic Experience as a whole – the holistic perspective. In this part *an object is aesthetic only due to the fact that a person lived something extra-ordinary during the interaction*. From normative and judgemental approaches to holistic and subjective frameworks, we show both perspectives not as opponents, but rather as two complementary directions for designing for experience.

The third section, Design, work & feelings (**§2.3** in **Figure 26**) focuses on **aesthetics in working environments** and shows what are the design tools and methods to support *collaborative work* in the design process and more globally in organizations. From *participatory design* to *cooperation environments*, from *intermediary objects* to *probes*, this section draws an overview on **new ways to apprehend innovation**. We show the role of **design culture** embedded in design practices and intermediary artefacts in *describing and structuring the organizational environment, actors and their relations*. Besides these roles, the design culture is also *transformative*. Therefore we tackle a new *role for design culture from an experiential perspective*. If subjectivity and experience are new trends in design research, we observe first possibilities for design to influence the organizational culture and create **an experience for the members of the innovation team**.

2.1 Aesthetics – from art to design appreciation

2.1.1 Aesthetica, the discipline of sensual cognition

This section draws an overview on Aesthetics as a discipline since Alexander Gottlieb Baumgarten defined for the first time 'Aesthetica' as ***the science of sensual cognition***. According to Baumgarten definition, there are two types of cognition:

- one **obscure**, without rational justification that Leibniz describes as an *I-don't-know-what (je ne sais quoi) that satisfies or repels us* (Leibniz cited in (Hammermeister, 2002)) and
- one **distinct**, complete conceptual knowledge that comes for **rational cognition**.

In-between, according to Baumgarten lies Aesthetics, "the confused cognition of sensuality" (Hammermeister, 2002). Therefore Aesthetics is different from rational cognition, but serves it.

Figure 27 Aesthetica by Alexander Gottlieb Baumgarden - cover book

This view on the concept, where aesthetics is defined as a discipline both related to *the theory of art* and *a theory of cognition* brings a growing interest of this concept in Philosophy. Shelly explains that along this philosophical movement, there are other movements that redefine aesthetics as the philosophy of art related to *the theory of taste*, as a corrective response to rationalism of beauty. **The rationalists of beauty**, called *les géomètres,* are a group of literary theorists that "aimed to bring to literary criticism the mathematical rigor that Descartes had brought to physics"(Shelley, 2009). Against the rational construction of beauty, the British philosophers begin to develop a theory of taste that resulted as an **immediate response to sensory judgments**. For them things are not beautiful as a conclusion or a process, but rather they 'taste' things and the judgment is created in the moment. *Immediacy, taste, instinctual judgment* - all these notions are related to the theory of taste that Kant develops in the end of the eighteen century. Kant's theory separates the aesthetic experience from the rational, understanding of reason. This way of seeing aesthetics perpetuates until nowadays.

However judging the taste of a meal and judging the beauty of poetry is not the same thing. Perceiving or 'tasting' and understanding have two *different temporal dimensions* and therefore judging a poem beauty is not a matter of immediate taste. Other philosophers like Hume argues that "in many orders of beauty, particularly those of the fine arts, it is requisite to employ much reasoning, in order to feel the proper sentiment" (Hume cited in (Shelley, 2009)).

But what is a beautiful poem or work of art? The formalist theories that results from the Immediacy and Disinterest thesis sustain that there

are some **relevant properties** that are graspable by human senses and these features create the value of the object. **An object is aesthetic if aesthetic features are perceived**. In continuation of these theories, Moore creates, at the begging at the twenty-century, the **method of absolute isolation**. This method asses aesthetic objects as 'if they existed *by themselves*, in absolute isolation' ((Shusterman, 2000), p.21) (see **Figure 28** for a representation of this theoretical perspective).

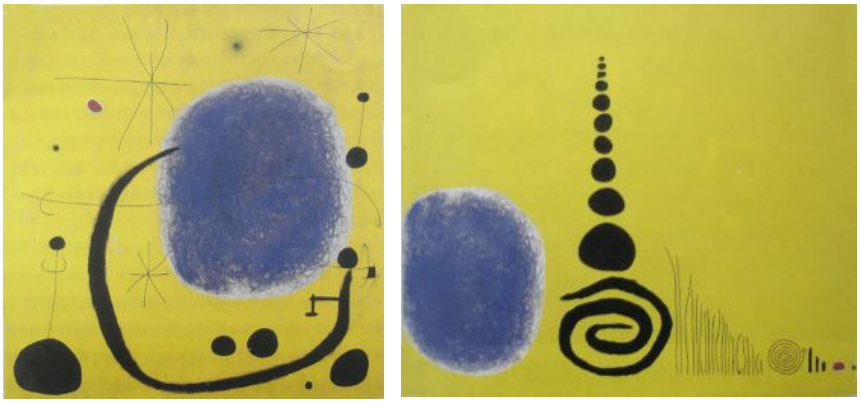


Figure 28 Decomposition of an aesthetic object in aesthetic features (I choose **Ursus Wehrli's** art of arranging paintings as a metaphor for the **method of absolute isolation** - here the artist isolates and organises the elements of *The gold of the azure* by **Miro**.)

The theory of isolation and the aesthetic features give first models to study how aesthetic appreciation is created and why we are attracted by certain representations. Cognitive psychologists study why people are attracted to art and show that the cognitive process of art produces **affective, often positive and self-rewarding responses** (Leder, Belke, Oeberst, & Augustin, 2004). Some researchers claim that it is **the act of the perception of different features**, called *aesthetic feature*s, that **brings this aesthetic pleasure** (Hekkert & Leder, 2008; Hekkert, 2006).

Besides the methods of isolation for value and art appreciation, other philosophical movements argue that the form alone of an artwork cannot create its value. It is **the art-historical context**, **the category** in which is classified the object, **the preparation** before the exposure that are important (Shelley, 2009). Further on, Dalto writes *about a special atmosphere of artistic theory* when appreciating a work like Duchamp's Fountain: "To see something as art requires something the eye cannot descry – an atmosphere of artistic theory, a knowledge to art history: an artworld"((Shusterman, 2000), p.21).

A more global view that takes into consideration both of these two approaches is presented in the next part through the formalization of the aesthetic judgement. From philosophy to empirical articulations, the knowledge that comes from cognitive psychology gives an understanding of **an artwork appreciation as an information-processing model**. The

design research community adapts this knowledge to product design in order to create **aesthetic products**. Starting with the modernist view of Bauhaus, beauty becomes “a basic requirement for civilized life” as Walter Gropius states in his writing on the Total Architecture. Besides functionality, perfect proportions, colours and well-balanced harmony transform the crafted environment to a higher order (Gropius, 1956). The next section shows psychological approaches to judge beauty and different design expressions from Product Design and Human-Computer Interaction systems.

2.1.2 The aesthetic appreciation – from psychology to design

2.1.2.1 The Aesthetic appreciation as an information processing model

The field of aesthetics is a blooming one, not only in traditionally related fields such as art history and philosophy, but also in psychology - *psychological/empirical aesthetics* and the neurosciences – *neuroaesthetics* (Augustin, Wagemans, & Carbon, 2012). In order to framework the aesthetic appreciation between a viewer and a modern artwork, (Leder et al., 2004) develops an *information-processing model* in five stages: **perception, explicit classification, implicit classification, cognitive mastering and evaluation** – **Figure 29.**

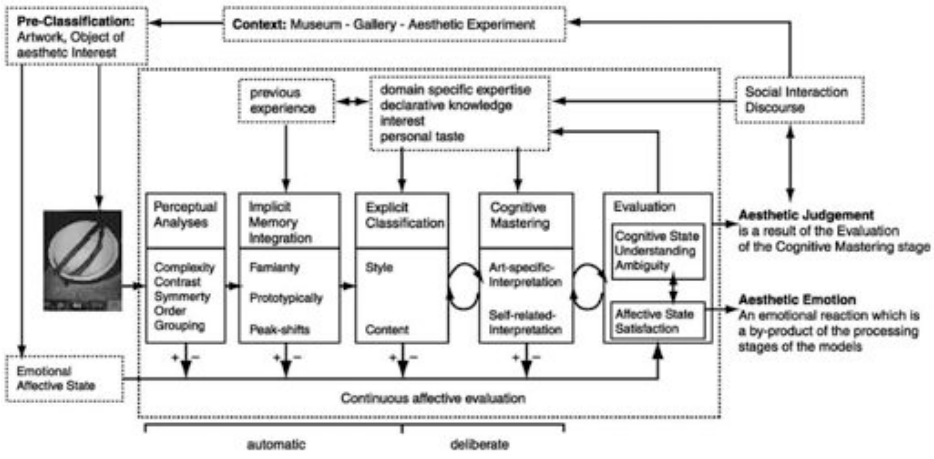


Figure 29 Model of aesthetic appreciation from (Leder et al., 2004)

This model shows that the aesthetic appreciation is a *cognitive* and *affective process*. It also goes beyond the mere appreciation of the artwork's *visual quality*. A piece of art can be good, without being necessarily visually pleasing (e.g., "DaDa"), or it can be visually pleasing, without

much quality (e.g., "kitsch") (Hassenzahl, 2008). During the first two levels, the person structures the perceived features of the artwork and assesses the artwork novelty and familiarity. These stages create *sensuous delight* or *displeasure* whereas the next levels trigger cognitive and emotional processes (Hekkert, 2006).

Besides the five stages there are also others blocks like *Pre-Classification*, *Context* and *Emotional Affective State* that influence the viewer's experience. The museum context for example represents a strong contextual cue. It classifies the object as one having an aesthetic potential. This notion is also mentioned by (Sandelands & Buckner, 1989) under the name of *boundary*. Boundaries focus the view of the person, offers a framework in space and time. In the same way, the artist's name has a special status. It serves as a predominant entry point to recognition of value and structures artworks in the person's memory (Belke, Leder, Harsanyi, & Carbon, 2010).

Beside these factors, *the initial* emotional state of the person influences the appreciation. A *positive mood* at the beginning of an exposure *positively affects the quality of aesthetic processing* (Leder et al., 2004). Norman underlines the connection between emotional valence and task orientation (D. A. Norman, 2004a). Positive emotions are critical to learning, curiosity and creative thought (see in **Figure 30)**. They support a holistic mode of processing that widens semantics fields and memory connections. On the contrary, negative effect, despite its negative connotation, is useful for focus and concentration.

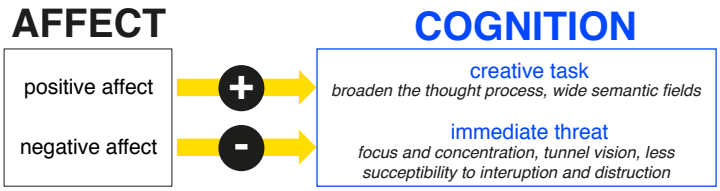


Figure 30 Affect and cognition interplay and their influence on task specificity (visual representation from (D. A. Norman, 2004a) and (Leder et al., 2004).

At a larger scale, the viewer's attitude towards the artwork has an important influence on the process. The *aesthetic attitude* is defined by the person's *openness and readiness* to explore an object. It is opposed to the instrumental attitude whereby objects are seen are useful or satisfying desires (Sandelands & Buckner, 1989).

Looking at other features that influence art appreciation, (Parsons, 1989) describes another type of model of aesthetic judgement. Parson's model looks at the cognitive abilities of a person to understand and appreciate an artwork. There are five stages that correspond to the person's degree of mastery of the appreciation (**Figure 31**).

Within the initial stage – **Favouritism**, the person personally resonates with the colour of the painting or with the subject. During the second stage – **Beauty and realism**, the person appreciates the beauty and the

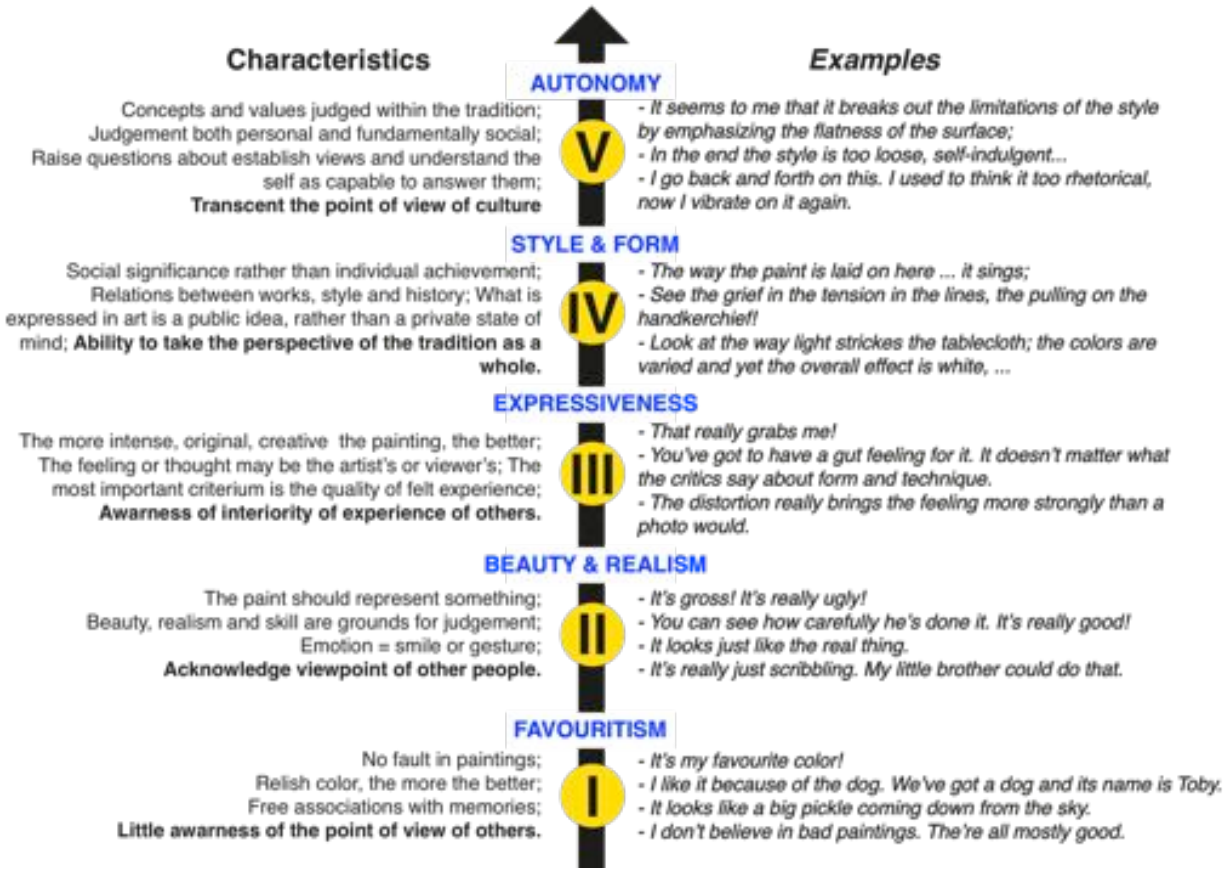


Figure 31 Parson's five stages of artwork appreciation ((Parsons, 1989), p. 22-26)

accuracy in which reality is reproduced in the artwork. **Expressiveness** stage relates the viewer with the artists feeling while producing the work. During the fourth stage – **Style and form**, the viewer is aware and deploys social conventions and rules of interpretation. Finally, the fifth stage – **Autonomy**, the person is able to understand the underlying concepts of the artwork and begins to evaluate and question the artistic tradition in relation within his or her experience.

Parson's model of art appreciation is not correlated to emotional arousal. However the cognitive aspects are present. One can see that the fourth and fifth levels are highly intellectual. Furthermore *sociability and awareness* are also scale-dependent – the higher level the more social the

appreciation judgement. In the same way awareness evolves towards Autonomy.

Outside the museum and artistic context, beauty appreciation is also studied in design. The next subsection gives an overview on judgmental models and aesthetic features in design. We show how an object becomes aesthetically pleasing due its features, its use and functionality. From product design to interaction design, crafting beautiful products, objects, situations or systems is a complex and challenging mission.

2.1.2.2 From a design perspective: aesthetic features and interactions

2.1.2.2.1 Aesthetic features

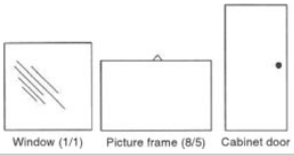
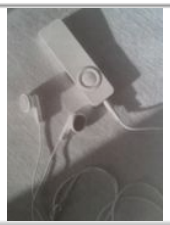
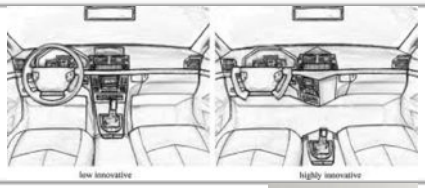
Understanding how an aesthetic appreciation is developed in the mind of the viewer and how people engage themselves with everyday objects brings knowledge also to the design community. (Hekkert, 2006) adapts (Leder et al., 2004) model of aesthetic appreciation for products. In a more recent publication on **Products aesthetics**, Hekkert et al. define the aesthetic object as *an object designed as appealing, that gives pleasure and delight* through the use of *aesthetic features* (Hekkert & Leder, 2008). These aesthetic features are extracted from the 125 design principles found by (Lidwell, Holden, & Butler, 2010) and are categorised into three groups:

- **Psychophysical properties** - formal qualities of objects like *intensity, size, colour*;
- **Organizational properties** - patterns that induce relationships between *edges, contours, blobs, basic geometrical shapes* or create order;
- **Meaningful properties** - not properties of things, but properties as a result of perceiving like *familiarity, prototypicality etc.*

Since 2008, other studies are conducted to understand people preferences on the aesthetics of products. (Blijlevens, Mugge, Ye, & Schoormans, 2013) show that trendy products are more aesthetically appealing. In order to achieve the **trendiness** effect, the authors propose to deviate from the typical properties of the *prototype* of a product. Regarding the formal aspects of objects, **curved objects** are preferred to sharped objects for objects with neutral or positive emotional value (Leder, Tinio, & Bar, 2011). Other researchers show a positive linear relationship of *trendiness, complexity, and emotion* on **novelty** - the objects perceived to be most beautiful are those with a moderate level of novelty (Hung & Chen, 2012). Regarding **style** in design, it is shown that

pleasure is indirectly derived from knowledge about design - i.e. for example recognizing products that are made by a certain designer could influence the perception in the same way as knowing that a painting is made by a certain painter (Hekkert & Leder, 2008). **Table 3** regroups some of these aesthetic properties and examples coming from the literature.

Table 3 **Aesthetic properties** for products – a theoretical overview with examples.

Aesthetic Features	Example of products
1. Intensity, size, colour	Generally such properties are culture and context dependent; *Colour* has the biggest impact for aesthetic appreciation; *Hues* are preferred for *blue, green, red and yellow*; *Saturation, brightness, hue* in this order impact the variance in colour judgment. (Hekkert & Leder, 2006)
2. Proportionality better than proportion; Aesthetic preference depends on the type of object.	 (Hekkert & Leder, 2006)
3. Conjunctive ambiguity - separate interpretations are compatible and jointly effective; **Unity in variety** - as much complexity with a maximum of order.	Conjunctive ambiguity – Institut du Monde Arabe by Jean Nouvel in (Hekkert & Leder, 2006)
Maximum effect for minimum means - Economy-driven in shape: few elements that solve a range of problems.	 (Hekkert & Leder, 2006)
Familiarity: Mere exposure to a stimulus increases its aesthetic appreciation, but over-exposure (>20 times) brings saturation and boredom; **Prototypicality**: people have a preference for prototypical models.	Prototypicality preference: Georgian chairs (left) are more prototypical than modern chairs (right) (Whitfield, 1983)
Novelty & Innovativeness Attractiveness for new - when people are able to identify and process the objects; Innovative products are not liked immediately; Repeated evaluation is recommended.	 Pretesting innovativeness in car design (Carbon & Leder, 2005)
7. Peak shift: Isolation and amplification of the essence of an object; this technique contributes to ease of recognition for the brain.	Peak-shift principle of 'Luminator' by A. Castiglioni (Hekkert & Leder, 2006)

8. Metaphors: The meaning is efficiently added to a product by reference to something else through name and form; metaphors can be effective even when people are not consciously aware of them.		Example of metaphor, Xcalibur by Philippe Starck (Hekkert & Leder, 2006)
9. Trendiness: Prototypes are constructed from an 'average' of those product designs that are repeatedly encountered. Deviating from the prototype properties trendiness is achieved.		Example of toaster using the prototype deviation technique (Blijlevens et al., 2013)
Trendiness, Complexity, and Emotion forms a positive linear relationship with novelty; the chairs perceived most beautiful are those with a moderate level of novelty, but chairs with a moderate level of novelty can elicit a wide range of aesthetic preference.		Example of chairs highly typical (1st row), **both typical and unique – moderate level of novelty** (2nd row) and highly unique (3rd row) (Hung & Chen, 2012)
Curved objects: Preference on curved version of objects to the sharp version of the same object, but only if the objects are neutral or positive in emotional valence.		(Leder et al., 2011; Leder, 2011)

In parallel with this corpus of knowledge coming mostly from Europe, in Japan the aesthetic pleasure is incorporated into **Kansei concept**. Kansei inclusively involves *sensitivity, sense, sensibility, feeling, aesthetics, emotion, affection and intuition* (S. Lee & Stappers, 2004). The concept is founded in 1970's by Mitsuo Nagamachi as *a design engineering approach to include consumer feelings and emotions in new products* (Nagamachi, 2002).

In order to obtain pleasing products, researchers in Kansei science introduce in the first phases of consumer appreciation translated through *words and images*. **Figure 32**(*left*) shows the Kansei Engineering System (KES). This input of the system two roles: to orient the design process towards cultural profiles of users (Bouchard, Mantelet, et al., 2009) or to evaluate, usually using semantic differential scales, what properties the future design should include process when these profiles are not available.

Kansei science offers designers tools for a better knowledge on aesthetic preferences and methodology on how to include these

preferences in early design phases. In France CPI Laboratory create tools using Trends Analysis Methods that enrich the KES. An example of this tool is exposed in (Bouchard, Mantelet, et al., 2009). The researchers show how *emotional effect is culturally depended* and *how it can be identified in early design phases* using sematic scales and Trend cards. Through these cards (see an example of Trend cards in **Figure 32**), relationships are found between *aesthetic preferences* and *behavioural values*. Knowing these behaviours values can help in predicting preferences for new designs (Bouchard et al., 2009). However aesthetics are studied only in terms of *colours, forms, texture and patterns*, a perspective, which is a limited view for our understanding of aesthetics (Bongard-Blanchy, Bouchard, & Aoussat, 2013).

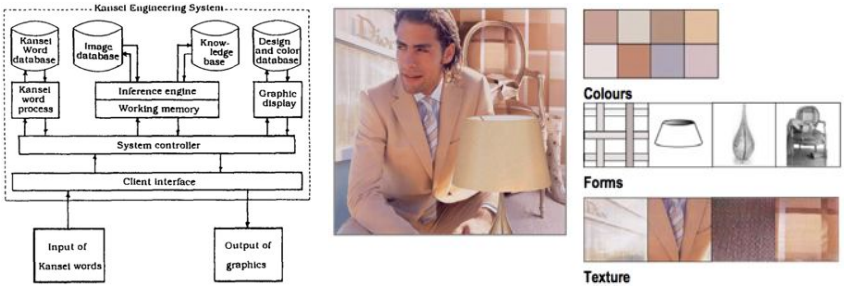


Figure 32 A system structure of Kansei Engineering System - KES from (Nagamachi, 1995) (*left*); Example of Trend cards used to reinforce consumers' values and products attributes, aesthetics and attractiveness from (Bouchard et al., 2009) (*right*).

Despite a growing interest of industries in Kansei – mostly automotive industry and electric home appliance industry (Nagamachi, 2002), Jordan criticize the complexity of this approach. The *high number of variables and evaluations* makes the design process become unwieldy and time consuming (Jordan, 2000). Moreover, even if Kansei is one of the most reliable and valid techniques for linking products properties to products benefits, it does not provide a *Gestalt model of all these properties*. Jordan argues that in Kansei design is the sum of parts – formal properties and that a global perspective could enrich the information on the product appreciation.

As the other aesthetic features presented before (**Table 3**), more holistic views on products and their usage give other perspectives to understand the aesthetic appreciation of a product. Furthermore when beauty is mixed with functionality like in human-computer interaction, the concept of aesthetics can be problematic. As interactive tools mostly serve purposes, other attributes related to usability come into play (Hassenzahl, 2008). The next section shows an overview of the research on aesthetics and usability and their interplay for interactive products.

2.1.2.2.2 Beauty & usability

> Have nothing in your houses that you do not know to be useful, or believe to be beautiful.
>
> **William Morris** - The Beauty of Life (1880)

During the past ten years there have been a growing number of studies showing and challenging the connection between aesthetics and usability. Norman's first publication on the topic (D. Norman, 2002) show the influence *of usability on beauty perception*. Later publications (D. A. Norman, 2004a; D. Norman, 2005) based on Tractinsky et al. first evaluations on the subject (N Tractinsky, Katz, & Ikar, 2000) stress the importance of studying the *aesthetic aspects as a mean to increase the usability* – **Figure 33**. Norman even places aesthetics ahead of usability. In order to show how attractiveness is created, the researcher maps the characteristics of products within three levels of interaction with the cognitive and emotional system: *the visceral design* is related to how products are perceived in appearance, *the behavioural design* is related to pleasure and effectiveness in use and *the reflective design* it connects with personal satisfaction, self-image and memories (D. Norman, 2005).

Figure 33 Usability and Aesthetics relationship: ordinary cup with tea ball (*left)*; Carleman's *Coffeepot for masochists,* Michael Grave's *Nanna* teapot, *The Ronnefeldt "tilting"* teapot (*right)*.

But what happens when appreciating interactive products? HCI community focuses on judgments of *visual beauty* and explores their impact on the adoption and use of interactive products (Diefenbach & Hassenzahl, 2009). Hassenzahl states that beauty judgments change *before and after* the use of a product. For non-interactive products beauty might be considered a stable characteristic over time. On the contrary, for interactive products, affective responses are inputs to the judgmental process rather than an outcome.

Regarding the relation between beauty and usability, **beauty is more affect-driven, faster and more consistent than goodness** (usability). Hassenzahl explains that this is due to the fact that beauty is primarily hedonic, i.e., more concerned with self-referential goals ("be") than action goals ("do") (Hassenzahl, 2008). More recently it was show that people *discount* beauty in a *choice situation* that requires a trade-off between beauty and usability – phenomenon called **the beauty dilemma.** The results of this observation are directly influencing selling interactive products: having a surplus in beauty (and in price) is desired, but hard to sell; on the other hand, primarily usable and useful products might be easier to sell, but they may not create a strong, long term emotional attachment (Diefenbach & Hassenzahl, 2009). Finding the right balance that gives *confidence in the usability of the product* and *ensure hedonic qualities* is challenging but essential for interactive products.

2.1.2.2.3 Aesthetics in Human-Computer interaction – beyond usability

It is shown that when talking about the aesthetics of a product, object, situation etc., "beautiful" and "ugly" are the most prototypical words to describe an aesthetic judgment (Jacobsen, Buchta, Köhler, & Schröger, 2004). Nevertheless HCI community gives a relatively broad **definition of aesthetics in the context of interactive products**.

Djajadiningrat et al. states that aesthetics becomes a topic in HCI when this community shifts from *semantic and cognitive approach* - in which the product can communicate information using symbols, signs, metaphors, *to the direct approach* – in which meaning is created in interaction. The new orientation focuses on perceptual and bodily skills, sensory richness and action-potential of physical objects (T. Djajadiningrat, Wensveen, Frens, & Overbeeke, 2004). **Figure 34** shows the characteristics of both approaches and a direct approach example.

Figure 34 The semantic approach vs. the direct approach (Djajadiningrat et al, 2004) (*left*); **Alarm clock** (*right*) by (Wensveen et al, 2000) reads the user's emotions by the way she set the wake-up time, the elliptical display show current time and the circular display the alarm time.

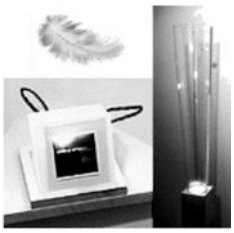


Figure 35 Communication system that indicates through the movement of a feather when the travelling partner is thinking of the other (Strong & Gaver, 1996)

Aesthetics in this community focuses less on the object per-se and its formal representations and more on the aesthetics during the interaction. *Expressiveness of movement* for example can not only enhance communication, but may also form a new source of aesthetics (T. Djajadiningrat, Matthews, & Stienstra, 2007). Others researchers talk about the *implicit, personal, and expressive* artefacts (Strong & Gaver, 1996) – **Figure 35**, *poetic interactions* (Axelsson, Eriksson, Lindros, & Mattsson, 2002), *graceful interaction* (Norizan & Hashim, 2009), expressive interaction through *fragile and magical* computation (Landin, 2005), *soft* interaction (Rullo, 2008), *richness* in appearance, actions, and role (J. P. Djajadiningrat, Gaver, & Frens, 2000) – **Figure 36**. Some of these contributions are also discussed in the next section where a more holistic perspective on aesthetics is explored.

Figure 36 **Appointment fan** for a polyandrous twenty-year old woman. Public mode, all the screens are folded in (*left*). Private mode that support her polyandrous behavior - the woman can rate and compare her boyfriends (*right*) (J. P. Djajadiningrat, Gaver, & Frens, 2000)

Figure 37 **Kitchen drawer**: the drawer gives the impression of having a character, stubbornness and fight with the user when closed or opened (T. Djajadiningrat et al., 2007).

Regarding **gestalt principles** and **qualities** there are several studies that describe aesthetics following interactivity attributes. Djajadiningrat et al.'s first studies on coupling between *action and reaction* explore the **unity principles** between the action of the user and the feedback of the product.

There are four principles: unity of *location, direction, modality* and *time* and if respected they bring fluency in interaction (T. Djajadiningrat et al., 2004). However in later publications on the subject Djajadiningrat et al. conclude that the *violation of unity principles* might potentially trigger a richer interaction and aesthetic response (see **Figure 37**). Also *smooth acceleration and deceleration,* instead of linear movement, the use of components with *multiple degrees of freedom* and of *superimposed movements* are other ways to create richness and aesthetics in interaction (T. Djajadiningrat et al., 2007).

Lim et al. introduces in 2007 the notion of **gestalt attributes** of aesthetic interactions depending on three key factors: *time, space* and *information* (Lim, Stolterman, Jung, & Donaldson, 2007). The concept of information is replaced with *data* in (Lim, Lee, & Kim, 2011). **Figure 38** presents a synthesis on **eleven attributes (2007)**, that evolve to **seven in 2009** and that are **re-discussed in 2011**. Even if these "are simply descriptions of the shape of the interaction", they provide a first base of a language to describe interaction (Lim et al., 2007). Results also show that using these attributes in teaching interaction changed students ways of approaching interactivity by creating more expressive and sophisticated artefacts (Lim et al., 2011).

In 2009 the authors test the meaningfulness of the interactivity attributes and conclude that the interactivity attributes "are all recognizable and create some distinctive and meaningful emotional effects" (Lim, Lee, & Lee, 2009). Using semantics differentials, they show that some half qualities are perceived, such as **natural and sympathetic** (sequential, continuous, unpredictable, wide range, slow, approximate, and delayed response) and the other half as **heavy, hard, and artificial** (concurrent, discrete, predictable, narrow range, fast, precise, and prompt response) (Lim et al., 2011).

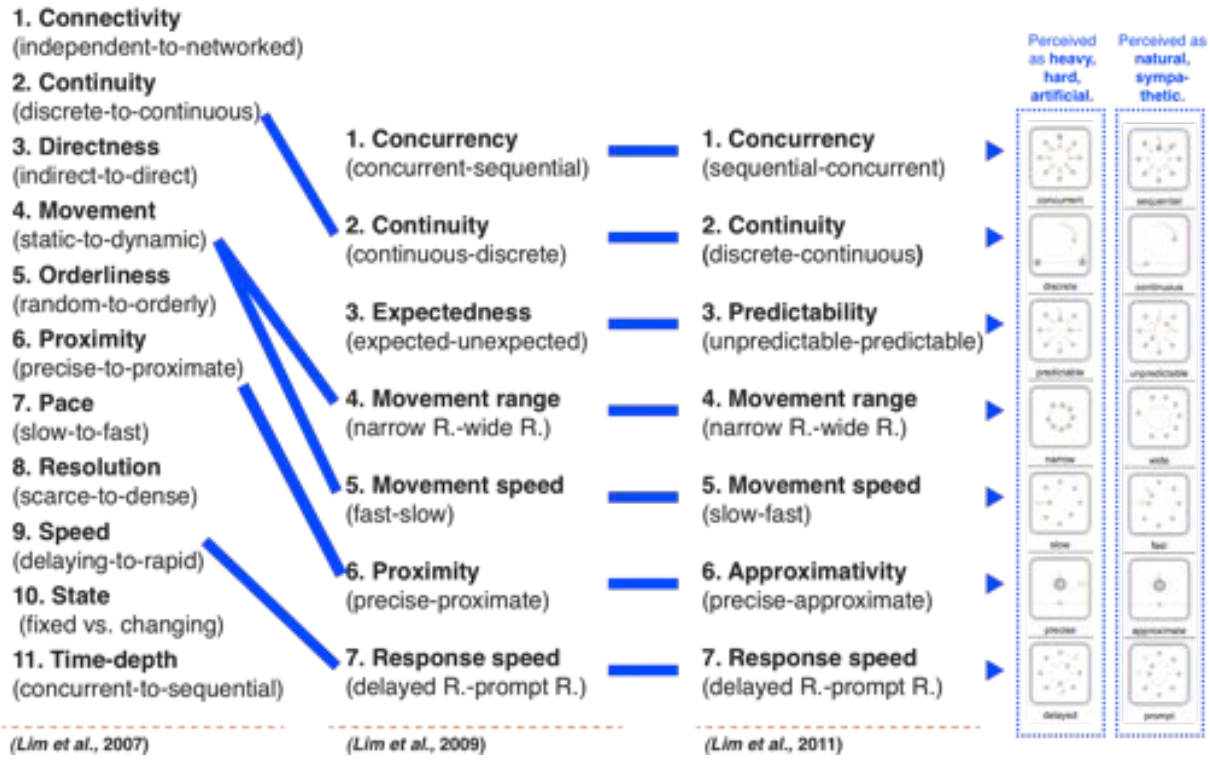


Figure 38 Aesthetic of interaction – a synthesis from (Lim et al, 2007, 2009, 2011)

In the same direction as (T. Djajadiningrat et al., 2007) hypothesis on *violation of unity principles,* Lidwell at al. suggest in 2010 that sometimes "the best designers sometimes disregard the principles of design. Future studies could also apply such violation on Lim et al. interactivity attributes. In product aesthetics, this perspective usually brings some "compensating merit attained at the cost of the violation" (Lidwell et al., 2010). Accordingly, *transgressing these attributes and principles could enrich the aesthetics of interactions.* Playing with these gestalts and exploring their limits through interaction could bring new perspectives in designing interactions.

Finally, beyond features and principles, there is a new tendency to switch to more global views, from products to experience. From *features to experience qualities* (Löwgren, 2009), from *ease of use to enjoyment of the experience* (J. P. Djajadiningrat, Gaver, & Frens, 2000). These approaches look at the human as a whole and study subjectivity of relations between products and persons: "products should be personal pathways that allow individuals to find and create their own experiences" (Hummels, Ross, & Overbeeke, 2003).

2.1.3 Conclusion of the first part

In 2004 Don Norman is invited to introduce a special section on beauty in HCI (D. A. Norman, 2004b). He starts this introduction by showing the differences of perspectives between art historians' view on aesthetics and psychologists' view on the subject. One culture is that of humanity and literature – art historians, the other is the culture of science - psychology. Norman underlines the necessity of both and their richest for each other, if only the communication gap could be traversed.

As it is also shown in this chapter, **psychological perspectives** focus on objective methods to grasp knowledge on how people perceive beauty. (Leder et al., 2004) develops an *information-processing model* in five stages, Norman suggests three levels of perceiving beauty: *visceral*, *behavioural* and *reflective* (D. A. Norman, 2004a). Research in design, based on these models, aims to understand aesthetics of products. Understanding the influence and role of **aesthetic features and principles** (Hekkert, 2006), how **to evaluate and generate the Kansei** of a product in its early phases (Bouchard, Mantelet, et al., 2009; Nagamachi, 2002) are first approaches to link users' aesthetic preferences with products properties. Further on, the relationship between **beauty and usability** (D. A. Norman, 2004a; N Tractinsky et al., 2000) and between **beauty, goodness and usability** (Hassenzahl, 2008) show the importance of aesthetics in shaping users attitudes and behaviour with interactive products in general (Lavie & Tractinsky, 2004).

The interest of HCI community in aesthetics opens new ways of seeing aesthetics beyond beauty. *Poetic, expressive, magical* interactions and **interactivity attributes** (Lim et al., 2011) develop a language of aesthetics for interactive products and systems.

However, even if these studies connect users' preferences with design attributes, they are mostly seen rational decisions coming from an information processing model rather than properties coming from human experience (N Tractinsky et al., 2000). Sometimes *ease of use* may just as often lead to frustrating experiences as it does to *good usability* (T. Djajadiningrat et al., 2007). The idea is also underlined by Hassenzahl: "experience emerge from a variety of aspects, many of them beyond the control of design... some outstanding experiences may come without careful crafting" (Hassenzahl & Carroll, 2010). The challenge for design research is related to the tension between **being rigorous and using scientific knowledge to predict the impact of the design intention**, and the **openness for subjectivity** to the mysterious "human motivation... tied to subconscious instincts, perceptions and influences" (Kimberly Elam in (Lidwell et al., 2010)). The next chapter focuses on more holistic and subjective framework of experience and the aesthetics of living an experience.

Figure 39 The Void by Yves Klein, 1958 (photo © Archives Yves Klein). In this 'empty' exposition Yves Klein paints the walls in white and prepares for the guests cocktails having the color people came to see: *le Klein bleu*. Experience comes in new forms and situations and design has to be prepared to understand and craft this concept properly.

Synthesis of Section 1 (§2.1 in **Figure 26**):

Information processing models of art appreciation give a detailed understanding on how an **aesthetic judgement** is created.

Aesthetic features and principles of objects, studied from both *visual and formal properties* to *attributes of interaction* are important elements to take into consideration when studying Aesthetics. **Beauty and usability** are tight connected**. Interactivity attributes** offer a language to describe aesthetics in interaction and their use enriches products.

This knowledge consolidates a work-in-progress **corpus of knowledge on Aesthetics**. Consequently as designers we have to **be aware** of this corpus of knowledge, but in the same time to **play with its limits and explore new laws** that sometimes are violations of basic principles.

A more global view on the subject could enlarge and contextualize **aesthetics as a characteristic of living experiences**.

2.2 Aesthetic experiences or the aesthetic of living an Experience

2.2.1 Living an experience

The first part of this section presents an overview of what means an **aesthetic object.** Due to its features and principles studied by psychology and translated to design the aesthetic appreciation is a response to an aesthetic stimulus. This corresponds to the vision proposed by *externalist theories* (second half of twentieth century). In the same period, the *internalist theories* promote the qualities of the experience (Shelley, 2009). Internalist theories - particularly John Dewey's (1934) and Monroe Beardsley's (1958), predominate the first part of the twentieth century. These theories look at the experience of people rather than at the beauty of an object – see **Figure 40**. In this case an object is aesthetic if *the experience lived with that object has an aesthetic character.*

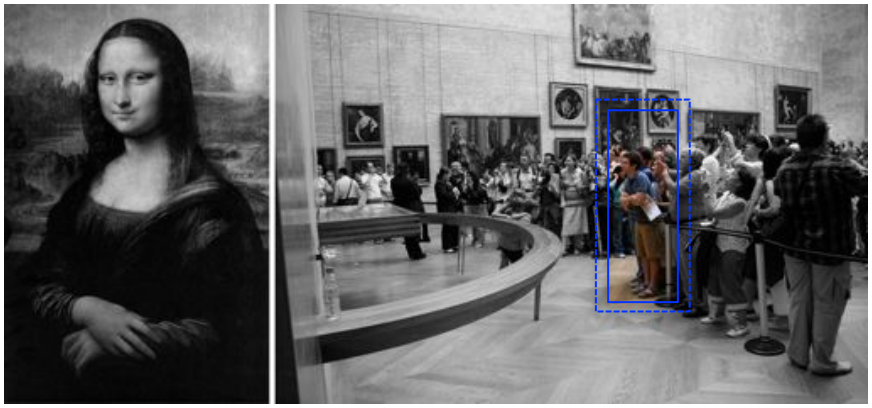


Figure 40 Two different perspectives of looking at Aesthetics: **a)** *Externalists* describe an aesthetic object due to the beauty of the features (photo of Mona Lisa); **b)** *Internalists* that look at the experiential character of the felt experience of the person (People looking at Mona Lisa - photo © J.P. Panter)

Hassenzahl is also talking about a similar distinction in design. He separates the *normative* and *judgement* approaches from the *experiential* approach. The first two focus on particular descriptive attributes to study what is judged to be beautiful or not. The ***experiential* approach** uses an all-embracing, holistic approach to study aesthetic experiences (Hassenzahl, 2008). This perspective, which preserves the *complexity and richness* of living an aesthetic experience, is built on the **pragmatic philosophy** of John Dewey.

Dewey describes the elements that are mixed together in order to create **an Experience**. An Experience is "a whole", a story, a history that has its own plot, inception, movement, time and unrepeated and individualizing quality. It is self-sufficiency and singular, a special and

extra-ordinary interaction between living creatures and their environment (Dewey, 1934).

In psychology there are different names that refer to concepts similar to what Dewey describe as an Experience (with a capital E). Maslow studies the **Peak experience**, 'ecstasies' or 'transcendent' experiences. They are profound and shaking integrated and unified situations. During a peak experience the person experiences the world in a detached, egoless, self-justified moment. The consciousness of time and space disappears and the persons feel a loss of fear, anxiety (Maslow, 1964).

Figure 41 Sophie Calle's *Last time first time* exposition - *To See the Sea* project, where the artist brought people for the first time to see the sea and filmed their reaction. (Photo © Gallery Perrotin)

The **Optimal experience** or **Flow experience** (Csikszentmihalyi, 1997, 1998, 2008) characteristics are similar to Maslow's description of peak experiences. Flow experiences are *autotelic moments* – worthwhile in themselves, usually encountered while doing an activity. The person feeling Flow, experiences an equilibrated dose of boredom and anxiety. This state appears from the involvement of clear goals and immediate feedback. The person feels in control in that particular activity, but she has no awareness of time.

One of the major differences between *Peak experience*, *Flow experience* and (Dewey's) *Experience* is that the first two are studied as momentary moments whereas the last one is developing over time. This might be explained by the disciplines studying such situations. Psychology takes a significant state of mind and analyses it deeply. Philosophy shows a global view on the phenomenon. In order to give our definition on the concept we focus on several aspects that we find central for the concept of Experience.

Figure 42 Photo taken by photographer Jack Bradley that shows the moment that Harold Whittles hears for the first time after being fitted with a hearing aid.

Firstly, a common characteristic of all these experiences is the fact that they bring in a **transformation** of the person involved in the interaction. Further on, **being conscious** of the fact that something changes or is transformed during the interaction is also required for the success of an experience. The fact that the situation is **memorable** due to its uniqueness is also important (see **Figure 41, Figure 42** for representations of people manifesting transformative and memorable experiences).

Using the Deweyan perspective on the concept and the observations that we gathered from the other theories on Peak experiences and Flow experiences, we propose the following definition:

An Experience is an extra-ordinary situation developed over time that modifies human being in a conscious and unique way. Memorability and transformation are ways to understand the success of the Experience.

In addition to these philosophical and psychological perspectives, the concept of experience is also investigated for its economic and socio-cultural impact. (Pine & Gilmore, 1998) argue that capital enters a new stage of production: the *experience economy*. Experience economy is not about products or services but about experiences. As Pine and Gilmore suggests, designing memorable experiences is about *designing meaning, time and activities* just as a trip to the magical kingdom of Disney land. Moreover Blythe et al. citing Slavoj Zizek, argues that products are no longer valuable for their functional or even symbolic value, but for their support to bring customers' *true self:* "commodities are no longer a supplements to our 'authentic life' they are themselves constitutes of authentic life" ((Zizek, 2009) in (Blythe, Hassenzahl, & Law, 2009)). The following part draws an overview on how design research understands the concept of experience and aesthetic experience through theoretical frameworks and methods.

2.2.2 The objective side of subjective experiences in Design Research

There is definitely a challenge within the design community to understand what are the 'ingredients' or qualities to take into consideration in order to understand what makes **a good product experience**. In this part of this section we show the great interest of the design community in studying experience with products. We present a rather objective side of understanding subjectivity of product experiences through two perspectives coming from product design, human-computer interaction and psychology: *Product experience* and *User experience*. Almost all frameworks described further on are descriptive and evaluative and represent *model-based UX research camp* that use mostly quantitative methods to evaluate user experience (E. Law, 2011).

2.2.2.1 Product Experience – an approach from industrial design

In 2008, Paul Hekkert and Hendrik Schiffertein edited Product Experience. They define the field of Product Experience as "the research area that develops an understanding of people's subjective experiences that result from interacting with products" (Hekkert & Leder, 2008). In order to study people experiences with products, they study blocks of human-product interaction and they divide the subjective experience into three kind of experiences: the **Aesthetic Experience** "*the awareness of the psychological effects elicited by the interaction with a product, including the degree to which our senses are stimulates*", the **Meaning Experience** "*the*

meanings and values we attach to the product" and the **Emotional Experience** "*the feeling and emotion that are elicited*" (Hekkert & Leder, 2008).

Figure 43 represents a view on *the interaction* between *a person* and *an artefact*. (Locher, Overbeeke, & Wensveen, 2010) represent the structures and the factors that contribute to an aesthetic experience with artefacts. They describe how the internal and external human attributes - memory, cognition and affect are mixed and depended on the artefact characteristics and context. In the experience of a product there is a *continuous, dynamic, bottom-up and top-down interaction between the form, functionality of the artefact and the sensory-motor-perceptual system and user's cognitive structure*. Even if this framework is one of the most detailed frameworks that describe an interaction between a person and an artefact, its complexity makes its adaptation as a generative framework almost impossible. It gives a solid base and an objective view of the whole system, but no guides to how craft an aesthetic experience.

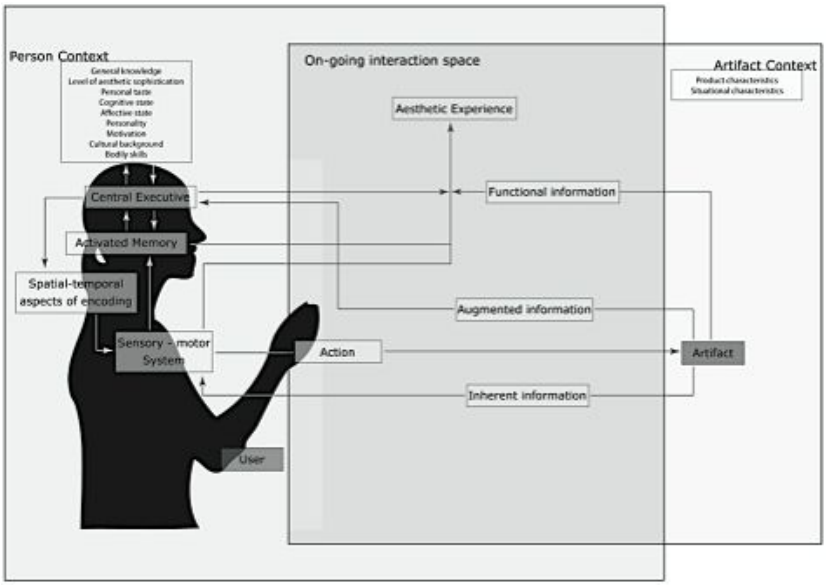


Figure 43 A framework of the Aesthetic Experience (Locher et al., 2010)

For example (Desmet & Hekkert, 2007) state that in order to craft an aesthetic experience, designers should focus on aesthetic pleasure and *disregard aesthetics displeasure*. More recently (Fokkinga & Desmet, 2012) show how *negative emotions* are used in the design process to enrich experiences with products. This new direction on products experience goes further the study of *sensory pleasure* described by Desmet & Hekkert to *more complex experiences and products.*

From a more general point of view, Law et al. argues that Product Experience approach has a narrower scope than **User Experience**: not all

objects are commercial products. Additionally product experience cannot be seen in isolation; *one product experience influences another one* and therefore the context, *other experiences* with similar products and the *brand experience* are mandatory (E. L. Law, Leicester, & Hassenzahl, 2009). Other researchers argue that in order to study experiences one has to have a larger view on the system presented in **Figure 43** and to examine relations between *function* and *expression* mediated by *structure*, rather than *function* and *structure* (Cupchik & Hilscher, 2008). In addition the aesthetic experience in product experience framework is situated within the first level of perception that Norman proposes, i.e. *visceral* (Desmet & Hekkert, 2007). User Experience frameworks go beyond this level to more abstract knowledge and more complex cognitive processes.

2.2.2.2 User Experience Design – an approach from Human-Computer Interaction

User Experience concept (UX) becomes in the last five years the most discussed topic in design research community. In order to show the complexity of this concept we organise this section into four parts. **Approach** shows the transition that User Experience brings in design and HCI community. **UX definitions and statements** clarify notions validated by the UX community. **UX over time** gives a central direction of studying the temporal dimension of this concept. Finally **UX measurability** draws an up-to-day overview of the methods used to evaluate experiences.

Approach: Nowadays, studying the concept of User Experience in the field of Human-Computer Interaction (HCI) is a core preoccupation. The term User Experience is introduced by Don Norman in the 1990s[4] and it is followed by rapid adoption in the software and web industry (E. Law, 2011). Last year, the biggest conference in HCI community, CHI2012, had the global theme User Experience.

The importance of this topic is this community underlines the transition from a **cognitive approach** in which *usability, user cognition and user performance* were the key guidelines, to a **UX approach** that is guided by *affect, values, sensations, pleasure, surprise, meaning, beauty, value of interactions, hedonic, aesthetic* ((Cupchik & Hilscher, 2008), (E. L. Law et al., 2009), (Hassenzahl & Tractinsky, 2006), (Ludden, 2008), (Blythe, Wright, McCarthy, & Bertelsen, 2006)) (see **Figure 44**).

The new paradigm in HCI might be simply understood using Blythe et al. example: "taking a shower cleans – efficiently - a 'shower experience' promises something more… This highlights emotion, universal need

[4] According to Peter Merholz, it can be traced back to 1985 in an InfoWorld magazine article authored by Roy Nierenberg (www.adaptivepath.com/ideas/the- earliest-use-of-user-experience-as-we-now-think-of-it)

fulfilment and sensuality much more than the more 'practical' world of products and services" (Blythe et al., 2009).

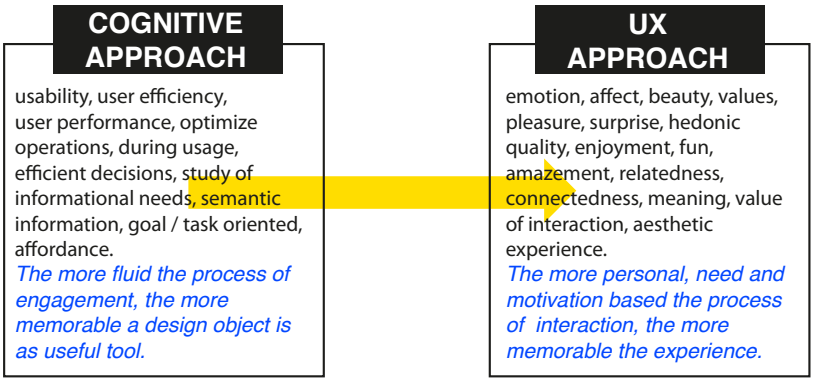


Figure 44 UX - the new paradigm in HCI research

But what are the definitions that design community brings to the elucidation of UX concept. **Allaboutux.org** website presents 27 definitions but we lack of a consensual definition of UX.

UX definitions and statements: A recent paper on the subject gathers views on UX from 275 researchers and practitioners (E. L. Law et al., 2009). These experts come mainly from HCI, psychology and technology area and less from design community. Their interests in UX are mostly three: *to design better products*, *UX per-se*, and *to make people happier*. The second motivation, UX per-se is related to the subject *originality* and the *intriguing nature* of this concept within this community.

(E. L. Law et al., 2009) study proposes five definitions for UX concept. Among these five definitions, one is highly chosen by UX experts - the definition given by Hassenzahl and Tractinsky in 2006:

> **UX is a consequence of a user's internal state (predispositions, expectations, needs, motivation, mood, etc.) the characteristics of the designed system (e.g. complexity, purpose, usability, functionality, etc.) and the context (or the environment) within which the interaction occurs (e.g. organisational/social setting, meaningfulness of the activity, voluntariness of use, etc.).** (Hassenzahl & Tractinsky, 2006).

Other observations related to UX are stressed within Law et al paper. The notion of **reflection** seems important for how experience is *memorized*. Future UX is influenced by how experience is recalled. The reflexivity of felt experience is also emphasize in (McCarthy & Wright, 2007). The authors argue that in order to study experiences, "we have to

inquire from the subject what the activity felt like as felt experience, (and this) entails reflection, *after the event*, on the personal meaning of the experience" ((McCarthy & Wright, 2007), p.15).

Secondly, Lim et al. stress the importance and the force of **social practices to influence personal experiences,** but they position their research 'only an individual can have feelings and experiences'. Thirdly, regarding the experienced 'object', Law et al. establish the area of UX as the interaction with user interfaces – i.e. *products, objects, systems and services.* In this paper we name all these entities as **design situations**.

Nevertheless the dynamic aspect of the experience, its **evolution over time**, is missing from this definition. The next part presents how experience changes over time within different temporal phases. These phases are central to understand how becomes memorable. Recently, different studies coming from **Memory Theory** are adapted to design to understand the temporal flow of experience and the difference between experiencing and thinking about an experienced situation.

UX over time: The temporality of an experience is firstly described in a white paper on UX in 2011. There are several temporal aspects as following: *anticipated UX*, *momentary UX*, *episodic and cumulative* (Roto, Law, Vermeeren, & Hoonhout, 2011). Hassenzahl talks about *micro, meso, macro* experimentation time (Hassenzahl & Carroll, 2010) and Karapanos et al. separates two temporal levels of the experience: *the anticipated experience* and *the actual experience* with a product. The relation between a person and a product evolves in these experiential states – *anticipation, orientation* and *incorporation* – **Figure 45** (Karapanos, Zimmerman, Forlizzi, & Martens, 2009).

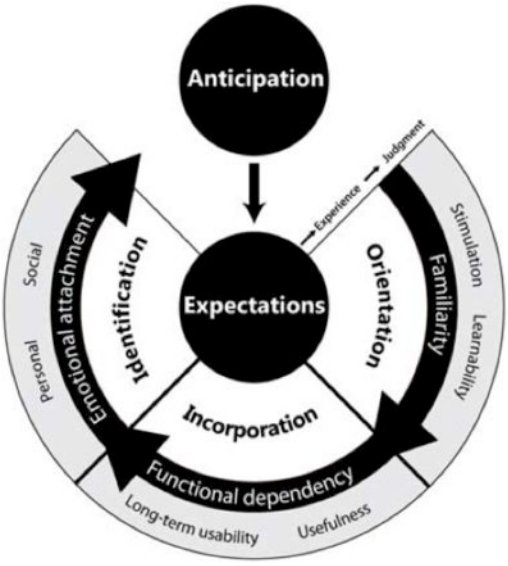


Figure 45 Temporality of experience in three phases that increase *familiarity, functional dependency and emotional attachment*: **Orientation, Incorporation & Identification** (Karapanos et al, 2009).

These studies and also recent knowledge coming from cognitive psychology conducted by Daniel Kahneman raise challenging questions. Kahneman states that people have two selves that are engaged when living experiences: *experience self* (what one feels during the experience – on live experience) and *memory self* (what one remembers from an experience). These two selves influence the overall experience and "the elimination of memories greatly reduces the value of the experience"((Kahneman, 2011), p.389). This research also shows that there exist a *memory - experience gap* – i.e. the discrepancy between the average of experienced emotions and the overall evaluation of the experience (Miron-Shatz, Stone, & Kahneman, 2009).

In design research, Forlizzi & Ford suggest the concept *experience as story*. Besides the concept of *experience* (a series of activities composing a routine) and *an experience* (defined as in (Dewey, 1934)), experience as a story is related to how people remember and share experience - stories are "vehicles that we use to condense and remember experiences, and to communicate them in a variety of situations to certain audiences" (Forlizzi & Ford, 2000) - **Figure 46**.

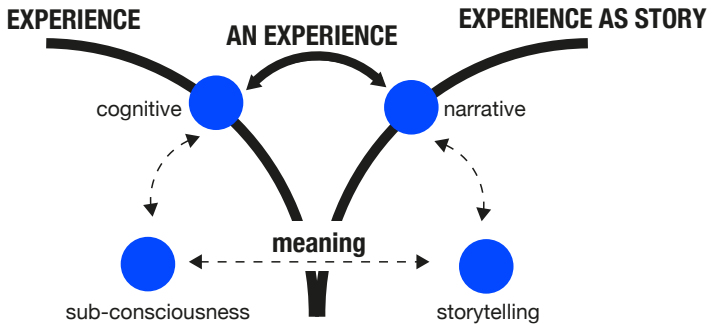


Figure 46 An initial framework of experience (from Forlizzi & Ford, 2000)

The relation between memory and experience is complex. Only by being aware of the present moment and saying that it will never be forgotten changes the character of the moment and "a self-consciously memorable experience gains a weight and a significance that it would not otherwise have" ((Kahneman, 2011), p.389).

Therefore **consciousness, awareness** and **reflection** are key factors to live and relive experiences. These factors also influence future situations. Maybe design could also teach us *how to experience*, how to look at certain products in order to experience something rich and memorable. Additionally, how the experience is developed between moment of *direct interaction* and *indirect use* (like reflection)? How to describe a subjective experience over time and what is the role of preparation, anticipation to create a memorable experience? These are open questions for the moment for the design research community.

UX measurability: Regarding the measurability of UX, different papers underline the acute necessity to create reliable quantitative and qualitative methods (Bargas-avila & Hornbæk, 2011; E. Law, 2011; Roto et al., 2011). Further on we present several statements coming from these papers and a synthesis of the course on *User Experience Evaluation Methods – Which method to use?* (Roto, Vermeeren, Väänänen-Vainio-Mattila, Law, & Obrist, 2013) attended at CHI 2013 conference:

1. There is *no general method to measure UX;* methods and evaluation are *strongly context and purpose dependent* and one has to take in consideration the *experiential qualities* at which the system is target (Roto et al., 2011);
2. *A combination of methods is recommended* (triangulation method) – for example moment-to-moment measurement and a post-test questionnaire (Roto et al., 2013);
3. *UX evaluations for academia and industry are different.* The focus of academia is to understand the phenomenon, to create and validate methods, to design well-planned studies, and to create knowledge and skilled researchers. The focus of industry is to prove product UX to management, to use cost-efficient methods, to plan small evaluations and test real life contexts; UX evaluation is often outsourced. For both environments *evaluation is also a tool for persuasion* (E. Law, 2011; Roto et al., 2013);
4. The UX methods are less useful than their usability counterparts to give diagnostics and solve problems (E. Law, 2011). A threshold level of usability is required for positive UX, but furthermore UX methods are more diverse than counting number of errors, time to learn, and time to complete a task -*usability criteria* by (Butler, 1996).

With these statements in mind, there are different attributes that could help us organize the UX methods for a specific evaluation. **Table 4** shows how to use UX methods over time within three groups: moment, episodic and long-term studies.

Table 4 Methods for different periods of experience (adapted from (Karapanos et al., 2012; Roto et al., 2013))

MOMENT	EPISOD	LONG-TERM
Observation Facial, body, vocal expressions (e.g. smile, lean back, sigh) **Psychophysiological measurements** Muscle, pupil, heart, skin, reactions detected with sensors. **Self-reporting** Verbal: PANAS, Affect Grid; Non-verbal: EmotionSlider, EmoCards, PrEmo;	**Observation** Experience think aloud **Self-reporting** Experience sampling method (ESM), AttrakDiff, Interviews, Day Reconstruction Method (DRM)	**Cross-sectional approaches** (analyse on different levels of perspective); **Pre-post approaches** (studies at 2 points in time) & **Longitudinal approaches** (micro-perspective – an hour; meso-perspective – e.g. 5 weeks, macro-perspective – years of use) **Retrospective reconstruction** DRM (tool iScale), Critical Incident Technique (tool CORPUS), Laddering, Repertory Grid Technique.

Among the methods presented in this table, **the long-term evaluation is the new challenge for the design community** – "the gold standard in studying changes in users' behaviour and experience over time"(Karapanos, Martens, & Hassenzahl, 2010). According to Karapanos et al. there are two reasons for this type of studies: *a prolongation of products warranties* that increases the number of returns under the claim that products do not satisfy users' needs, and the *shift from products to experience that increases the support* for a prolonged use with products (Karapanos, Martens, & Hassenzahl, 2012).

Yet the laborious procedures and methods of longitudinal studies show the complexity of this topic. An alternative is **retrospective elicitation** from memory theory that is proposed first by (Kahneman, Krueger, Schwarz, & Stone, 2004) – **Day Reconstruction Method (DRM)** as an alternative to **Experience Sampling Method (ESM)** created by Larson and Csikszentmihalyi.

The initial need of *ESM* come form the observation that *people are unable to provide accurate retrospective information* on their daily behaviour and experience. Therefore ESM does not depend on memory recall (Csikszentmihalyi & Larson, 1987). An alternative to ESM is *DRM* - a retrospective/offline method that asks respondents to reconstruct the previous day by completing a structured self-administered questionnaire. The information is written in a diary and regroups *feelings, activities* and *circumnutates* (Kahneman et al., 2004). Regarding the critique that people are unable to remember situations in an accurate way, in the context of design research such accuracy seems less important: "what we remember might be different from what we experienced; however, as long as these memories are consistent over multiple recalls, they provide valuable information" (Karapanos et al., 2012).

In order to analyse data and to describe the temporality of experience (Karapanos et al., 2009) use DRM and gather 482 narratives from 6 individuals during 5 weeks of pre-use and use. They used (Strauss & Corbin, 1998) **Grounded theory** for a qualitative analysis of the narratives. We presented and discussed the results of this study before (see **Figure 45**).

In a recent study, researchers change the temporality of the recall. In order to increase participants' **effectiveness in reconstructing** product experiences, a graphing approach is proposed with **iScale tool** (Karapanos et al., 2010, 2012). iScale (**Figure 47**) measures the *usefulness, easy-of-use* and *innovativeness* of a product. The tool has two versions. **The constructive** iScale imposes a *chronological order* in the reconstruction of experiences. This approach increases the contextual cues and the affect. The **value-account** iScale starts with an *overview of the affect change over*

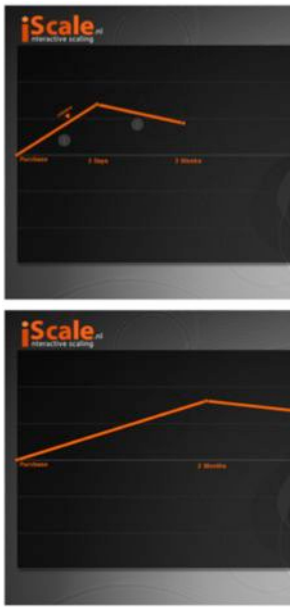


Figure 47 iScale tool by (Karapanos et al., 2012) → Top, *the constructive iScale* – the participants are asked to recount details once the line is drawn; Bottom, *the value-account iScale* – the participants draw the pattern of all the experience and then enter into details for each segment.

time. Then using the general shape of the recall, more details are provide for significant situations. (Karapanos et al, 2012) show that **the constructive iScale provided better assistance than the value-account iScale tool in the reconstruction process on and contextual cues.** This information is extremely valuable for the study of long-term experiences. It changes the perspective of longitudinal studies in which data have to be raised along the process to studies that focus on ways to remember an experience.

Longitudinal studies can be replaced by retrospective elicitation in product experience, and doing this in a chronological order, triggers both information and affect information from the participants. For this direction, memory theory is central.

Regarding the UX attributes, (Karapanos et al, 2012) study proposes three parameters to characterize the user experience: *usefulness,* the *easy-of-use* and the *innovativeness* of a product. Other researchers look at other variables and tools to characterize UX like *Affect & Emotion, Enjoyment, Fun, Aesthetics & Appeal, Hedonic quality, Engagement & Flow, Motivation, Enchantment, Frustration* as shown in (Bargas-avila & Hornbæk, 2011). The techniques used are mainly scale-based quantitative techniques. The products analysed are generally art projects, websites appealing, imagined products, interactive games (Bargas-avila & Hornbæk, 2011) etc. (E. Law, 2011) regroups different UX qualities and methods and make a critical analyses of empirical studies proposes by (Bargas-avila & Hornbæk, 2011) that we present in **Table 5**.

Table 5 Measures of UX attributes (adapted from (E. Law, 2011) and (Bargas-avila & Hornbæk, 2011))

UX attributes	Example of methods & tools
Generic UX	Interviews on the overall experience; use collage to express UX;
Affect	Self-Assessment Manikin (SAM);
Emotion	Heart rate, Eye-tracking, PrEmo, Differential Emotion Scale
Fun	Play categories; Coding on 'fun'
Aesthetics	Appealingness, Attractiveness, Visual aesthetics of web sites using scales
Hedonic	AttrakDiff
Flow	Flow State Scale (FSS)

These findings, both quantitative and qualitative, represent a valuable overview of UX dimensions and evaluation methods. Moreover it has been underlined that better results might be obtained using mixed-methods for empirical triangulation (E. Law, 2011; Roto et al., 2013). However few of these methods are tested in *real settings*. They are generally coming from psychology for in-situ studies. Or in-situ environments are fictitious; they

cannot simulate real settings and projects in which User Experience is created. Therefore **testing these methods in real situations seems to be a must for the understanding of the User Experience concept.**

Regarding the evaluation of the aesthetic experience, these methods are still normative and judgemental and correspond to the conceptual frameworks presented in the first part of the thesis. Within the UX evaluation methods, **the measurement of aesthetics rests in the field of visual aesthetics of webpages**. (Lavie & Tractinsky, 2004) uses a five items scale to measure *classical aesthetics* – orderly and clear design, and *expressive aesthetics* – creativity and originality by breaking design conventions, for web pages. (Lindgaard, Fernandes, Dudek, & Brown, 2006) suggests that web designers have about *50ms to make a good first impression*. (Noam Tractinsky, Cokhavi, Kirschenbaum, & Sharfi, 2006) confirms that the immediate aesthetic impressions of web pages are formed quickly and are remarkably consistent. For their study they use *attractiveness* ratings of webpages and they conclude that visual aesthetics plays an important role in users' evaluations of the IT artefacts.

Beyond the visual aesthetics and appearance, qualitative methods studying aesthetics and aesthetic experience come from the *design-based UX research camp* (E. Law, 2011). Frameworks from this community are generally looking at **experience as a whole.** They take into account a global **richness of the experience** that may be absent from quantitative measures. (Swallow, Blythe, & Wright, 2005) argues that quantitative approaches "may be useful for experimental analysis but they can miss some of the insights available in accounts that resist such reduction". The holistic qualitative community is using philosophical theories, design artefacts and case studies to understand how complex concepts like *imagination, daydreaming, ludic interactions, trust, complicated pleasures* influence the user experience.

With these in mind we conclude this part with several observations:

→ There is a growing interest in evaluating experience with products and the recent advancement coming from **psychology on memory theory are fundamentally improving design research**;

→ The **temporality of experience** seems to be a key in elucidating the quality of the UX. However this concept is generally studied in lab experiments and not in **real life situations**.

→ The quantitative methods on aesthetics and **aesthetic experience regard the aesthetic experience only in a narrow field** – i.e. aesthetics of web pages etc.

→ Moreover there is a lack of knowledge in how an **aesthetic experience is evolving over time.**

Memorability and transformative situations are definitely challenges in studying what makes a good experience. As Blythe et al. suggested: "Experience ties together *motivation, action, emotion and sense making* … **Experiences will be remembered and communicated;** imagined experiences are the ultimate drivers of our actions" (Blythe et al., 2009). In the same time more global approaches are needed to grasp the subjectivity and complexity of understanding, describing and generating aesthetic experience.

2.2.3 Holistic perspectives on Experience and Aesthetic Experience in Design

In this part we present the *design-based UX research camp* as (E. Law, 2011) describes the researchers proposing qualitative studies on experience. The holistic ideas and theories coming from phenomenology and philosophy "offer a valuable counterpoint to sequential cognitive models of the creation and appreciation of design products" (Cupchik & Hilscher, 2008). If **cognitive approach** looks at ease of use and how the ease-of-use produces automatic processes, **UX approach** looks at values, affect, emotions to study the experience with design situations, **the holistic approach** or experience design, is inversely related to automaticity and unconsciousness. Experience design is about *contemplation or awareness* of the design object itself, and of the actions involved in utilizing it. It is an *active involvement* that triggers "*imaginative openness* to novelty and fantasy" and *connectedness* with the design product that is manifested in *critical episodes* (Cupchik & Hilscher, 2008).

Using Dewey and Shusterman theoretical frameworks for understanding the aesthetic aspects of an experience, this part shows the encounter between pragmatic philosophy and design. It is within this space that the aesthetic experience finally appears - **Figure 48**. But what are the elements of an aesthetic experience developed in this space?

Shusterman describes the aesthetic experience as a mixture of "bodily sensation and an intellectual challenge ... connected to context, use and instrumentality ... prolonged beyond the immediate experience" (Shusterman, 2000). In order to explore these concepts in design, (Petersen, Iversen, & Krogh, 2004) coined the concept of **pragmatic aesthetics** in interaction design. Their framework consists in three aspects: *social-cultural aspects, instrumentality of the experience* and *mind & body interaction*. Like other researchers (Dunne, 2008) that talk about the *aesthetics of use rather than the aesthetic of the appearance*, Petersen et al. emphasize the fact that designing for aesthetic experiences invites people

to *actively participate* in creating sense and meaning. This approach is similar to *reflective beauty*, an intellectually driven process (Norman in (Blythe & Hassenzahl, 2004)) that differs from the *behavioural* (perceptually driven) and *visceral* (expectation driven).

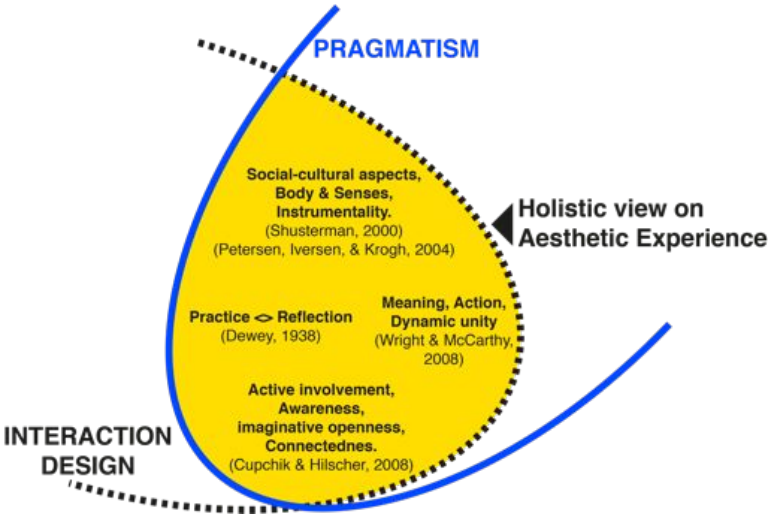


Figure 48 The holistic view on Experience and Aesthetic Experience

Besides these features, pragmatism emerges in the "construction of relations between artefact and viewer, subject and object, user and tool" (Wright & Mccarthy, 2008). Therefore an aesthetic experience connects action, meaning and settings as a whole. Following this perspective, we explain this concept following (McCarthy & Wright, 2007) definition:

> **In aesthetic experience, the lively integration of means and ends, meaning and movement, involving all our sensory and intellectual faculties is emotionally satisfying and fulfilling. Each act relates meaningfully to the total action and is felt by the experiencer to have a unity or a wholeness that is fulfilling**. ((McCarthy & Wright, 2007), p.58)

According (Wright & Mccarthy, 2008) there are **four threads** that characterise the meaning creation - *compositional, sensual, emotional, and spatio-temporal* and these threads are evolving dynamically within **six processes**. Moreover they also suggest **five sensibilities for enchantment** to underpin an empathic design process. We synthetize these elements in **Figure 49**.

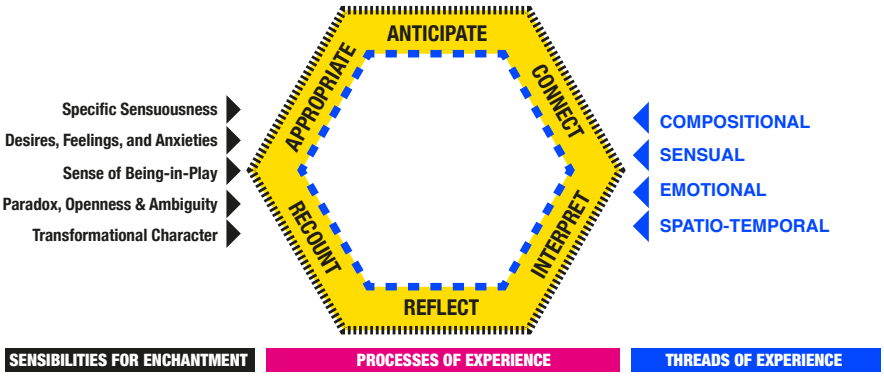


Figure 49 Aesthetic Experience sensibilities, processes & elements – a synthesis of (Wright & Mccarthy, 2008) pragmatist framework

Regarding Wright & McCarthy framework we have two observations. Firstly, there has been clearly stated within the pragmatic theory that aesthetic experience is *dynamic, that it evolves over time and that it goes beyond immediacy* (Shusterman, 2000). However there is no connection between the processes presented in **Figure 49** and the temporality of the experience. As we show in the previous section (2.2.2.2) findings coming from memory theory could give hints in understanding **the order of the processes** and their interference. For example the four temporal phases that describe how an experience evolve over time - *Anticipation, Orientation, Incorporation & Identification* (Karapanos et al., 2009) are similar with Wright & McCarthy six processes. An integration of both frameworks could better consolidate the holistic perspective.

Secondly, we also challenge the four elements proposed by (Wright & Mccarthy, 2008) and we propose three concepts: **narratives, mind & body interaction** and **discourse.** For example the *compositional thread* that refers to how people make sense of the relationships between the parts and the whole of an encounter, we propose another concept: ***narrative***. In a recent paper on Experience Design, Hassenzahl discusses the qualities of a good experience with products. He talks about the Philips Wake-Up Light that has the power to 'transcend its encasing', due to the fact that it creates meaning, a story that emerges "from the dialogue of a person with her or his world through action"(Hassenzahl, 2013). Therefore the experience is not only sense making, but also *an imagination exercise* seen as a dialogue between the person and the object. Dunne is talking about the purpose of design to imagine possible and impossible futures and *to extend people's mind* through aesthetic interaction (Dunne, 2008).

Figure 50 O*bject for seeing the world in detail – usage of the object* by **Philippe Ramette** (1990)

Figure 50 shows how Philippe Ramette suggests a narrative through an image and a title. As he suggests "it's not the object that's important, it's the idea of a possible future use and *especially what that use is going to*

entail in terms of transformations"[5]. Following the same train of thoughts (Petersen, Iversen, & Krogh, 2004) argue that aesthetic interaction is not about conveying meaning and direction through uniform models; it is about "*triggering imagination, it is thought-provoking and encourages people to think differently*".

(Wang, 2009), for example, propose objects that show habits we are too ashamed to admit or illustrate irrational fears or anxieties we suffer from like a weighing machine that is telling "white lies" (**Figure 52**). The further back you stand on the scale, the lighter you become. The user can gradually move closer and closer to reality. These examples show how design situations open a space for discussion and encourages people to image new life scenarios. As characters of these scenarios objects become meaningful in people lives, triggers of rich and personal experiences.

Figure 52 *White Lies* (Wang, 2009)

To conclude on this aspect, we give a definition to the narrative dimension as following:

The narrative quality transports the user towards a space that elicit the imagination and that is connected to the user's imaginary. It is within this intersection between user's imagination and imaginary where meaning and stories are born and where subjectivity and appropriation have a potential to be developed.

Figure 51 Origami interface by HaYeon Yoo that translates the basic functions of a remote control into playful interactions. www.hayeonyoo.com

Furthermore, to the *sensual thread* we propose the term used by (Petersen et al., 2004): ***mind & body interaction***. The sensual thread is concerned with our sensory, bodily engagement with a situation. It refers more to how senses are excited in a specific moment without any intellectual challenge. However we showed before that within the pragmatic perspective *the bodily sensation* and *the intellectual exercise* are inseparable. In **Figure 51** we show an example of design in which interaction activates ludic activities. HaYeon Yoo's remote-control investigate curiosity, exploration and reflection while playing with the origami interface. Then, mind and body are mixed for playful and engaging experiences. Following Petersen et al. proposition, we settle the following definition:

The capacity of human beings to interact and create knowledge with the world through their bodies and senses.

Figure 53 Informative Art (Hallnäs & Redström, 2001).

Finally we also challenge the *spatio-temporal* thread. We argue that experience can also be described, understood, transmitted and

[5] Citation in the catalogue of the exposition Philippe Rammette (Xippas Gallery): http://xippas.com/en/i/artiste/philippe_ramette

encapsulated in a rational discourse. Therefore we propose the term ***discourse*** to grasp all the *objective facts and properties* of the experience. The object description and it contextualization might belong to this dimension. The awareness of discourse elements is important for the comprehension of how an object integrates our life and opens a space for dialogue and appropriation. With their concept *Slow technology*, Hallnäs and Redströ̈m present 'Informative art', an application that 'amplifies' the object by presenting information on the context (Hallnäs & Redström, 2001). **Figure 53** show several screens that do not have a decorative role. They enable visitors to get a clue on the place and the activities of people living or working in that specific room. Presenting such information could create a potential for a better understanding and resonance with the object and might reinforce the narrative potential of the experience. Consequently we present our definition on this third element of the aesthetic experience:

The discourse elements are the objective facts and properties of the experience within an object, a service or a socio-material situation.

Finally *the emotional thread* refers to "judgments that ascribe to other people and things an importance with respect to our (or their) needs and desires" (Wright & Mccarthy, 2008). However the authors do not describe the typology of emotions related to aesthetic experiences. From the psychological point of view (Csikszentmihalyi & Robinson, 1991) show that during an aesthetic experience *delight, joy, awe* appears.

Figure 54 *Tyrant* alarm clock (Wang, 2009).

Other researchers like (Fokkinga & Desmet, 2012) show how *negative emotions* could enrich an experience. Another design object by (Wang, 2009) is the "Tyrant" - **Figure 54**, an alarm clock that randomly shuffles through the contact list of one mobile and force the person to get up. The interest on such complex emotions is also claimed by (Dunne & Raby, 2001) that stress the importance of creating design situations that explore **complicated pleasures** like *loneliness, deception, paranoia, hopelessness, and lust* to bring awareness of technology experience. Other researchers like (W. Gaver et al., 2007) choose *ambiguity* to create rich and engaging experiences.

In this subsection, we identify that a holistic approach is suitable to study aesthetic experiences. We also settle for a definition and explained the structure of an aesthetic experience into four dimensions: *narrative, body & mind interaction, discourse elements* and *emotions*. However among all studies in design research few of them propose **a measurement tool** for observing and describing such a complex concept. Such a tool implies the characterization of the states of mind of a person living an aesthetic experience. The next section aims to create such a theoretical tool. In the

same way as Flow Experience is presented and measured in (Csikszentmihalyi, 2008), we found different sources that can be operationalized into a theoretical evaluation tool for observing and describing aesthetic experience.

2.2.4 Creating a theoretical tool to observe and describe Aesthetic Experiences

> The products we design are only a small part of this; they can be triggers for an experience, they may influence or even alter experiences, but they are not experiences themselves. The experience is created elsewhere - at a place beyond designers' complete control.
>
> **Now with Added Experience?** – M. Blythe, M. Hassenzahl, E. Law (2009)

For Csikszentmihalyi & Robinson, the aesthetic experience occurs when *information coming from an artwork interacts with information already stored in the viewer's mind.* It is within this conjunction that the **fusion process** begins and that the person experiences "a sudden expansion, a recombination, or ordering of previously accumulated information and emotional consequences" (Csikszentmihalyi & Robinson, 1991).

Within this process, Beardsley claims that there are **five recurrent themes** that describe this mental state (Beardsley, 1982). In order to attain such aesthetic experience one should experience at least three of these themes: *object focus, felt freedom, detached affect, active discovery* and *wholeness.* (Csikszentmihalyi & Robinson, 1991) draw a parallel between Beardsley conditions and Flow experience conditions: *merging of actions and awareness, control of actions, loss of ego, clear goals and feedback, autotelic nature* (1st & 2nd column of **Table 6**). These notions come from (Csikszentmihalyi, 1975) theory on optimal experiences. Csikszentmihalyi & Robinson conclude that there are similarities between these two types of experiences.

In addition to these two theories on experience, the discussion can be completed with Dewey's criteria for an Experience – 3rd column of **Table 6**. Within Dewey's conceptual model developed in the book "Art as experience", we find similar criteria with those presented before as following: *object focus*, *freedom*, *consciousness state*, *dynamicity, direction and action*, *internal integration*, *completeness, closure and fulfilment*, *locally satisfying but a struggle* and *name* (Dewey, 1934). We add the 3rd column of **Table 6** in order to have similar notions on the same line. For example, *Object focus* in Beardsley column is similar with *Object focus* in Dewey

column and *Merging of Action and Awareness* in Flow Csikszentmihalyi column. This table is a *theoretical* synthesis of Aesthetic Experiences. It describes the conditions of such experience coming from three theories.

In their study, (Csikszentmihalyi & Robinson, 1991) present also an empirical analysis of 57 museum professionals and their subjective experience with artworks. The results of this study bring more knowledge to the concept of aesthetic experience, and give a **first field-validated framework on aesthetic experiences**. This framework has four dimensions – four types responses that the museum professionals experienced with artworks: *the Perceptual response*, *the Emotional response*, *the Intellectual response* and *the Communicative response*. Though very exhaustive, these dimensions are not directly confronted with the theoretical synthesis researchers draw upon (i.e. **Table 6** – 1st & 2nd column). Therefore we integrate Csikszentmihalyi & Robinson findings with the theoretical conditions presented in **Table 6**.

Table 6 Comparison of three types of experiences: an Experience, the Aesthetic Experience, and the Flow Experience (a synthesis from (Csikszentmihalyi & Robinson, 1991) and (Dewey 1934, 36 – 60))

N°	**Aesthetic Experience** **Adapted by (Csikszentmihalyi & Robinson, 1991) from (Beardsley 1982, 288 – 289)**	**Flow Experience** **Adapted by (Csikszentmihalyi & Robinson, 1991) from (Csikszentmihalyi 1975, 38 - 48)**	**an Experience** **From (Dewey 1934, 36 – 60)**
1	OBJECT FOCUS: Attention fixed on intentional field	MERGING OF ACTIONS AND AWARENESS: Attention centered on activity	OBJECT FOCUS As opposite to distraction and dispersion
2	FELT FREEDOM: Release from concerns about past and future	LIMITATION OF STIMULUS FIELD: No awareness of past and future	FREEDOM: As opposite to tightness and to a submission to conventional practice
3	DETACHED AFFECT: Objects of interest set a distance emotionally	LOSS OF EGO: Loss of self-consciousness and transcendence of ego	CONSCIOUSNESS STATE: Ideas and emotions emerge as a conscious intent
4	ACTIVE DISCOVERY: Active exercise of powers to meet environmental challenges	CONTROL OF ACTIONS: Skills adequate to overcome challenges	WILL TO GO ON, DYNAMICITY, DIRECTION AND ACTION: As opposite humdrum it is about a continuous merging, movement and skills towards an internal integration
5	WHOLENESS: A sense of personal integration and self-expansion	CLEAR GOALS, CLEAR FEEDBACK	INTERNAL INTEGRATION & COMPLETENESS: Fulfillment reached through ordered and organized movement
6		AUTOTELIC NATURE: Does not need external rewards, intrinsically satisfying	EMOTIONAL TRANSFORMATION, LOCALLY SATISFYING BUT A STRUGGLE: There are several emotional states that might be savored with a special intensity or as struggle that creates drama.
7			NAME: The experience is nameable "that situation".
8			CLOSURE: It completes the total experience and that is the institution of felt harmony.
9			SELF - TRANSFORMATION: The experience transforms the person in a conscious and unique way.

Further on we detail these dimensions and propose a new theoretical framework of aesthetic experience in **Table 7**. The header of the table is built using Csikszentmihalyi & Robinson four dimensions and each dimension is translated into conditions coming from Beardsley and Dewey.

Within **the perceptual response,** the participants see an overall physicality and objecthood of the work (as opposite to reproductions in which this notion do not exist). They perceive something that is balanced, a particular form, harmony (not especially related to beauty), and conscience towards how things are made, wonder in front of perfection. We synthetize these notions into four conditions (see **Table 7** – 1st column) in which we incorporate the conditions *Wholeness & Integration* and *Freedom* from the previous table.

The emotional response describes the emotional connection, resonance between the participants and the artwork and also a personal interpretation and significance that evolves over time. Some of the participants are affected by works that surprise them. Others prefer familiar ones that bring comfort and nostalgia. Moreover the evolving aspect of this dimension emphasizes the importance of the *emotional intensity* over the emotional states (the positive and negative is less important than the emotional intensity that an artwork triggers in the viewer). This last aspect is translated in **Table 7** - 2nd column through the condition *Emotional transformation* that implies that there exist significant emotions and they evolve over time. *Personal associations & Resonance* and *Familiarity & Surprise* are other two conditions of the Emotional dimension.

The intellectual response is composed of two types of experiences: the experience of understanding and experience of imagining. *The experience of understanding* is manifested by willing to close an experience and to solve a questioning, a desire to get to the bottom, to figure a puzzle, or something related to a discovery that is difficult to grasp. This notion is also related to elucidating challenging situations and sometimes a sense of power raises when a particular questioning is solved.

Table 7 Aesthetic Experience framework – four dimensions and their conditions

I. PERCEPTUAL CONDITIONS [a]	II. EMOTIONAL CONDITIONS [a]	III. INTELLECTUAL CONDITIONS [a]	IV. COMMUNICATIVE CONDITIONS [a]
Physicality & Objecthood [a]	Familiarity & Surprise [a]	Will To Go On, Object Directness [a, b, c]	Dialogue Over Time [a]
Balance & Harmony [a]	Personal associations & Resonance [a]	Overpass Challenges & Solve problems [a, b, c]	Connectivity Work, Context & Artist [a]
Wholeness & Integration [a, b, c]	Emotional Transformation [a, c]	Imagination & Openness [a]	
Felt Freedom [a, b, c]			

a (Csikszentmihalyi & Robinson 1991, p. 27 – 71),
b (Beardsley 1982, p. 288 – 289)
c (Dewey 1934, p. 36 – 60)

The conditions related to this type of experience are *Will to go on & Object directness*, *Overpass challenges & Solve problems*. The *experience of imagining* is attained when participants have a feeling of bottomless, an openness that leads to different interpretations. This phenomenon is an exercise of imagination and appropriation and we propose *Imagination & Openness* condition for this experience (3rd column of **Table 7**).

Finally, **the communicative response** gathers participants desire to relate with the works, the artists and their time. It is a temporal construction of a dialogue, a change of thoughts that occurs over time upon several exposures to the work. This last dimension is context related and therefore we propose two conditions in 4th column of **Table 7**: *Dialogue over time* and *Connectivity Work, Context & Artist*.

Table 7 synthetises the states of mind a person living an aesthetic experience. These conditions are grouped into four dimensions, *Perceptual, Emotional, Intellectual and Communicative*. In order to observe Aesthetic Experience these responses could **guide us to identify if an experience *is* or *is not* an aesthetic experience**. Furthermore as some researchers claim, "the aesthetic experience takes place mainly outside awareness" and therefore "it can be observed only indirectly... reported after the fact" (Sandelands & Buckner, 1989). Our table could be transformed in a tool to observe if a certain situation is or is not an aesthetic experience after the fact, through retrospection. In order to strengthen this direction, the recent studies on User Experience and Memory Theory could be valuable.

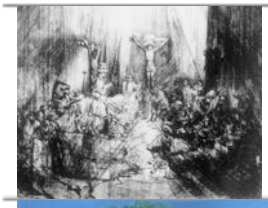
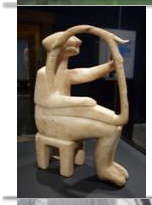
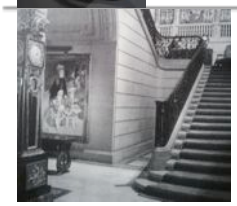
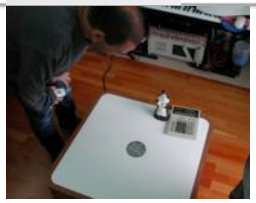
In another train of thoughts, even if these notions are coming from an art-related study, this tool could be used also outside this environment. This context is not a constraint. As Dewey suggests an aesthetic experience might happen during eating a meal or playing chess or taking part of a political campaign (Dewey, 1934).

Building this theoretical tool conclude the last part of this section on **The Aesthetic Experience and the aesthetic of living an Experience** (2.2). In this section we identify among the different theories studying Aesthetics the holistic perspective to understand this concept. Using this approach we settle definitions, characterise its structure and propose a theoretical tool to observe such phenomenon.

We end this section with a final table of examples that correlates artworks, design objects with the state of mind presented before (**Table 8**). The artworks are taken from (Csikszentmihalyi & Robinson, 1991) as examples of how certain paintings trigger specific feelings. To these examples we also add design objects.

This table could have been a part of **Annexes**. However we found that its evocative power could bring more clarity to the subject of our discussion. Moreover the goal of this table is also to show that **design objects** *and not only artworks can trigger aesthetic experiences.* This ideas also underlines that aesthetic experiences can also appear in other contexts, in everyday life, with everyday objects.

Table 8 Examples of artworks and design objects that trigger aesthetic feelings.

Paintings	Design objects	Feelings and states of mind
		((Csikszentmihalyi & Robinson, 1991), p.xviii) chose Turner's *Longship Lighthouse Land's End* to express a evident **exhilaration of people in front seeing or hearing something beautiful**, and also how little we know about this response. From design culture, we chose Ron Arad's *Bodyguard chair* that creates the same feeling of awn in how light and metal create a magical structure.
		((Csikszentmihalyi & Robinson, 1991), p.72) chose Hopper's *Nighthawks* to suggest one of the most important characteristics of an aesthetic experience: that it **stimulate fantasy and imaginative reflection**. We chose Dunne & Raby's *Faraday chair* that shelter from electromagnetic fields invading our homes and suggest alternative realities, a new place to live and dream.
		((Csikszentmihalyi & Robinson, 1991), p.26) chose Rembrandt's *The Three Crosses* to suggest that sometimes **people are impressed by the technical assurance of the drawing**. We chose Theo Jansen's *Bio-mechanical perfection* that impress through his structural complexity and the artist's imagination and creativity.
		((Csikszentmihalyi & Robinson, 1991), p.116) chose to talk about how aesthetic encounter makes people **understand aspects of quality of live and connection to the world**. We chose Jurgen Bay's *Tree-Trunk Bench* that is a manifest that triggers reflection on natural resources and consummation as only the chair backs are for sale.
		((Csikszentmihalyi & Robinson, 1991), p.177) chose to show the Cycladic Harpist to suggest that the **knowledge of the historical and cultural context are important**. We chose to show Gerrit Rietveld's *Red Blue Chair* that is today a symbol of modernism and an aesthetic encounter for each designer.
		((Csikszentmihalyi & Robinson, 1991), p.138) chose the view of staircase with *Régulateur and Renoir's Mother with Children* to emphasize the influence of context within the experience. We chose Gaver's *Drift Table* to show how **context and usage trigger for intimate relations with the design object**. This table displays aerial photography controlled by the distribution of weight on its surface.

2.2.5 Conclusion of the second part

With the growth of the importance of the **Experience** concept in design research, we enter a new era of consuming and designing products. This new economy - experience economy (Pine & Gilmore, 1998) involves **designing meaning, time and activities** (Blythe et al., 2009). Moreover we are living with commodities so intimate and subtle that go beyond their functional and symbol nature towards a tight relation with *true selves* ((Zizek, 2009) in (Blythe et al., 2009)). In this context, studying the aesthetics of living and the subjective qualities of our relations with our environment become conditions of our existences. After all, aesthetics is "a basic requirement for civilized life"(Gropius, 1956).

This section draws an overview of different theories, frameworks and methods to describe, analyse and generate **extra-ordinary, memorable, transformative** situations. The knowledge coming from User Experience field create a solid base for approaching and evaluating this concept. Among these studies the recent protocols of UX evaluation based on memory theory show remarkable results: **experience evolves in temporal phases** (Karapanos et al., 2009) **and it can be evaluated using retrospective elicitation** (Kahneman et al., 2004; Karapanos et al., 2012). Regarding the aesthetic of living an experience, pragmatic philosophy proposes a holistic view on the subject. Aesthetic experience involves **sensory and intellectual faculties, have a narrative potential that is created as an integration of meaning and movement** (Petersen et al., 2004; Wright & Mccarthy, 2008). Regarding **the states of mind of a person** having such experiences, (Csikszentmihalyi & Robinson, 1991) study is one of the most complete research on the subject. Both their protocol and results consist a solid base for studying aesthetic experience in other contexts. From this study we create **a theoretical tool to observe and describe aesthetic experiences**.

Beside the role of aesthetics for the final user, (Ross & Wensveen, 2010) suggest that "aesthetics can be a **powerful design driver** that helps connect dynamic form, social and ethical aspects". Moreover notions like empathy and subjectivity are already used by researchers to inspire and bring awareness of the human complexity in the design process (W. W. Gaver, Boucher, Pennington, & Walker, 2004; Mattelmäki, C, & Helsinki, 2002). The next chapter explores notions of subjectivity, aesthetics in other fields and environments and focuses on how this concept is related to the design process and organization culture.

Synthesis of Section 2 of the State of the Art (§2.2 in **Figure 26**):

Experience is a new concept that has the attention of economy, psychology and design. It focuses on **the quality of living a situation from a subjective perspective**. We briefly define an Experience as a **memorable and transformative** situation that is **developed over time**.

To capture the transformative and memorable character of User experience, design research adapts results from psychology and uses **retrospective elicitation** to understand how an experience with a product is evolving over time.

Regarding the Aesthetic Experience, we define it using a holistic perspective coming from pragmatic philosophy. An Aesthetic Experience is an Experience having **sensory and intellectual faculties, a narrative potential** that is created as an integration of **meaning and movement through interaction.** The products having such characteristics come mostly from interaction design.

To study Aesthetic Experience we focus on the **characterisation of the states of mind** that a person has during the aesthetic encounter. These states of mind have four dimensions: **perceptual, emotional, intellectual and communicative** and each of them is elicited through identified conditions.

2.3 Design, work & feelings – aesthetics in work and the innovation culture

In this part we present the concept of Aesthetics in other fields and environments and studied by other disciplines like *management science or sociology* (see **Figure 55**). Organizational Aesthetics is a recent topic in these disciplines and it shows two perspectives. The first one - **Aesthetics in Organizations,** focuses on the **aesthetic artefact** (an artwork placed in organizations). Other perspectives describe the **aesthetic feelings** in work. This topic opens a new direction and new roles for subjectivity and aesthetic experience in working environments.

Looking at the entities that interact within organizations, further on we integrate in our analysis other objects that are nor artistic, nor categorised as aesthetic objects. The second part - **Design & Collaboration** presents *intermediary objects, probes, boundary objects* - tools and techniques used to support *collaboration and coordination* in the design process. Moreover, these objects are *analysers of the organizational environment*; they are *representations of the relations between the actors of innovation* and they also bring a degree of *subjectivity in the design process.*

Finally, in the third part - **Design and innovation culture** we tackle a new role of design as a vector of change through the subjective perspective presented before. We also focus on the notion of *innovation culture* and we show how design contributes to this concept through its tools and methods.

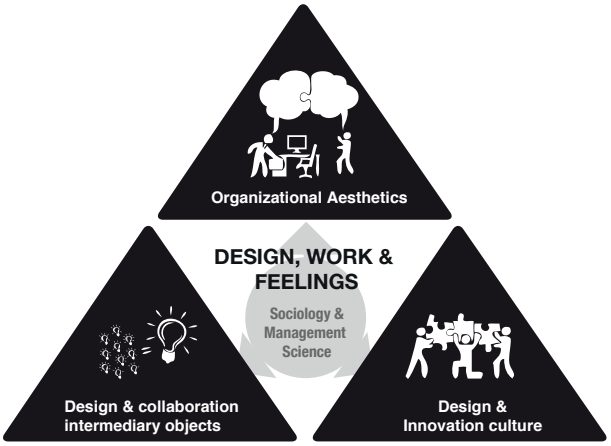


Figure 55 A representation of the three parts of the section **Design, work & feelings**.

2.3.1 Aesthetics in organizations

> What has been discussed as a psychology of art is no less a psychology of work. Aesthetics experience is not confined to art but is potential in any kind of activity.
>
> Of Art and Work: Aesthetic Experience and the Psychology of Work Feelings by *Sandelands & Buckner* (1989)

The conditions of aesthetic experiences are not the same than those related to power and wealth but they are more subtle criteria related to the quality of living: "the value of a person's life is determined more by the sum of experiences over time than by the sum of objective possessions or achievements"(Csikszentmihalyi & Robinson, 1991). Even if it is difficult to measure the impact of living such experiences, **the quality of work is examined in the field of design management**.

Hackman and Oldman showed that understanding how workers feel about their work is critical for the organizations that rely on motivation such as *research institutions and laboratories* (Hackman & Oldham, 1976). Furthermore (Csikszentmihalyi & LeFevre, 1989; Moneta, 2004) argue that *Flow experience* in work fosters *overall subjective well-being and performance*.

Other researchers talk about aesthetics in organisations and extend the analysis of beauty from art to social practices (Sandelands & Buckner, 1989; Strati, 1992). These studies analyse the perceived *meaning and order* in organisations and the impact of aesthetics for knowledge creation. In the study *Aesthetic understanding of organisational life*, Strati describes physical situations and objects - like office decorum. These objects become windows of the organization: they bring insights on the emotions and feelings that they arouse in the organisational culture (Strati, 1992). Even though these objects are not *aesthetic* in an artistic sense, people in organizations feel powerful emotions when interacting with these objects and environments.

In another study the author proposes **the aesthetic approach** to study organizations and introduces the concept of **the aesthetic artefact**:

> The aesthetic approach, actor network theory and the three strands of inquiry comprising workplace studies, cooperative learning and participatory design, therefore, all emphasise the importance of **the organizational artefact** in the everyday lives of organizations. **They stress symbolic interaction and the social and collective construction of reality**.(Strati, 2005)

Figure 56 *Garden for the New SOWI Building* by **Weinberger Lois** is a representation of the Iron Cage (University of Innsbruck, Austria) (Weiskopf, 2002).

Figure 57 Live performance the entrance to the University of Trento, Italy : *The Iron Cage* (*Top*) ; The installation used in the performance (*Bottom*) : *Density Spectrum Zone 1.0* by Loris Cecchini.

The organizational artefact changes status from *a tool* to *an actor in organizational dynamics*; these artefacts are "physical and tangible objects, … not static, immutable, and determinable once and for all" (Strati, 2005). What differentiates the other approaches of the aesthetic approach is the fact that the **aesthetic artefact** is studied in terms of **pathos.** Pathos is manifested in **practice** and opens a space for personal resonance and aesthetic potential: "sounds, body movements, and heterogeneous artefacts 'evoke' and stir the emotions by their beauty, ugliness, rhythm, style, and artistic language" (Strati, 2005).

In order to attain this level of pathos, Strati presents an example of an aesthetic artefact. It is a *performance* that enhances action, reflection and aesthetic thought in organizations. In order to create such an aesthetic artefact a *powerful metaphor* is chosen: the Iron Cage[6] - a reference to Max Weber sociological concept. The Iron Cage suggests capitalist order that demand to work hard and methodically (Swedberg, 2005) for "efficient production and the predictability of outcomes in the face of competitive market pressures" (Weiskopf, 2002). So as, to break this hostile environment, "to fold" the metal, sociology and organization sciences suggests a *folding of the iron cage through aesthetics* (see **Figure 56** for a representation of the Iron Cage). As (Weiskopf, 2002) argues "an aesthetic of folding attempts to shift attention to **the creative process of organizing**, which happens always on the boundary[7]. It positions organizational actors in a field of tensions from which **experiences and possibilities of creative re-formation arise**". Therefore the aesthetic experience is a way to decompose the image and representation of the Iron Cage in organizations into a house of fantasy and desire.

In (Strati, 2005) case study, the performance is an ephemeral organizational artefact (**Figure 57**) exposed at the entrance of the Faculty. Strati shows the influence of such artistic performance inside the laboratory: how people constructed it, how it provoked professional jealousies once the performance grown from a minor event and finally how press reported this artefact as an one-dimensional 'performance' artefact rather than the experience of the Iron Cage concept.

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[6] There are different interpretations for this concept. For 'The Max Weber Dictionary' (Swedberg, 2005) "the word is suggests a prison that is impossible to break out of". Later came other translations on the concept: 'a shell as hard as steel', 'carapace' or 'cloak' that protects an inside form the dangers of a hostile outside (Weiskopf, 2002).

[7] Boundary as a frame: "Organizations, individuals or other entities are surrounded by boundaries. The role of the boundary, in this case is to hold together, what is supposed to belong together…The function of the boundary is to mark off, to hold together, etc. unities that are given and derive their meaning and self-identity from intrinsic characteristics…This concept of the boundary is maintained even when organizations are constructed as "open systems" … in which the boundary is seen and conceptualized as permeable" (Weiskopf, 2002).

Regarding the uncomfortable and complicated feelings that such a artwork might trigger in organizational environments, (Weiskopf, 2002) underlines that "organizational aesthetics do not constitute an imaginary terrain of peace, harmony and love. On the contrary, ... *they are subject to social conflict in organizations, to the violence of corporate cultures and to the power of dominant coalitions in organizational life*". Therefore aesthetics in working environments are activators of certain awareness and consciousness.

Other researchers like Sandelands and Buckner have other approaches to introduce aesthetics in organizations and study **the feelings** related to work. They claim that aesthetic experiences in work bring *personal growth and development* for the organisation employees. The researchers suggest preparing and encouraging for those doing the work to appreciate its aesthetic possibilities - transcendence, transformation etc., and to assume *an aesthetic attitude* rather than instrumental attitude toward the work. As there are courses on art appreciation, why not courses on work appreciation. Awareness and consciousness are first steps towards the aesthetic encounter (Sandelands & Buckner, 1989).

This double perspective on aesthetics raises two questions: one on the **aesthetic artefact** and its properties, and other on the **aesthetic feelings**. The first perspective studies how the insertion of aesthetic artefacts within organizations triggers an aesthetic experience. One can ask, *are only artistic objects triggering such experience*? For example, do other artefacts made by designers like **prototypes, intermediary objects have an experiential and aesthetic potential?** On the other hand, regarding the second perspective that studies feelings *of work*, **no study actually describes the aesthetic states of mind in this environment**. **Is the working experience similar with an aesthetic experience people have in museum for example? What are the states of mind that overlap and what are particularities of aesthetics in work?** The next part shows an overview of different design tools used in the process and in organizations and shows a recent movement of these techniques towards experience and subjectivity.

2.3.2 Design & collaboration

As design researchers, and due to the professional nature of this PhD, we are particularity interested in the influence of design practices entering R&D departments. Thirty years ago N. Cross discussed the impact of design culture, the *Design with a capital D,* and how it is badly served by its intellectual leaders to interact with other cultures such as the scientific culture (Cross, 1982). As design enters corporations and research laboratories, we are interested in understanding *how the cognitive and*

creative abilities of designers trigger new forms of interaction for multidisciplinary teams. These interactions contribute to *living stories* and *influence the way projects and activities are lived and remembered*. For this goal we are going to discuss different tools and methods already used in the design process called intermediate representations and objects.

2.3.2.1 Design & co-design

With the growth in importance of notions like experience, emotion and subjectivity, (E. B. Sanders, Stappers, & Ave, 2008) argue that design practices are changing (**Figure 58**). The authors plead for a collective creativity in the design process that brings all the stakeholders to rethink their methodology and tools. The goal of this collective creativity is "to provide **alternative learning experiences** and curricula for those who are designing and building scaffolds". In order to achieve this role, Sanders et al. propose **co-design** or **participatory design** – a practice that includes users and other stakeholders of the innovation process.

The traditional design disciplines focus on the **designing of** "products".	. . . . . while the emerging design disciplines focus on **designing for** a purpose
visual communication design interior space design product design information design architecture planning	design for experiencing design for emotion design for interacting design for sustainability design for serving design for transforming

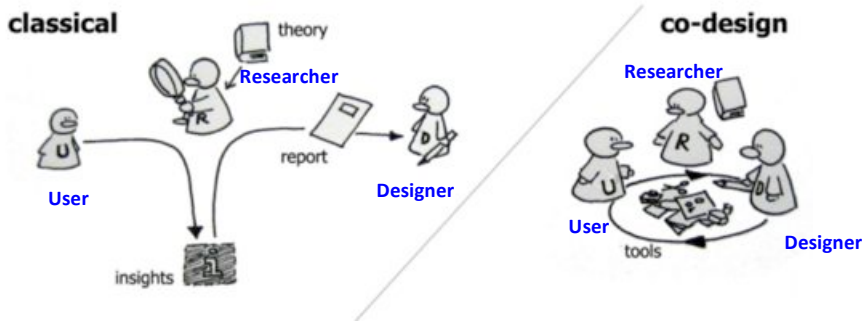


Figure 58 A snapshot in time and organization of traditional and emerging design practices (E. B. Sanders et al., 2008)

The goal of this approach is to incite cultural exchange in information and experience: *disciplinary culture, company culture, ethnic culture, worldview, etc.* and to create "new co-design languages that support and facilitate the many varieties of **cross-cultural communication**".(E. B. Sanders et al., 2008). (E. B. Sanders, Brandt, Binder, & Ave, 2010)

framework provides an overview of participatory design tools and techniques for engaging non-designers in specific participatory design activities (**Table 9**).

Table 9 Tools and techniques for participatory design from (E. B. Sanders et al., 2010, 2008)

Participatory design goals	Example of tools & techniques
Making tangible things	**2-D collages** using visual and verbal triggers on backgrounds with timelines, circles, etc. **2-D mappings** using visual and verbal components on patterned backgrounds **3-D mock-ups** using e.g. foam, clay, Legos or Velcro-modeling
Talking, telling and explaining	**Diaries** and daily logs through writing, drawing, blogs, photos, video, etc. **Cards** to organize, categorize and prioritize ideas. The cards may contain video snippets, incidents, signs, traces, moments, photos, domains, technologies, templates and what if provocations.
Acting, enacting and playing	**Game** boards and game pieces and rules for playing **Props** and **black boxes** **Participatory envisioning and enactment** by setting users in future situations **Improvisation** **Acting out, skits** and **play acting**

In a recent paper on the subject (E. B.-N. Sanders & Westerlund, 2011) introduce a new concept **co-design space**. If **Table 9** regroups techniques and tools mostly object-focus (like cards, collages, mock-ups etc.) and activities (games, acting out etc.) the co-design space is an **experiential physical space** (**Figure 59**)**.** For this concept, architecture and furniture are chose to create a *co-designing experience* to solve several issues identified as problematic: too much time is spent on one early idea instead of exploring many possibilities, the fact people do not feel creative and they think that they have insufficient knowledge on the subject. With this final example co-design is enlarging its scope towards *crafting experiencing in the design process for knowledge transmission and for supporting creative practice*. Moreover the co-design space is "a mirror of the *conceptual co-design* spaces and afforded the visual display of the artefacts that were produced and discussed along the journey" (E. B.-N. Sanders & Westerlund, 2011).

Figure 59 Images of a co-design physical space (E. B.-N. Sanders & Westerlund, 2011)

Another core of literature in the design research is focused on the *tools that help the design process to progress as planned*. This community, focusing on solution oriented processes, test a particular hypothesis or solve a given problem (Eckert & Boujut, 2003). On the other side recent publication reveal the value of unstandardized approaches that observe the design process from an ethnographic and holistic point of view (C. P. Lee, 2007). The next part presents these tools and their roles in the design process.

2.3.2.2 Collaboration & cooperation in design process: from solution-oriented to unstandardized approaches

Solution-oriented design process looks at the design activity as a structured activity. Being in a cognitive process but also in action (Mer, Jeantet, & Tichkiewitch, 1995), the designer solves problems related to the collaboration in a multidisciplinary team and invents new ways, tools and methods to share, discuss and create ideas. Mer et al. presents the role of such tools that they call **intermediary objects**[8]. This notion that becomes a concept in design research (Boujut & Blanco, 2003) is close related to other concepts like **boundary objects**[9] and **prototypes** (C. P. Lee, 2007; Subrahmanian et al., 2003) or **intermediate representations** (Bouchard et al., 2005). Other tools like **probes**[10](B. Gaver, Dunne, & Pacenti, 1999; W. W. Gaver et al., 2004; Hutchinson et al., 2003; Mattelmäki et al., 2002; Paulos & Jenkins, 2005) suggest that *ambiguity and uncertainty* could enrich the design process and open spaces for inspiring conceptual exploration. Further on we present these concepts and emphasize their roles and influence in the design process.

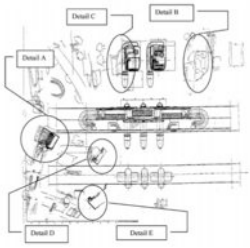


Figure 60 Detail of a sketch from (Boujut & Blanco, 2003). These design sketches are mostly related to mechanical pieces and engineering design.

Intermediary objects are hybrid objects created to model the reality toward the future product and in the same time they are a coordination material between the members of the design team (Mer et al., 1995). According to (Boujut & Blanco, 2003) there are three main features of intermediary objects.

A) Transformation or translation as a collective process. To gradually attend a common understanding, each actor materializes ideas and concepts. For Boujut & Blanco this cooperation is a process of disambiguation if it is properly framed. This materiality brings in judgments and activates decision processes. Sketches (**Figure 60**) are conjectures that allow fast evaluation. In the same time they open a *'cognitive trap'*: they crystallise features of the future product and, by this, they create irreversibility in the process (Boujut & Blanco, 2003).

B) Mediation between the actors involved in the process: the object acts as a prescription from one actor to another. The mediation can be open or closed. *Open objects* encourage the divergence and the interpretation and they could be used as inspirational material. *The closed objects* are used to inform, to present or to prescript a task or other specifications (Mer et al., 1995). Depending on the transparency degree between the idea and the object there are two types of objects:

[8] The concept is coined by Vinck & Jeantet in 1995.

[9] The concept is coined by Star in 1989.

[10] The concept of 'probe' in design is coined by Gaver in 2000.

commissioners (idea = object) and *mediators* (the object changes the initial idea).

C) Representation: either representations of the product or of the design process (Gantt charts, planning, etc.), intermediate objects provide means but also limitations. Depending on *the phases* of the design process, intermediary objects focus activities and direction (Mer et al., 1995). In the first phase, they can be a material for *identification and presentation* - here one can use closed objects and commissioners. Along the process they can be used as a *coordination & communication* - commissioner objects, *creativity* – open objects, and *test and prototype*.

A similar concept with intermediary objects, are **intermediate representations**. In the design process, these representations are a mediation tool between mental representation and the world. (Bouchard et al., 2005) present such a tool - graphical cards. They show how these cards optimize the communication aspects in brainstorm sessions where the participants come from different corporations. Each profile involved in this activity creates a card. This card is a simple and graphical representation of the expertise in a particular field and the most recent innovation (see **Figure 61**). The use of this support introduces two important aspects in the design process: *communication* between the persons involved in the creativity session and a tool that *stimulated the collective creativity*: "Cards have a playful effect, recognized for its efficiency during creative sessions involving sometimes conflictual debates between different corporations… The use of visual matter, such as illustrations and photographs, and of simple keywords, answered the need for very simple representations" (Bouchard et al., 2005).

Figure 61 Example of intermediary representation used as an input for the creativity session in car design

Within this category, Ideo Cards is another tool, mostly used by professionals. These cards are created for designers and they have two roles. They are *generative* as they support the creation of new ideas in a specific domain of activity. They are *evaluative* as they test the potential of a design solution for a better redefinition (Moggridge, 2007). Divided in four categories, "Learn", "See", "Ask" and "Try", Ideo Cards help designers to open themselves to other disciplines, from an egocentric perspective towards design ideas influenced by users and usage contexts (**Figure 62**).

Figure 62 Ideo Cards. Each card contains a textual description of a method, a brief example of its use and "an illustrative and sometimes whimsical image on the other side" ((Moggridge, 2007), p.669).

Regarding other properties of intermediary objects and representations some researchers argues that these tool should bring clarity in the design process (Bouchard et al., 2005; Boujut & Blanco, 2003; Stacey & Eckert, 2003). Bouchard et al. suggest that *cognitive consensus makes the organizational action easier* and social representations "aim to *organize, control* our environment and to build behaviours and

Figure 63 Cultural probe pack includes a small camera, a listening glass, a small solid state recorder packaged in a sleeve called 'dream recorder' etc. (photo by W. W. Gaver © 2001). Researchers criticize how cultural probes, that initially are designed for a specific project, become today *a pack* used as *a recipe* to rapidly gather data about people – i.e. as a substituent of ethnographic studies (Boehner et al., 2007).

Figure 64 Video Probe by (Hutchinson et al., 2003) is a technological probe. Here the probe is used to collect data of how people interact with future technology.

communications to *establish a common vision in any socio-cultural group*" (Bouchard et al., 2005). Stacey and Eckert claim that design research embraced ambiguity as a synonym of creativity, but there is no shared definition of what this notion really means and how it can be useful for creativity. For these scholars, ambiguity is synonym of *inadequate communication codes*, *provisionality and under-specifications* of intermediary objects. It "can lead to the discovery of useful alternative ideas" it is rarely proven as successful creativity technique (Stacey & Eckert, 2003). On the other side, ambiguity can *trigger dialogue and social interaction*, but this is a cost-effective operation as discussion takes time and resources. Other researches like (W. W. Gaver, Beaver, & Benford, 2003) describe *ambiguity and uncertainty as resources for design*. They suggest that ambiguity in the design process creates a space for *exploration, reflection and personal appropriation.*

Besides the solution-oriented techniques used in the design process like intermediary objects and representations, **probes** are instruments of dialogue between designers and future users that use ambiguity in the design process. As an alternative for ethnographic studies, questionnaires and interviews, probes are "*instruments that are deployed to find out about the unknown - to hopefully return with useful or interesting data*" (Hutchinson et al., 2003). **Cultural probes** are the first probes in design research. They are designed objects, physical packets containing *open-ended, provocative and oblique tasks that elicit personal and intimates responses from people* (**Figure 63**); once the probes are filled in they do not directly lead the design process but rather *inspire it* (B. Gaver et al., 1999).

Since Gaver et al.'s first paper on the concept, lots of other probes are created: **Urban Probes** - a provocative methodology "designed to rapidly deconstruct urban situations, reveal new opportunities for technology in urban spaces" (Paulos & Jenkins, 2005), **Technological Probes (Figure 64)** - a method that "collects information about the use and the users of the technology in a real-world setting" (Hutchinson et al., 2003), **Empathy probes** (Mattelmäki et al., 2002) etc.

In 2007 (Boehner, Vertesi, Sengers, & Dourish, 2007) analyse approximately 90 papers from ACM digital library related to the concept of probe. They criticise how design community used and adapted this concept since 1999 as *reproductive methods* – a ready to use kit, *data collection approaches* or *a ticket* to enter the design research community by using a 'design-y' concept that tells an original story. Boehner et al. underline the value of probes that lays into *the dialogical and interpretative* nature of these objects (see **Figure 63** legend). (Gaver et al., 1999) cultural probes are a manifest to include *unpredictability and*

ambiguity within the dialogue between designers and users. Therefore this approach is not so uncomfortable for communities that plead for finding the right answer, solve problems and express a need to establish clear and single interpretations. As Boehner et al. argues: the "discomfort with the corresponding value of uncertainty leads to an overwhelming desire for codifying a design approach into easily-reproducible" (Boehner et al., 2007). The concept of probe and the uptake of the design community to rationalize such subjective approached show the tension that still present in the design process related to methodologies for such openness. (W. W. Gaver et al., 2004) propose *probology* as an approach to encourage the design community to use uncertainty and subjectivity in the design process.

A concept that is situated between intermediate objects and cultural probes is **boundary objects**. These objects are "objects which are both *plastic* enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites… they have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation" (Star & Griesemer, 1989)**.** These objects are not necessarily representations of the future product.

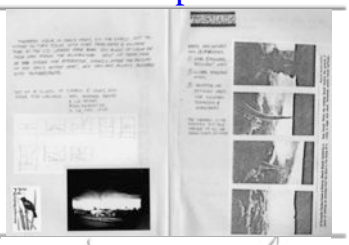
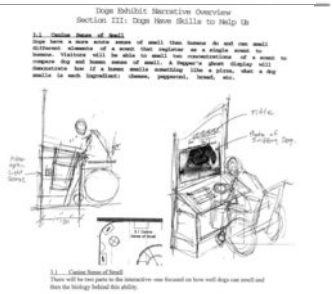
(C. P. Lee, 2007) builds another related concept: *boundary-negotiating artefacts.* These objects fail Star & Griesemer definition. They are *unstandardized, impartial and incomplete*, *fail to satisfy the informational needs of collaborating parties* and *act as negotiators* by establishing and destabilising protocol. Finally the boundary negotiating artefacts *push boundaries* rather than sailing them and appear in *a chaotic design process*. However the authors explains that this chaotic design process is *the real design process* with complex and non-routine collaborations. In a year-long ethnographic study of collaborative work, Lee finds four types of artefacts created for crossing and negotiating boundaries between communities of practice: *inclusion, compilation, structuring, and borrowing*. We synthesize this classification in **Table 10**. Rather than discussing new guidelines for the design process, this study conceptualizes valuable properties of boundary objects and how the actors of multidisciplinary projects create and use these artefacts. Consequently **its value goes beyond new protocols of collaborative work to a practitioner view and understanding of the collaborative work**.

Further on we underline the importance of intermediary objects for other roles and influence of design and design practises in organizations. Besides looking at how these objects bring solutions to a certain problem, a holistic view coming from social sciences gives a larger perspective on the subject. As (Boujut & Blanco, 2003) underlines, such view also comes in professional PhDs, where "PhD students spend long periods of time

immersed in design teams as designers. The advantage of this methodology lies in the fine descriptions of actual design practices while giving access to the design process in real world settings".

Hence, the researcher can understand other aspects of her work *in practice* and integrate them within a larger theoretical framework (Schon, 1984). The next part describes such framework and shows how **intermediary objects are actors and analysers of social interactions and activities** in organizations.

Table 10 Boundary negotiating artefacts - properties, roles and examples (from (Lee, 2007))

Boundary negotiating artefacts properties	Example
Self-explanation Private artefacts that sometimes are indirectly presented to others (for ex. journals). **Role:** *Artefacts are a tool for learning, remembering and reflecting.*	
Inclusion From self-explanation artefacts, some personal ideas are given form and are translated to others. Some of the inclusion artefacts are accepted by the community and become symbols in the project (for ex. a sketch of a concept). **Role:** *Artefacts are a tool for presenting, accepting and rejecting ideas.*	
Compilation These artefacts are used to develop a shared and mutually agreeable understanding of a problem and to pass crucial information from one community of practice to another. (for ex. a table that gather all the info on a subject). **Role:** *Artefacts are a tool for remembering, gathering, organizing, discussing.*	
Structuring These artefacts coordinate media and are also used to establish ordering principles, establish tenor in narrative forms, and to direct and coordinate the activity of others. (for ex. an exhibition narrative or concept maps). **Role:** *Artefacts are ordering, organizing, give orders and directions.*	
Borrowing Artefacts that are taken from the creator community and are used in unanticipated ways by another community of practice. This includes awareness and acceptance of both communities (for ex. a collage physical of self-exploration artefacts of others). **Role:** *Artefacts have to be properly shared and accepted to be used as material for others.*	

2.3.2.3 The intermediary object as a lens to look at organizations – a holistic view

Different studies underline the importance of *materiality* of things in social sciences (Vinck, 2009) and in Computer Supported Cooperative Work (CSCW) research (Eckert & Boujut, 2003). There is a tendency of *materialization of the methods and of the tools* in these fields for a better *order, structure and coordination* (Vinck, 1999, 2009). (Vinck, 2009) describes the use of intermediary objects (instruments, texts, representations etc.) in the network of *scientific cooperation* as:

- **Actors**: in order to describe and talk about scientific projects, researchers talk about objects. Therefore the intermediate object *is the 'thing' that materializes the scientific project*;
- Way to **map and qualify the relations** between all the actors and their activities: identifying and following intermediary objects permits *analysing and understating design and innovation*.
- **Representations**: intermediary objects represent not only a projection of a future something[11], an 'inscription' into reality. They also represent the people that create them. Consequently intermediary objects are *'traces' and 'markers' of the conditions of their making, their creators and of their relations*. Moreover intermediary objects are *commitments, projections of expectations* and *work-in-progress knowledge*. In a recent study, (Löwgren, 2013) coins the concept of *intermediate knowledge* and shows how *design research has the abilities to support collaborative practices by annotation and portfolio creation*.
- **Translations and transformations**: the materialization of ideas and concepts brings in transformations and translations that are neither controlled nor wanted. Vinck call these transformations *betrayals*. The matter that enters into action (representations, objects, materials, etc.) introduces *opacity* in the process. Also Blanco underlines that the ease with which *graphic representations are reproduced is a thread to the harmonious representation of a given object* due to the increased number of rival representations ((Blanco, 2003), p. 133).

[11] We present in section 1.3.2.1.2 the definition of intermediary objects for design practice. One of the two requirements for an object to be named intermediary object is the fact that it is a representation of a future design. Here (Vinck, 2009) opens the definition for larger communities of practice that use intermediary objects for scientific work.

(Vinck, 2009) also observes *the diversity of intermediary ob*jects for scientific cooperation. From texts and instruments to phantoms and animals, the roles identified in design (section 2.3.2.2) are enriched from a sociological perspective.

→ Intermediary objects (IOs) are operators that **change perspective** of the actors involved in the process;

→ IOs **mark the design process in its temporal dimension** (objects have different forms depending the phases of the process and they come and go through substituent forms and functions – they show how the representational language changes over time);

→ IOs are also frames for actions as they define, restrict and structure a space for action and focus people to look from a certain perspective. Blanco et al. also talk about **the quality of being an intermediary object**. They show how an object substitutes another - they are *ephemeral,* and how they *appear and disappear* in the organizational decorum.

Further on we focus our view on the concept, on the intermediary objects and knowledge created by **designers**. As intermediary objects are materialisations of a culture, the design outcomes are a representation of the **design culture**: "The disorderly accumulation of *physical objects* does, however reflect one of the characteristic features of this design office and its *design culture*. Indeed, each designer has a multitude of parts, samples and prototypes hidden in his drawers"(Blanco, 2003). And studying the design culture is a way of studying innovation. Different studies argue that design tools and methods *foster innovation* (Brown, 2009) or increase the *capacity of a company to innovate* (Masson, Weil, & Hatchuel, 2006). Among all the other disciplines of *Conception* (in French), design seems the vector that brings in new values in the design process and new business opportunities (Masson et al., 2006).

On the other hand, as we showed in this part, the recent intermediate knowledge and objects coming from design *are less solution oriented*. They bring in the design process **ambiguity and subjectivity** and adapt themselves to a milieu that is *chaotic and instable* (C. P. Lee, 2007). This direction resonates also to new approaches to innovation that takes place into *uncertain and risk-augmented* environments (Masson et al., 2006). It is design again, and a new Design Theory, that propose a larger perspective to take into consideration this *uncertainty* as a constraint and a characterisation of real situations in which innovation may occur. This new view that is no more focused on *decision-making* and *problem-solving*, but on *unexpected expansion and social-interaction* as described in (Hatchuel, 2001).

More than optimizing the design process, innovation is related to innovation capacity (Masson et al., 2006) and innovation culture (Brown, 2009). With this in mind, we present the last part of this section related to design, innovation culture and how this relation is created in organizations.

2.3.3 Design and innovation culture

In spring 2013, MIT Sloan Management Review published an article presenting a tool to measure the culture of innovation: **Innovation Quotient survey** (Rao & Weintraub, 2013). This survey contains six modules. Each module has three factors and each factor is composed of three elements with a survey question (**Table 11**). In total, Innovation Quotient survey has 54 questions to **measure the innovation culture of a company**. Rao & Weintraub also present several case studies and emphasize different strategies of companies to attain an innovation culture. Moreover they underline that *the way to innovation is not about having high scores in each of these modules* but rather identify areas of strength, weakness and inconsistency. They also give examples of successful companies that have a low score for some factors. However they do not give any classification or hierarchy of these modules, except that they call *Value, Behaviours* and *Climate* as *intangible, people-oriented blocks* and *Resources, Processes* and *Success* as *tangible, tool-oriented blocks.*

Table 11 Modules, factors and elements of the innovation culture (adapted from (Rao & Weintraub, 2013))

	Intangible (people-oriented blocks)			**Tangible** (tool-oriented blocks)		
MODULES	VALUES	BEHAVIORS	CLIMATE	RESOURCES	PROCESSES	SUCCESS
Factors & Elements	**Entrepreneurial** Hungry Ambiguity Action–oriented	**Energize** Inspire Challenge Model	**Collaboration** Community Diversity Teamwork	**People** Champions Experts Talent	**Ideate** Generate Filter Prioritize	**External** Customers Competitors Financial
	Creativity Imagination Autonomy Playful	**Engage** Coach Initiative Support	**Safety** Trust Integrity Openness	**Systems** Selection Communication Ecosystem	**Shape** Prototype Iterate Fail smart	**Enterprise** Purpose Discipline Capabilities
	Learning Curiosity Experiment Failure OK	**Enable** Influence Adapt Grit	**Simplicity** No bureaucracy Accountability Decision- making	**Projects** Time Money Space	**Capture** Flexibility Launch Scale	**Individual** Satisfaction Growth Reward

Other scholars, coming from Organization and Management science, define the **organizational culture** using other perspectives and reveal

more subtitle elements of the complex concept of *culture*. Schein this concept as following:

> **A pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems**. ((Schein, 2004), p.17).

But what are the manifestations of the organization culture? (Johnson, 1992) propose seven dimensions that define a cultural web that a manager can define in their organization (**Figure 65** - *Left*). This framework is a "cultural audit…, which helps to make explicit that which is taken for granted and to generate managerial debate about the cultural barriers".

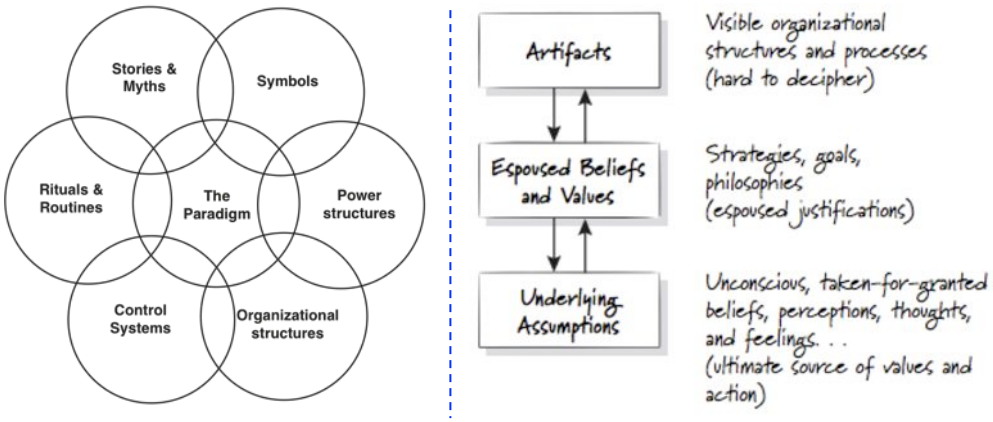


Figure 65 *Left*: The cultural web of an organization (Johnson, 1992); *Right*: Levels of Culture (Copyright © E. H. Schein)

Like (Rao & Weintraub, 2013), Johnson's framework does not give any classification of these dimensions. Some notions are *abstract and less visible* (i.e. paradigm, symbols, stories & myths) others are *more concrete and visible* (i.e. control systems, organizational structure). (Schein, 2004) present three levels of the organization culture that represent *the degree of manifestation of this culture* (**Figure 65** - *Right*). **Artefacts** level is the most *tangible and palpable* and regroups all type of phenomena that sees, hears, and feels in a culture[12].

Espoused beliefs and values are *assumptions about values, norms, ideologies, philosophies*, but also what is right or wrong, what will work or

[12] For example physical environment, language, all type of product and creation, dress-code, formal descriptions of how the organization works, and organization charts etc. but also myths and stories about the organization, observable rituals and ceremonies (Schein, 1990, 2004).

not work. These elements are explicitly articulated and serve as *normative or moral* function. The last level, the **basic underlying assumptions,** is less evident to grasp. "Through more intensive observation, through more focused questions, and through involving motivated members of the group in intensive self-analysis, one can seek out and decipher the *taken-for-granted, underlying, and usually unconscious assumptions* that determine perceptions, thought processes, feelings, and behavior"(Schein, 1990). Schein also shows the challenges to understanding these dimensions. The difficulty of the first two levels – *observable artefacts and espoused beliefs*, lies in the understanding the subjective relation between people and these elements. On the other hand basic assumptions are difficult to grasp due to their profoundness (Schein, 2004).

Figure 66 Ideo San Francisco studio. "At IDEO, we continue to create new spaces and work arrangements that invite inspiration, collaboration, and serendipity. Our spaces are ever-evolving prototypes" http://designthinking.ideo.com

From a design perspective, the influence of this discipline lays mostly in the first level of the organizational culture – **observable artefacts**. Design is about creating artefacts and tangible things. As Mat Hunter suggests designers are making "**ideas tangible, it takes abstract thoughts and inspirations and makes something concrete**"(Mat Hunter, 2010). (Cupchik & Hilscher, 2008) explain that the value of design is to create objectifications of lived experiences and embodiments of a culture.

In the same direction, Stappers claims that "the design act of creating prototypes it is in itself a potential generator of knowledge"(Stappers, 2007). These prototypes live and are part of the 'texture' of design labs (see **Figure 66**, **Figure 67**), and together with design studios, they influence and are influenced by researchers, students and visitors. Moreover the design prototypes are *physical hypothesis* for the innovation process. As described by (Masson et al., 2006) the today context of innovation is a uncertain and instable. Designers "ability to cope with unknowns" and adapt themselves to "terra incognita" is a response to this uncertainty and complexity (Stappers, 2007). A challenge in this direction for designers and design researchers is to understand *the impact of their work outside their design process and the design activity*. Stappers argues that there is a lack of literature on this matter and that designers are more interested in creating artefacts than in observing how these artefacts influence their environment and for the growth of knowledge.

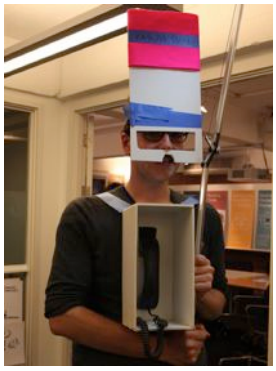


Figure 67 Prototyping culture at IDEO's London studio (Make-a-thon: Mixing makers, hackers, designers, and Open IDEOers)

> The act of creating prototypes is in itself a potential generator of knowledge (if only its insights do not 'disappear' into the prototype, but are fed back into the disciplinary and cross-disciplinary platforms that can fit these insights into the growth of theory).
>
> Stappers in **Design Research through Practice: From the Lab, Field, and Showroom** by Ilpo Koskinen, John Zimmerman, Thomas Binder, Johan Redstrom, Stephan Wensveen (2011), p. 60

From a practitioner experience, Tim Brown underlines the importance of **design culture** as an important contributor to the **innovation culture**

through its culture of prototypes, playfulness and users experience brought in the design process:

> Innovation has become nothing less than a survival strategy. It is, moreover, no longer limited to the introduction of new physical products but includes new sorts of processes, services, interactions, entertainment forms, and ways of communicating and collaborating… What is a prerequisite is an **environment—social but also spatial—in which people know they can experiment, take risks, and explore the full range of their faculties**.
>
> Change by design – Tim Brown (2009), p. 32

In order to measure the innovation culture (Brown, 2009) proposes indicators like *time to first prototype, number of skills including improvised acting, brainstorming, and prototyping, number of physical spaces and prototyping environments.* Within companies designers' role are more complex than creating future products. **It is not the object of the design creation that is important but the changes that this object makes in an organization, what it brings in and what it teaches and finally what experience brings in the process**.

Moreover different researchers look at how design fosters an innovation culture. (Mozota, 2010) present a value model for design to fosters innovation as *a differentiator, integrator, transformer* and *design as a good business.* As Law suggested in 2011 in talking about the User Experience factors in organizations: "an organizational culture is a UX factor that may (strongly) influence individual as well as social experiences with a groupware".

Therefore understanding what design brings into corporations as a culture might contribute to **quantify the value of design** and to **measure its relation to innovation**. Through their *physical hypothesis* (Stappers, 2007), *tangible outcomes* (Mat Hunter, 2010), intermediary objects and through their activity as *reflective practitioners* (Schon, 1984), designers bring in new ways for collaboration and influence organizational culture. They unbind routine and embrace chaos in real project situations (C. P. Lee, 2007). These characteristics are similar to the **aesthetic approach** presented in the first part of this section. The difference however is that the *aesthetic artefact is now the design object.* It is not a finalized object but an intermediary object. Both these objects have a force to change the environment - they are *transformative*. Both bring a new *perspective* and incite to *symbolic interactions* from which results new meaning in action. And as the capacity of a company to innovate is more than its potential to create new products, but also about creating *new values*, and *to expend propositions and existent concepts*, these design objects and the experience that they create for the actors of innovation seem to be, in context of today, the direction to follow.

2.3.4 Conclusion of the third part

The third part of the state of the art looks at aesthetics in organizations from the perspective of the *aesthetic artefact* and that of *the aesthetic quality of work*. The aesthetic artefact is usually an artistic installation that has the role to ask questions and to create a transcendental dialogue with workers. *The aesthetic quality of work* is about the feelings of people described as responses to job perception - experiential aspects *of work*. Both these perspective are subversive for the efficiency and productivity-focused approaches in work. However *organizational aesthetics do not describe in detail the aesthetic feelings of work*, but rather directly refer as the same feelings coming from artistic judgement. Few studies show similarities of the aesthetic experience in work and the 'generic' way of describing aesthetic encounter - as we saw in the second part of the state of the art (2.2).

From the artefact point of view, we look at other objects – tools and methods, which are used in collaborative and cooperation environments. We describe concepts such as *intermediary objects and representations, probes, boundary objects*. These elements whether solve solutions or bring in the design process subjectivity, ambiguity and reflection. They are also descriptors of the design activity in action. These artefacts have different roles and influences: they *represent* and *transform* the actors of innovation and they *trigger social interactions*. Consequently one could question **the aesthetic and experiential aspect of these artefacts**. As presented in the second part of this manuscript, *an experience is about creating transformative, extra-ordinary situations in action*. Some of these intermediary objects have such aspects. However little literature discusses these aspects through the lens of the aesthetic experience. This subsection shows the complexity of design artefacts and their transformative power in organizations.

Finally, the third subsection looks at innovation and organizational culture. By presenting different models of innovation and organizational culture, we emphasize the role of design as **an objectifier** of culture. The *design artefact is a lens to observe and understand this culture through the form of physical hypothesis*. Moreover designers' ability to cope with the unknown brings in the collaborative design process new tools and methods. From a solution-oriented approach, design becomes today a vector of innovation: **its flexibility and adaptation in action and the tangibility of its outcomes are important requirement for the tomorrow products and services**. Besides, for the actors of innovation, recent activities like participatory design introduce in the process engagement and new collective experiences.

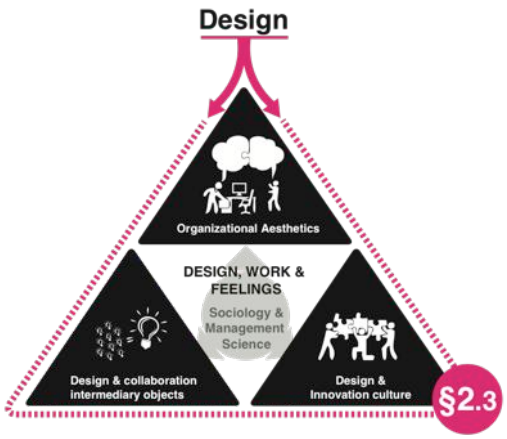
Synthesis of Section 3 of the State of the Art (§2.3 in **Figure 26**):

Aesthetics in organizations are studied through the perspective of the *aesthetic artefact* and that of *the aesthetic quality of work*. These directions propose an alternative view on the working process, usually studied for its *efficiency* and *production optimisation*.

In design, and more globally in organizations, **intermediary objects** have a complex role and strongly influence the collaborative process and the organisation culture. They have **transformative power** that is **manifested in action** and they are **temporal and space markers** of the design activity.

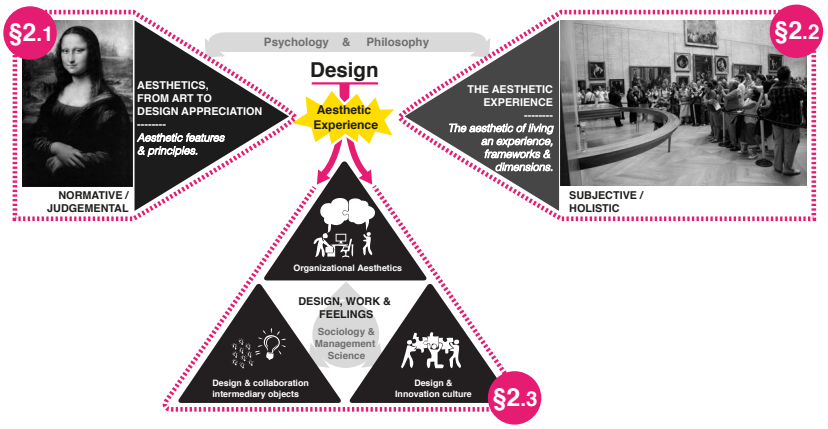
Design artefacts are a lens to look at the organization culture and in the same time they influence the innovation culture as **physical hypothesis.**

In the context of today innovation, in which uncertainty and instability are general constraints, design becomes a major actor of innovation due to its **ability to cope with the unknown**. It also brings for the actors of innovation **new collective experiences** through its *tools and methods for collaboration*.



2.4 Conclusions of the state of the art and topic positioning

Chapter 2 represents the State of the art of this thesis. From the first observations coming from the Context (**Chapter 1**), the experience of a *design practitioner*, and the round explorations between theory and action of *Research-Action approach*, we identified themes and concepts that we organize in three parts of this state of the art: *Aesthetics - from art to design appreciation*, *The aesthetic experience and Design, work and feelings*. This construction also comes from the experience built up in the Alcatel-Lucent Bell Labs projects during the first two years of this research project. The reader will discover this knowledge in practice in the Empirical study, section Pre-Experimentation (**Chapter 4**.1.). Before that, we sum up the knowledge of the State of the Art and we create a topic positioning for the next chapter - Research Question & Hypotheses (**Chapter 3**).



Recall **Figure 26**: The representation of the three parts of the state of the art.

The first section (§2.1) focuses on the concept of **aesthetics** and more precisely on the **aesthetic appreciation**. Psychology offers objective models to understand beauty perception: the *information-processing model* of (Leder et al., 2004), (D. A. Norman, 2004a) *three levels of beauty perception* and (Parsons, 1989) *five stages of artwork appreciation development*. These models show that the aesthetic appreciation depends on the **aesthetic features** that are perceived, **the context** of the artwork, **the maturity of the viewer** in aesthetic appreciation, **the attitude** in the moment of the appreciation etc. Some of these aspects are also studied *in design* through the creation and validation of *aesthetic features and principles* (Hekkert, 2006) and *Kansei properties* (Carole Bouchard, Mantelet, Aoussat, et al., 2009). These principles are rules to follow in order to link users' aesthetic preferences with products properties.

However, new directions in design show that the transgression of these principles and rules might lead to rich aesthetic responses for products. With the birth of interaction design and HCI, aesthetics is studied in relation with *usability and usage*. Findings show that there is a tight connection between *beauty, goodness and usability.* Moreover beauty in HCI opens a new field that is not focusing on the appearance of the product but on *qualities of interactions. Poetic, expressive, magical interactions* and *interactivity attributes* are first attempts to create a language in interaction design. As the aesthetic principles, this view on aesthetics is contested in design research due to its too narrow lens on studying such complex concept. Besides this critique, the birth of User Experience and Experience Design, propose new frameworks to understand and apply aesthetics in design research. We present this knowledge in the second part of the state of the art.

The second section (§2.2) draws an overview on different theories, frameworks and methods to describe, analyse and generate experiences – defined as an **extra-ordinary, memorable, transformative situations.** We also show first holistic approaches to study the aesthetic experience both as theoretical concept as a design framework.

Among these studies the recent protocols of UX evaluation based on *memory theory* show remarkable results: **experience evolves in different temporal phases** (Karapanos et al., 2009) and it can be evaluated using **retrospective elicitation** (Kahneman et al., 2004; Karapanos et al., 2012). Regarding the UX evaluation methods of aesthetics and aesthetic experience, we identify a lack of knowledge of these notions in terms of *definition* and *evolution over time*.

Pragmatic philosophy adapted to design proposes first frameworks to study the aesthetics of living an experience, as a quality of the experience. Aesthetic experience **involves sensory and intellectual faculties, have a narrative potential that is created as an integration of meaning and movement** (Petersen et al., 2004; Wright & Mccarthy, 2008). From this perspective we show the limitations of these studies and we propose first **dimensions** of the concept: **narratives, mind & body interaction, discourse and emotions**. Regarding the evaluation of the aesthetic experience from a holistic perspective, design research lacks of an evaluative framework. In order to address this point, (Mihaly Csikszentmihalyi & Robinson, 1991) study on museum professionals and artworks is one of the most complete research on the subject. Both their protocol and results consists a solid base for studying aesthetic experience in other contexts and thus for design research. From this study we create **a theoretical tool to observe and describe aesthetic experiences**.

The third part (§2.3) of the state of the art looks at aesthetic in organisations and focuses on the different roles of artefacts as translations and embodied manifestations of a culture. Firstly, the *aesthetic artefact* – usually made by an artist, introduces *the aesthetic approach* in organizations. Through symbol interactions and a social and collective construction of reality (Strati, 2005), this approach proposes a paradigm shift from *efficiency* to *aesthetic feelings* in work. Studies related to this perspective like Flow experience (Csikszentmihalyi, 2008; Moneta, 2004) stress the importance of such feelings for personal development and even productivity.

Further on we orient our view on other artefacts, less aesthetic in the artistic sense[13]. We draw an overview on *intermediary objects and representations, probes, boundary objects.* These artefacts are classically *solution-oriented*. Recent studies introduce in the design process *subjectivity through reflection and ambiguity* and show the importance of these notions for creativity and more profound reflection on the users' behaviours, needs and desires. Besides these roles in the design process, **intermediary objects are also a lens to study and influence the organizational culture**. They have *transformative power* that is manifested *in action* and they are *temporal and space markers of the design activity* (Vinck, 2009). Among the different types of intermediary objects, we focus on *design artefacts.* Design is a vector of change in organizations (Brown, 2009) and a condition to foster the innovation capacity (Masson et al., 2006). Designers' ability to cope with the unknown, its flexibility and adaptation in action and the tangibility of its outcomes are important requirement for the tomorrow products and services. In another trains of thoughts**, design is an objectifier of cultural aspects in organizations**. These observations lead to the conclusion that there is a tight connection between **innovation culture and design artefacts** and that design culture brings for the actors of innovation **new collective experiences** through its *tools and methods for collaboration*.

Topic positioning: At this point we showed a global view on Aesthetics in design research with **definitions, evaluation methods, dimensions** and **a theoretical tool on the states of mind** of a person living an aesthetic experience. We showed that *the designer is not only crafting the product, the interaction, but also the experience of users.* The professional context of this PhD and the recent design practices that include the user in the design process – like participatory design, brings a

[13] The object is not designed to trigger an aesthetic feeling. However these objects might trigger such feelings due to their interaction with the actors of the design process and their qualities developed in action.

new view of the roles and influence of the designer both in the design process as for organisations. Besides *the product, the interaction and the experience, designers are also introducing a design culture in organisations.*

In **techno-centred** departments designers are in interaction with other specialists and work in multidisciplinary teams. They also introduce new ways of doing and thinking and design is a vector of change (Brown, 2009). In the first chapter of this thesis (Context) we discuss the ethics of design and propose subjectivity and questioning as characteristics of design practice. These elements both respect *design laws of morality* (Vial, 2010) and bring new ways of doing and thinking innovation. These new changings seems to activate a new experience ***in*** *the design process* and ***of*** *the design process.* As practitioners in a Techno-centred department, we observe a transition **from the concept of User Experience to a new concept of Design Team Experience** (see **Figure 68**). This experience is transformative and mark the persons involved in the process. For research engineers, working with designers in their daily projects changes their ways of doing and thinking. They explore new ways of collaboration and seem to live memorable experiences. With these observations in mind we present the next chapter of this PhD, the Research Question and Hypotheses.

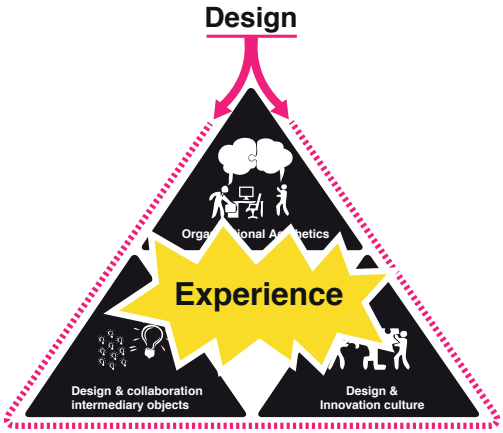


Figure 68 Topic positioning – a new perspective on Experience & Design

2.5 Synthesis of the State of the Art

I.	The normative and judgemental perspectives frame the aesthetic appreciation as an information-processing model. Through the creation and evaluation of **aesthetic features and principles**, design research builds rules to follow on order to attain an aesthetic appealing. However this perspective is *narrow*, as too detailed on features and less on context. *The violation* of the aesthetic principles might also bring unexpected appealing. These principles should be understood in terms of *exploration*, rather than a solid corpus of knowledge.
II.	The holistic perspective shows a larger view on Aesthetics and on Aesthetic experiences. **An experience is an extra-ordinary situation, transformative and memorable that evolves over time**. The Aesthetic Experience has four dimensions: **narratives, discourse, body & mind interaction and emotions**. To study temporality of experiences, recent studies on *User Experience* and *Memory Theory* suggest that **retrospective elicitation** is a reliable method.
III.	Identifying *the states of mind* of a person living aesthetic experience could be a way to observe and study aesthetic experiences. From the state of the art, we propose a **theoretical tool** with four dimensions: the **Perceptual, the Emotional, the Intellectual** and **the Communicative**, to study aesthetic outside the context of museums and art-related encounters.
IV.	*Aesthetics in work* are recently studied by management science. The *aesthetic approach* consists in introducing an *aesthetic object* within organizations to bring reflection and new perspectives for the employees. Other studies like Flow experience show that introducing such feelings in work brings *motivation* and *personal development*.
V.	**Intermediate objects** are tools that *optimize collaboration and cooperation* and, in the same time, they are *embodiments of an organizational culture and functioning*. Besides providing solution-oriented approaches, design artefacts like probes and boundary objects *unbind routines, embrace chaos through subjectivity and ambiguity* in the design process. These qualities are also valuable to *foster innovation* and to *influence the innovation culture*.
VI.	The recent interest of *participatory design* to include *the user* into the design process and the growing number of the *User Experience* studies in the design community brings a translation of **the concept of Experience, from the user to the process**. Moreover the *transformative* character and *subjective* perception introduced by design artefacts in the design process is similar to the characteristics of aesthetic artefacts. This perspective seems to give birth to a new concept: the **Aesthetic Experience in the design process.**

3 Research question

Research Question and Hypotheses

3 RESEARCH QUESTION AND HYPOTHESES

3.1 Introduction

This section formulates the main research question of this study and develops the hypotheses of this thesis. This question relates to the concept of *Aesthetic experience* as explained in the State of the Art. The recent development in the field of User Experience, and the new design practices - like participatory design, that include the user in the design process, brings a translation of the concept of Experience: *from User experience to Experience in the process.* Furthermore, the qualities of *design artefacts* as intermediary objects for the actors of innovation are similar with the qualities of the *aesthetic artefacts.* In Techno-centred environments, *design is a vector of change and transformation* and seems to bring in an approach similar with the aesthetic approach in organizations. With this in mind, we challenge *the influence of design to create an aesthetic experience in Techno-Push environments* and, in the same time, *to enrich the innovation culture.*

Therefore the core research question explored in this thesis is related to the concept of **aesthetic experience** of a Research & Development Department[14] and **the influence** of this experience **on the innovation culture**. In a Techno-Push environment as R&D departments, design culture changes the way in which innovation is built and experienced. This study also explores how **Design-Pull** and **Techno-Push approaches** *collaborate and transform each other in an R&D department.*

During this study the following hypotheses are explored:

Hypothesis 1 suggests that there exists an aesthetic experience in R&D departments and this experience can be frameworked.

Hypothesis 2 investigates the relation between the dimensions of the aesthetic experience and the innovation and design culture.

The last part of this chapter presents an overview on the Experimental approach and the organization of the Experiments for the next section – Empirical studies.

[14] *The R&D department* is constituted in 2011 from **83% research engineers** – technical profiles, **12% designers and design researchers** – profile reconversions to design included, and **5% psychologists and sociologists**. Sometimes we use the term *design team* – *Concepteurs* in French, to refer to the multidisciplinary teams of the department.

3.2 Research question

Based on the **six statements** presented in the Synthesis of the State of the Art (**section 2.5**), we raise the following research question:

RQ:	**How the aesthetic experience of an R&D department influences the innovation culture?**

Aesthetics and subjective experiences are topics of growing interest in the design community. In order to study these concepts, psychology proposes methods to **observe and analyse a person living an aesthetic experience usually in art contexts**. Pragmatic philosophy decontextualizes this concept from its original frame and suggests that **aesthetic experience lies in action and interaction, and it can appear in real live situations**. Several studies from management science, interested in **the psychology of work feelings,** suggest that **studying aesthetic experiences in organizations opens for new experiences and attitudes in this environment** – from an *instrumental attitude to an aesthetic attitude* that brings in *learning, change and living extra-ordinary and memorable situations.*

From *the design point of view*, scholars tackle the notion of aesthetic experience. In the state of the art we show different limitations of these studies regarding the structure of this concept and the evolution of this type of experience over time. In order to explore this perspective, recent studies on *User Experience* and *Memory Theory* recommend **retrospective elicitation** as a reliable method to study experience over time. This direction could also be a way to study aesthetic experiences.

Besides *the product, the interaction and the experience, designers are also introducing a design culture in organisations.* In a techno-push department, the encounter between research engineers and designers triggers new ways of collaboration and social interaction. These new interactions between the two cultures trigger **transformative and memorable experiences**. *The first hypothesis* explores this perspective and tries to depict the aesthetic of the collective experience of an R&D department.

Moreover we are interested in understanding the influence of this two-cultures-encounter for innovation. *The second hypothesis* evaluates the relation between *researchers subjective experience*, the ***outcomes in terms of innovation*** of the R&D department and ***the role of design culture to elicit such experience***. In order to represent these relations and the central concept of this thesis, **Figure 69** draws an overview of the research question in its context and propose first elements to build the hypotheses space.

Figure 69 Contextual elements and the central concept of this thesis: Aesthetic Experience in R&D labs

3.3 Developing hypotheses

To answer our research question: *How the aesthetic experience of an R&D department influences the innovation culture*?, we develop two hypotheses as following:

H1:	**There is an aesthetic experience in an R&D department and it can be frameworked**.
H2:	**There is a strong correlation between aesthetic experience of research engineers and both Innovation and Design culture**.

Figure 70 summarizes the two hypotheses of the study within the context of this PhD. We also represent the actors of the R&D department and the outcomes of their design process within the three cultures

presented before: *the innovation culture, the design culture and the techno culture*. Further on we detail the hypotheses and prepare the

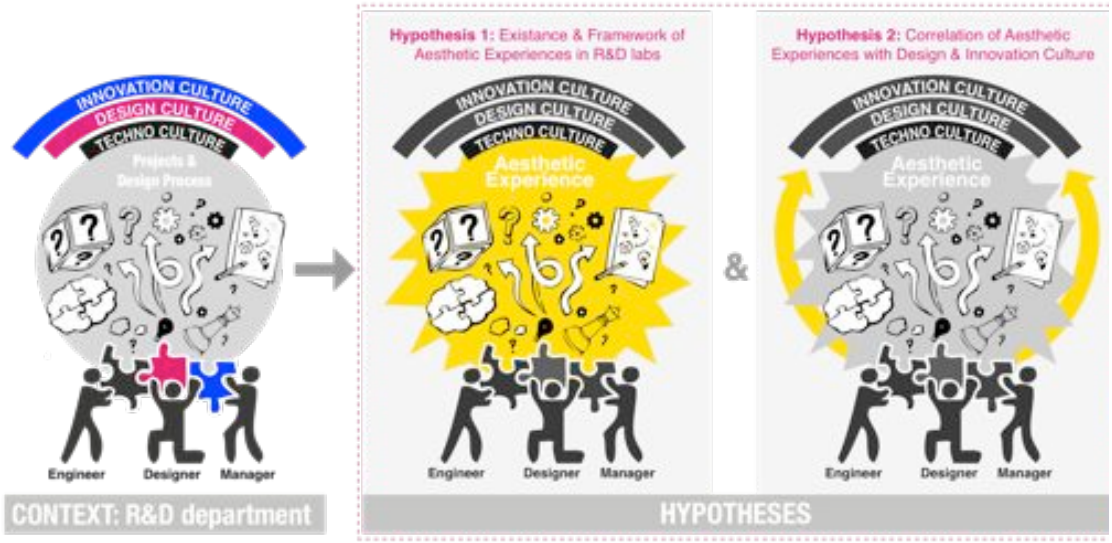


Figure 70 Developing hypotheses: The context of the study (*Left*); The first Hypothesis on the existence of an Aesthetic Experience in R&D labs (*Middle)*, The second hypothesis on the influence of Aesthetic Experience on Design and Innovation Culture (*Right*).

experimentation phase.

3.3.1 Hypothesis 1: Investigation on the aesthetic experience in an R&D department

Hypothesis 1 focuses on the study of the **aesthetic experience of an R&D department.** We presented in the State of the Art **a definition** of an Aesthetic Experience, in which *transformation, memorability and consciousness* are important characteristics. These characteristics are for us first filters to depict the nature of such experiences. Moreover it is stated that such an experience is developed over time and it is not a momentary situation. These first statements generate two questions. One is on the *timeframe chosen in order to study subjective experience of researchers.* The second question is related to the *protocol that 'detects' the aesthetics in working experience.* To sum up, **what protocol to use in order to detect if researchers live aesthetic experiences in R&D departments and what is the temporal frame of such study?** (Csikszentmihalyi & Robinson, 1991) work published as "*The art of seeing: An Interpretation of the Aesthetic Encounter* " is representative for the goal of this hypothesis.

Protocol: At the end of the book, the authors publish the *interview grid* used in the study. This interview grid is specific to works of art – mostly paintings, and the population chosen for the study are museum professionals, mostly curators. In order to adapt this protocol for our study we make a correspondence between *Museum, Artworks and Curators* to **R&D department, Project** and **Research Engineers** (see **Figure 71**).

The correspondence *Museum – R&D department* and *Curators – Research engineers* are more evident than *artworks* corresponding with

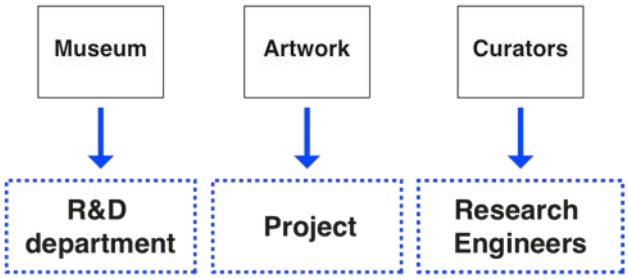


Figure 71 Correspondence between museum context and organizational context to study aesthetic experience in an R&D department.

projects. As the definition of experiences, projects are *stories over time, they have a beginning and an end, and they mobilize people during a certain time on certain activities towards a common goal*. These characteristics seem adequate for the study the subjective experience in an R&D department and therefore we choose to study projects in the same way as Csikszentmihalyi & Robinson studied artworks.

We conduct this study at Bell Labs France in the Applications Research Domain (APPRD) presented in the Industrial context (**Section 1.1).** During the 4 years of APPRD people work on more than 70 projects – *transversal*, *team-specific* and *European* projects.

Temporal frame: Regarding the temporal frame, we analyse the subjective experience of researchers at Bell Labs **from beginning of 2008 to the end of 2011**. This period coincides with the existence of this multidisciplinary research department. In January 2012 the APPRD of Bell Labs is closed due to an organizational restructuration. Therefore we choose the *four years of APPRD existence* as a *temporal frame*. During an a-posteriori study, we interview researchers about aspects of their work that **transformed** them, made them live an **extra-ordinary situation** and **persisted in their memory**. What is worthwhile living in the mind of a researcher and what are the conditions that make a project memorable? Moreover this hypothesis challenges *the universality* of the concept of aesthetic experience: **is aesthetic experience in work similar with aesthetic experience in museum contexts**?

3.3.2 Hypothesis 2: Influence of aesthetic experience in R&D departments on innovation and design culture

We show in the State of the Art that different studies underline the role of aesthetic experience and Flow experience in work to *fosters overall subjective well-being and performance*. In the second hypothesis of this thesis, we challenge the relation of aesthetic experiences to productivity and innovation and investigate the influence of design culture to trigger such an experience. In order to validate this hypothesis, we divide our investigation in two parts:

H2:	**H2.1:** There is a correlation between **the aesthetic experience** in an R&D department and **innovation.**
	H2.2: There is a correlation between the **aesthetic experience** in an R&D department and **design culture**.

Sub-hypothesis 2.1 (see Figure 72) explores the relation between the conditions of an aesthetic experience and innovation indicators. At Bell Labs innovation is quantified through the following Key Performance Indicators (KPIs): *Number of publications* (articles in specialized journals, international conferences, invited papers), *number of patents* (the patents accepted by the internal intellectual property department), *number of technological transfers* (technologies transferred from Bell Labs to the business structures), *number of breakthrough solutions* (outcomes of projects with original approaches that arrive to new products - rupture innovation, or to new market opportunities). APPRD projects are contexts in which these outcomes come to life. An efficient organization in this department is one that enables APPRD members to contribute to each type of realizations described above and to attain established targets.

Figure 72 The development of the second Hypothesis in the context of Bell Labs: the relation between the Aesthetic Experience in an R&D department and Innovation KPIs – **Sub-Hypothesis 2.1** (*Right*) and the relation between Design Culture and Aesthetic Experience – **Sub-Hypothesis 2.2** (*Left*).

For example is an *extra-ordinary* project in which people live rich experiences, one that produces lots of *patents, articles, technological transfers or disruptive innovation solution*? If not what is the impact of such projects? Furthermore the **Sub-hypothesis 2.2** investigates **the influence of design artefacts and design activity in living memorable projects and aesthetic experiences in an R&D environment** (see **Figure 72**). The results of this hypothesis could also bring knowledge on design influence in Techno-Centred environments at a larger scale, on the elements of this culture that encourage innovation. As experiences are transformed in *remembered stories that are communicated* and finally they become the ultimate drivers of our actions (Blythe et al., 2009), we believe that **projects in which people live rich subjective experiences foster the imaginary of organizations, and influence future projects and products**.

3.4 Experimental approach

In order to explore the two hypotheses of this study and to answer to the research question, we use an *Action-Research approach*. In **Section 1.3.1.2** Definitions & approaches – design as a discipline, we represent a classical exploration between Theory and Practice within the two cycles of the Action-Research, the first cycle of exploration and the second cycle focusing on validating the research question.

Figure 73 shows the experimental strategy of this PhD. Within the first phases of this approach (**Section 1.1 to 1.4**), local questions and experimentations are conducted to understand the field as practitioners. These investigations are not directly related to the research question. They are *pre-experimentations*, problem-solving situations in multidisciplinary projects of the APPRD to solve initial situations through first experimental actions. For Bell Labs the goal of these projects is to create technical demonstrators with Bell Labs technologies. As a designer and a UXD team member, I worked on use-cases and scenarios to framework and create a good user experience. After a year of practice on techno-centred projects, we observed *a tendency of design practice to influence not directly the user experience, but the way people worked together*. From a global perspective of the Action-Research approach, this first experience on the field gives a diagnostic of the first cycle: **in a techno-push environment, design is not directly influencing the User Experience, but the working experience of the design team.**

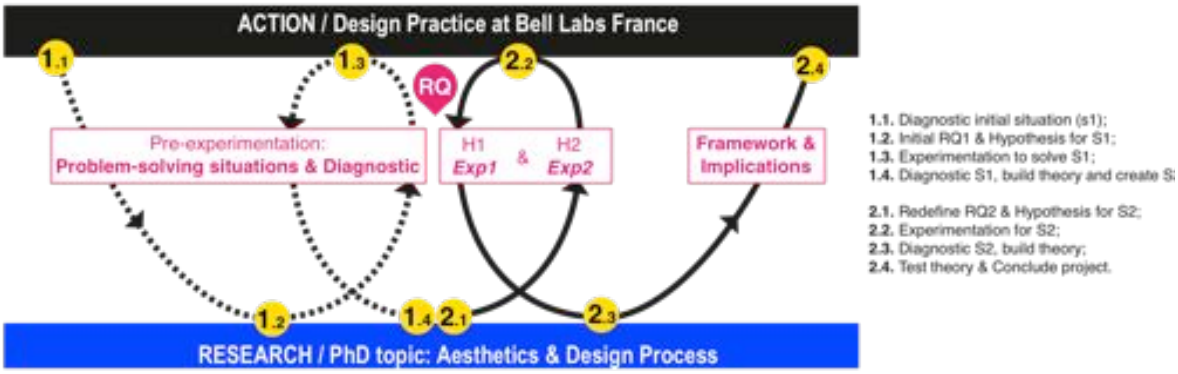


Figure 73 Action-Research approach and the strategy of exploration and experimentation. The main research question (RQ) and the Hypotheses (H1 & H2) of the study are built after a phase of Pre-experimentation.

It is here that the research question appears, from the *field experience* and *the research interest* on *User Experience* and *Aesthetics* (see **Figure 73**). Once the research question (**RQ**) is formulated we conduct two experimentations correspondents of the two hypotheses (Exp1 & Exp2 in **Figure 73**). These experimentations are two studies, the first to *depict and framework the aesthetic experience of the R&D department* and the second, to *understand the connection between aesthetic experience and innovation and design culture*. The outcome of these two experimentations is a **theoretical framework** to **observe and describe** *long-term aesthetic experience in real settings*, *the relation of this experience to KPIs* of Bell Labs and the *influence of design culture to trigger such experience in an R&D department*.

The **generative aspect** (the last step of the Action-Research approach: **2.4** in **Figure 73**) of this framework is not directly tested in this thesis. Due to temporal and organizational constraints we could not directly test the theoretical framework directly at Bell Labs. We give first hints for its exploitation and usage. These suggestions are related to *how to create aesthetics experiences in techno-centred department through design culture that foster innovation*.

3.5 Conclusion

This thesis aims to explore the concept of **aesthetic experience in an R&D department**. In order to theoretically build this concept we use a Research-Action approach. The first phase of this approach, Pre-Experimentation, and round exploration between Theory and Practice,

give birth to the main research question of the study: **How the aesthetic experience of an R&D department influences the innovation culture?**

To answer this research question, we propose two hypotheses. The first hypothesis, **H1** - *There is an aesthetic experience in an R&D department and it can be frameworked*, is explored in an *a posteriori* qualitative study in APPRD department of Alcatel-Lucent Bell Labs France. The result of this first report shows the dimensions of an aesthetic experience in the Techno-centred department.

The second hypothesis, **H2** - *There is a correlation between the aesthetic experience of Research Engineers and both the Innovation and Design culture*, is investigated in quantitative study in the same field. The first sub-hypothesis of our analysis measures the correlation of the dimensions of the aesthetic experience depicted in the first experimentation, and the Bell Labs innovation indicators - KPIs. Moreover as this research project is conducted in a Techno-centred department, the second sub-hypothesis explores the influence of design to trigger such experiences in the department.

The next part – *Empirical studies*, shows the development of the two analyses corresponding to the two hypotheses – **Experimentation 1** and **Experimentation 2,** accompanied by a **Pre-Experimentation** phase.

4 Empirical studies

4 EMPIRICAL STUDIES

4.1 Introduction

In this chapter we present the empirical studies conducted in this thesis. In order to answer the research question and to validate its hypotheses presented in the previous chapter, we perform a Research-Action approach in two cycles (see **Figure 73**).

The first cycle, called **Pre-Experimentation** groups examples of design approaches conducted during this thesis in Bell Labs projects. Besides bringing solutions as design practitioners in the APPRD department, during this phase we also acquire a larger view on *the role of design in a Techno-centred department*. From the theoretical point of view, we observe a tendency of design practice to influence not directly the user experience, but the way people work together. Both the interest in Experience and the aesthetic quality of living Experiences, as the insights learned during Bell Labs projects, lead us to the proposition of a new concept: *aesthetic experience in an R&D department,* and its investigation in the second cycle of the Action-Research approach.

The second cycle is called **Experimentations** and is divided in two parts, *Experimentation 1* and *Experimentation 2* that correspond to the two investigations performed to validate the two hypotheses.

In **Experimentation 1**, we conduct a qualitative study with 31 Research Engineers from APPRD Bell Labs to depict the aesthetic aspects of their work in the R&D department during four years – from 2008 to 2011. We study the most memorable and transformative projects and extract the dimensions and conditions of an aesthetic experience in this department.

In **Experimentation 2**, we perform a quantitative study that analyse Bell Labs projects on the dimensions of the Aesthetic Experience, found in Experimentation 1 and the relation between these dimensions and KPIs and design culture. Through a questionnaire completed by 30 Research Engineers from APPRD Bell Labs, we identify the relation between aesthetic experience, innovation indicators and design culture. Moreover we identify the *dimensions and conditions* the most significant in order to trigger an aesthetic experience in this environment and the corresponding *design tools and practices* that activate such a state of mind for the R&D engineers.

4.2 Pre-experimentation and explorations

4.2.1 Introduction

In this part we show the first cycle of Research-Action approach of this thesis (see **Figure 74**). Among the approximately 50 projects produced by APPRD from 2008 to 2012, we present two case studies of two projects and other design activities conducted during this thesis. 76% of APPRD projects are located in France (see **Table 12**). Almost all cross-department projects are multidisciplinary; they are rich in interactions between design and Techno-centred practices.

Table 12 Typology of APPRD projects (a total of 50 projects except European projects)

N° Cross-department projects	N° Multidisciplinary projects	N° Location of projects
Cross: 6 (12%)	**Multidisciplinary: 22 (44%)**	**France: 38 (76%)**
Non-cross: 44 (88%)	Technical: 28 (56%)	Belgium: 5 (10%)
		India: 5 (10%)
		USA 2 (4 %)

In order to understand these interactions, Pre-experimentation describes two *cross-department* and *multidisciplinary* projects France – TechCards and Knock-Knock. The two names are not the names of Bell Labs projects. They have the name of the design artefacts - intermediary objects, developed in the project. Firstly, we show how design provides local solutions in accordance with a techno-push demand. Secondly, we describe design influence at a larger scale, beyond the projects frame. Design artefacts bring a new culture in the Techno-centred department and inspire the engineers to develop a range of new tools and practices in their work. The insights gained as a design practitioner in the phase of Pre-Experimentation contribute to the creation of the research question and the development of hypotheses.

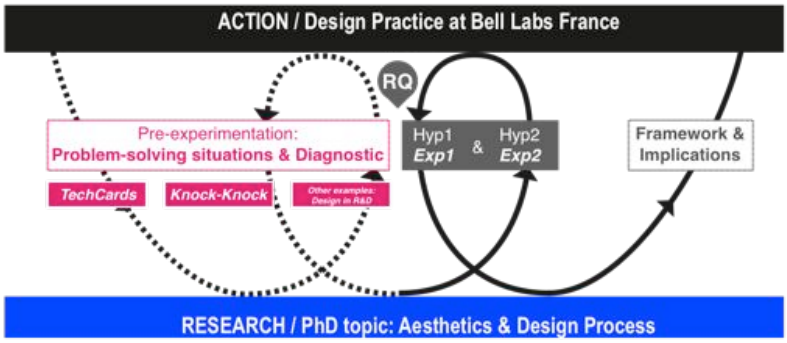


Figure 74 The first cycle of the Action-Research approach - solution based design and first diagnostics

4.2.2 TechCards – a design solution and its influence in the R&D department

4.2.2.1 A communication problem and a design solution

Context - a multidisciplinary project in a Techno-Push environment. **SlideWorld** is the first project of this PhD. It is an international project with Bell Labs teams from France, Belgium and India. Having a deadline of six months, from June 2010 to December 2010, the project goal is Techno-Push: to build a technical demonstrator with the latest Bell Labs technologies. It is one of the first multidisciplinary projects in Application Research Domain (APPRD) and the design team is involved from the beginning of the design process. The project team consists in *16 Technical specialists*, *6 Designers* and *one Psychologist*.

The problem - multidisciplinary and highly specialization. In June 2010 *SlideWorld* project starts with a day workshop in France. The purpose of this meeting is to explain the recent Bell Labs technologies to the design team for the scenario creation. The workshop outcome is a list of technologies names (see **Figure 75**). The level of abstractness of the information was to high, and the granularity of the listed technology too different to be directly exploited by the design team. A communication problem is identified due to the cultural differences between the design and the techno-centred approaches.

Figure 75 The workshop participants at Villarceaux in June 2010- Alcatel-Lucent Bell Labs France (*left*) and the list of technologies resulting the workshop (*right*)

In order to fix this problem and to take into account the Design-Pull and Techno-Push factors, we propose a double flow of information process as presented in **Figure 76**. The particularity of this process adapted from (Ebenreuter, 2008), is the importance of the first steps of the process, *Technology Classification* and *Comprehension*. Before creating scenarios and user-stories, a common representation for all members of the team is mandatory.

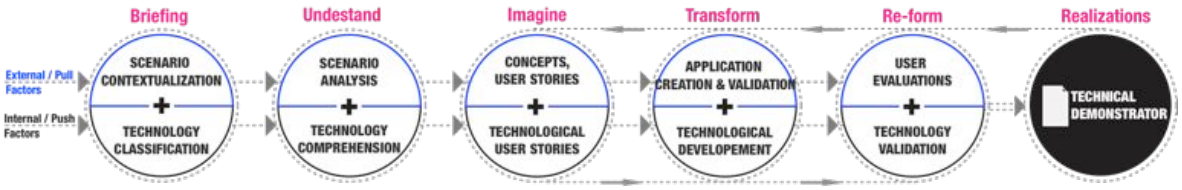


Figure 76 The design process framework (adapted from (Ebenreuter, 2008))

The design solution – the TechCards: After the global workshop, the design team classified the listed technologies on their *maturity level* and *technology type*. The high specificity of this technical knowledge made the information gathering very complex. Due to their abstract nature and their specialisation, a first challenge is to put easy-to-understand labels on technologies. By repeated meetings, names are chosen and we succeed in creating a coherent document that regrouped all the technologies of the three technical teams involved in the project – the Understand phase of the design process.

Knowledge coming from human sciences and design research shows how **intermediary objects** and **representations** are useful in the design process to solve problems related to communication (Boujut & Blanco, 2003; C. P. Lee, 2007; Mer et al., 1995; Vinck, 1999, 2009). Some of these studies use *card representations* in the design process for their playful effect and easy manipulation (Bouchard et al., 2005; Moggridge, 2007). Inspired by these tools and we created the **TechCards – cards** representations of technological bricks. TechCards have an A5 format and the information is distributed in a specific layout of both sides of the card as shown in **Figure 77**).

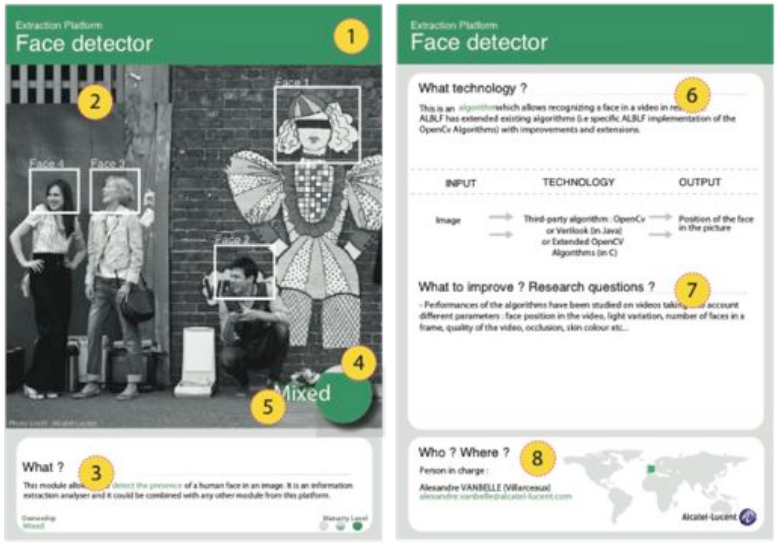


Figure 77 *A TechCard composition, both sides.* **1:** Title and name of the platform, **2:** Metaphorical image, **3:** Short description of the technology, **4:** Maturity level, **5:** Ownership, **6:** Technical characteristics, **7:** What to improve points, **8:** Location & contact.

Each technology is represented through **an image** chosen by the design team. In order to choose the images, there are used two databases: *the company marketing image-data base* and *flickr.com* – with the creative common license. Regarding the **text,** a short technology description is presented on one side of the card, just under the image. The other side regroups all the technical details: the technical characteristics, inputs, outputs and corpus. We also create a place for research questions, comments and points to improve and, at the bottom, the persons to contact for more information. Due to the specificity of our project and its constraints, we develop two icons: *the maturity level* - a circle that is gradually filled up with the technology development, and *the technology ownership* – represented in three key words: *internal, external and mixed*.

The **A5 format** was chosen in order to easily read the text information. The plastic cover made them more robust and easy to play (see **Figure 78**). Once the cards are finished, the next step consists in creating scenarios - the **Imagine** phase. During this phase and using the TechCards, we create user-stories. In parallel the technical specialists work on the development of the technological bricks. At the end of this step, and having all this material we are able to imagine a whole scenario for the technical demonstrator.

Figure 78 TechCards and their use for the scenarios creation.

During the design process, the TechCards had different roles for the members of the SlideWorld team. As (Vinck, 1999) underlines secondary roles of intermediary objects are discovered during their use and interaction. Both the creation of this material and the use these intermediate objects, influenced the way teams collaborate and share a common understanding. Further on we show the different roles of TechCards for designers, engineers and managers. Moreover **Subsection 4.2.2.3** presents the influences of the card format at a larger scale, in the APPRD department.

4.2.2.2 TechCards – from a solution-oriented tool, to new adaptations in the process

The primary goal of the TechCards is to help the design team understand technologies in order to create use-cases. From this point of view, we emphasized their role as *intermediary objects*. We observed their quality as intermediary objects both in SlideWorld project, as in controlled conditions tested with a population of forty-six design students. The observation on this matter can be found in two publications (Ocnarescu, Bouchard, Aoussat, Pain, & Sciamma, 2011; Ocnarescu, Rodio, et al., 2011). It is shown that TechCards are an inspiring material for creativity sessions, and that they influence the intrinsic motivation of the design team.

Figure 79 Small TechCards labeling algorithms on computers.

Besides these results, along the design process, we observed surprising adaptations of these materials by engineers and managers. These new roles appeared without designers' control. For example, we discover that people are proud to have their name on the back of a card as the author of a technology. During the final demo of the Technical demonstrators, engineers printed TechCards in small formats and stuck them on computers to label technologies (see **Figure 79**). Regarding managers, they used the cards as a planning and management tool. Having all the TechCards gave them a global view on the technologies developed by their team and their degree of maturity (see **Figure 80**). **Table 13** synthesizes these roles and influences.

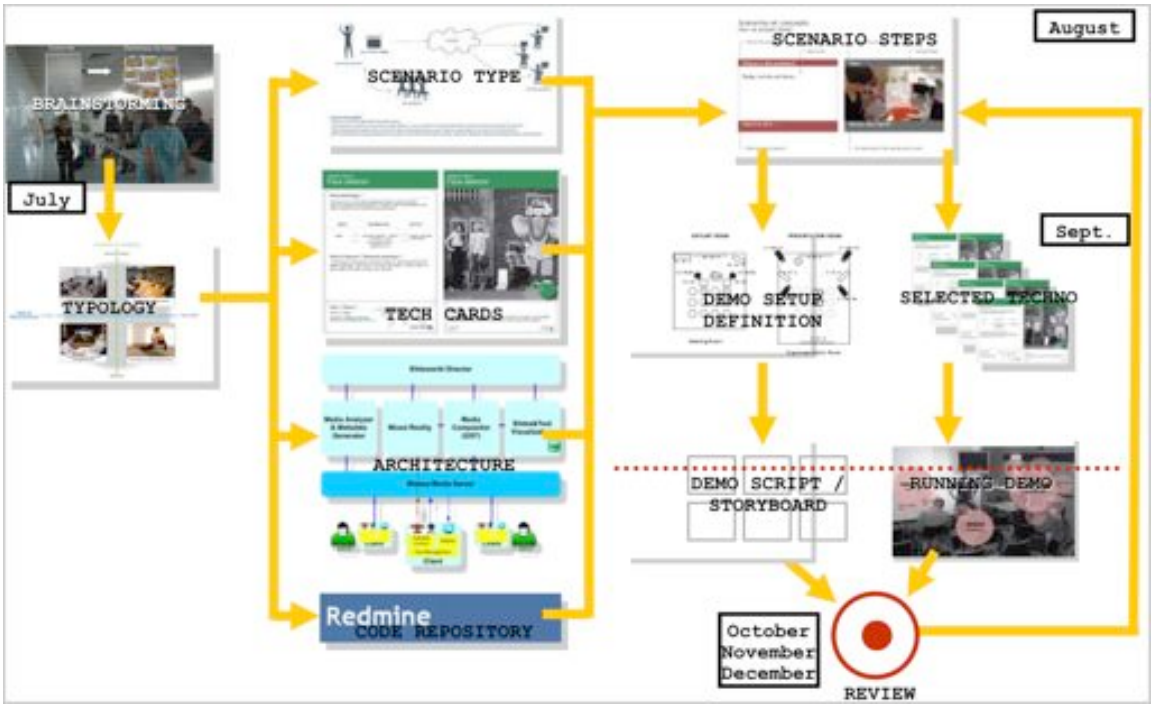


Figure 80 Example of usage of TechCards as a planning tool in the management process. Screen shot from the manager's presentation of the project – Oct 2010.

Table 13 TechCards influence in the design process from (Ocnarescu, Bouchard, et al., 2011; Ocnarescu, Rodio, et al., 2011).

Project team members	**TechCards roles and influence**
DESIGNERS	▪ **Understand** technologies; ▪ Work with engineers to build them→ tool for **collaboration**; ▪ **Inspirational & motivational tool** → cards combined with game rules increase creativity and bring a subjective experience in the design process; ▪ **Scenario creation** → the context of the project is usually forgotten due to the focus on the **image** and the **technology**;
ENGINEERS	▪ The **tangibility** of the cards → first tangible ideas in the process; also used to label technologies (see **Figure 79**); ▪ Ownership and the format → **proudness;** ▪ **Clear format** → efficiency in communication and description of technologies; ▪ **TechCards adaptations** in other projects (see **Figure 81**);
MANAGERS	▪ **Global view** of all the technologies and their maturity level; ▪ Plan the attainability of use-cases→ **project management tool** (see **Figure 80**).

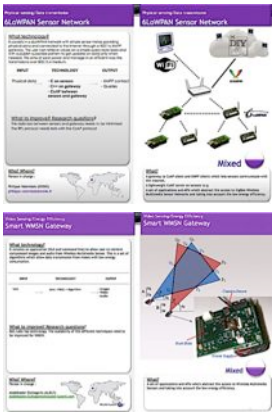


Figure 81 Examples of TechCards made by engineers in other projects – PowerPoint format.

Slideworld project becomes a success of APPRD and finally, the TechCards format spread in the department. Other teams explore this format and engineers start to create their own TechCards, sometimes called Techno-cards (see **Figure 81**). Concerning these adaptations, we observed a significant difference between the TechCards made by designers and the one made by engineers. The engineers use the image to explain an algorithm and prioritize the efficiency and clarity in communication. Designers use the image to metaphorically represent the technology and to trigger an emotional state in the same time. **Figure 82** shows two different proposals for Face detector TechCard.

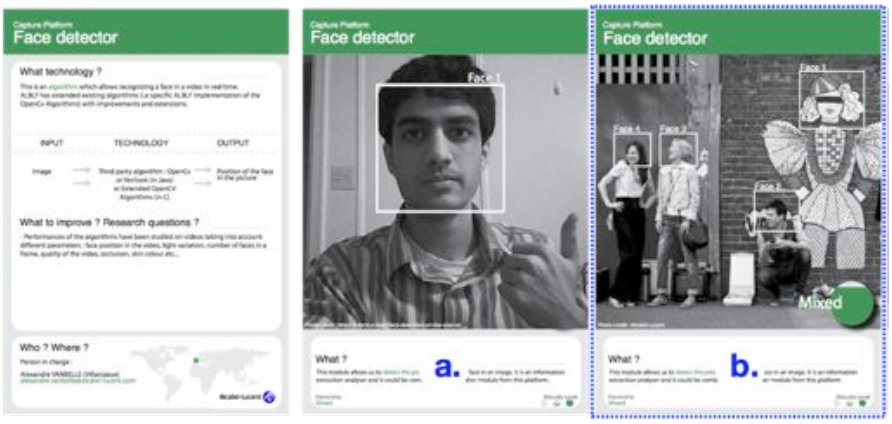


Figure 82 Different images proposals for the TechCard 'Face Detection'. The first image (a) is a typical image made by engineers working on face-detection algorithm, the second image (b) comes from Alcatel-Lucent database and presents the concept in a playful way.

However, even if engineers' images propositions are usually techno-centric and the openness of the card for inspiration and creativity is lost, the fact that they created their own TechCards shows their interest in the reconfiguration of design artefacts. This phenomenon, called *exaptation* (Labrune, 2007), takes place in creative environments where functionalities or formal properties of objects with non predictable rules, inspire the actors using them to new usages. It shows how *ideas and tools from design are 'stolen' and adapted* in other contexts. The fact that this tool is used in other projects shows its impact from a *larger perspective than the design process.* The next session shows other *translations* of the TechCards concept.

4.2.2.3 A new quality of intermediary objects? Design influence on the organizational culture

TechCards are intermediary objects as (Mer et al., 1995; Vinck, 2009) define this concept: *they are both intermediate representation of future technological bricks and in the same time they offer a global view to all the team member of the 'matter' to design*, i.e. technologies. Besides their use in the design process, we observed how these cards influence persisted even once the project is over. At a larger scale we witnessed how these objects become artefacts of the organizational culture of APPRD.

Figure 83 An example of CreaCards, a convergence technique for Creativity sessions: *Comparison.*

After TechCards, in 2011 other members of the R&D department created CreaCards. These cards are an educative tool made by creativity specialists on creativity methods and techniques. As **Figure 83** shows, CreaCards have a similar layout as TechCards. They are not created to serve a particular project, but rather as a tool-kit for the multidisciplinary teams of APPRD. Therefore they are not intermediary objects but *boundary objects.*

Figure 84 PIPCard of the TechCards made in 2012.

A similar toolkit, People Innovation & Participation (PIP) Toolbox, is a set of 37 cards with inspiring methods and tools when doing user-driven innovation research (see **Figure 84**). These cards are created by Bell Labs Belgium designers in 2012. As CreaCards, PIP Toolbox cards are made by designers to share knowledge between design and techno-centric culture. Thus, a first observation of these practices is the **transversal influence of the card support in the APPRD department** since 2010 and the **popularization of design practices as intermediate representations and boundary objects**. The *tangible and playful effects* of this support, combined with *its synthetic nature of information* made cards a design tool that influenced both the design process and the organisational culture of the R&D department.

Additionally the TechCards project became a project per-se. After the SlideWorld project, as the interest in these cards grew, we decided to

create an *online platform (internal use only)* – TechCards Collection (see **Figure 85**). We put all the TechCards created in APPRD (over 40 TechCards) and we develop a module for other people to *create, edit and print* their TechCards. Moreover for the Bell **Labs Open Days 2011** we create an interactive application that connected physical cards with their virtual representations on the website. The system also records all these ideas and visually represents them within the application (see **Figure 85**). This last example of exploration of TechCards shows the diversity and the plasticity of this concept. Finally today TechCards are a part of the history of APPRD and of the organisational culture of the department.

Figure 85 TechCards collection on the website (*top*); TechCards Augmented at OpenDays 2011: by showing a TechCard at the camera, the program recognizes it and shows on the screen the virtual card on the website (*bottom*).

4.2.2.4 Conclusions of TechCards project

(C. P. Lee, 2007) introduces the concept of *boundary negotiating artefacts* to describe how certain boundary objects *embrace chaos and complexity*. We too observe the same phenomenon of borrowed, structuring, self-explanation artefacts with the exaptation of TechCards by other teams. **Figure 86** shows an overview of TechCards influence in APPRD and their reconfigurations. As Lee we observed the richness in the process and in the department, interactional processes such as *negotiating, persuading, educating, manipulating, and coercing*. Buchenau at al. argues that design team not only creates solutions as toolkits or sets of techniques but they develop an *attitude and language* to *solve design problems* (Buchenau & Suri, 2000) and to *create a culture of innovation* (Brown, 2009). Therefore we propose a new role for design intermediary and boundary objects. Besides offering a solution to problems that appear in the design process, they are also embodiments of a culture - **cultural vehicles,** and they **transform the environment in which they act.** They educate and they informally bring knowledge on the design culture. Their formal and usage properties like the playfulness and interactivity of cards bring in new aesthetics in the design process for the actors of innovation.

Moreover our study (Ocnarescu, Rodio, et al., 2011) shows how these intermediary objects have **an influence on motivation** and **subjective experience in the design process**. We showed how TechCards with game rules transform the generative phase of the design process into a serious game. Additionally this support makes engineers proud and introduces a subjective experience in the design process through the image designers chose to represent technologies. Today, due to the recent restructuration of the department, TechCards become a concept rather than a tool and its influence is limited in time. Further on we show similar element of the design culture. Our aim is to *collect, understand* and finally *measure* the design influence in the R&D department for innovation and for the working experience of the researchers.

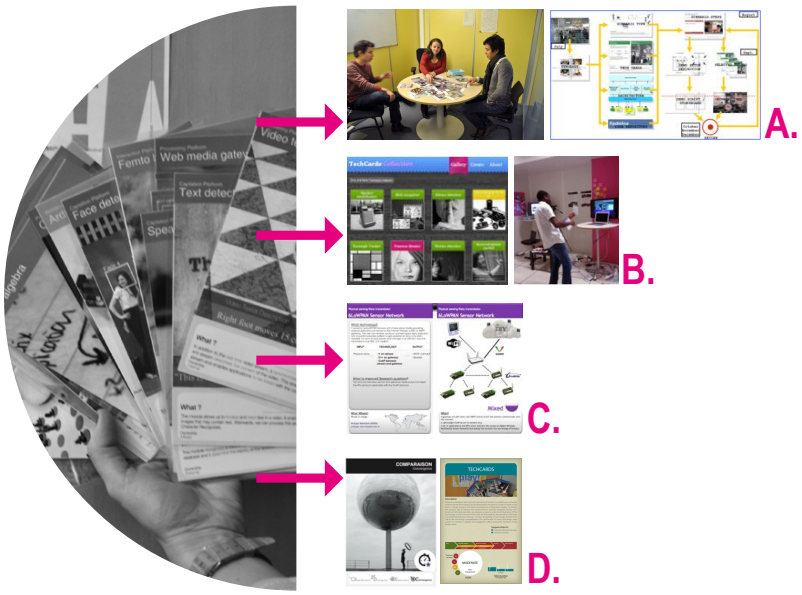


Figure 86 TechCards influence in APPRD from 2010 to 2012. ***A***: The roles in the design process for SlideWorld project as an intermediary object; ***B***: The continuation of TechCards as a project per-se through a website and an interactive demo for Bell Labs Open Days 2011; ***C***: Use of TechCards in other projects; ***D***: The apparition of other cards in APPRD after the TechCards.

Synthesis of TechCards case-study (**Section 4.2.2**):

→ In a multidisciplinary R&D department, **design artefacts inspire research-engineers to new reconfigurations**. Through this rich phenomenon of *exaptation*, **design culture influences the organisational culture and the local techno-centred practices**.

→ Besides their role in problem-solving situation, **intermediary objects also impact the collective experience of researchers** by influencing their intrinsic motivation.

→ **Design artefacts act as educative and cultural vehicles** in a techno-centred environment and they bring in the design process *new formal and usage aesthetics.*

4.2.3 Knock-knock & a design research collaboration

4.2.3.1 Building the Knock-Knock

Context - two projects, one Techno-Push, one Design-Push to respond to a same goal: Another project of this PhD is the Knock-Knock. Knock-Knock is a communication device that is created during Zero Knowledge Latency System (ZKLS) project (2011-2012). ZKLS is a *Techno-Push project* that uses Bell Labs technologies to create an application for highly distributed organizations **to share and spread more efficiently knowledge across borders in organizations**. Developing internal tools that foster research and development, and engaging researchers to build applications for themselves, is an important characteristic of APPRD department. The application is a Question and Answer (Q&A) system, similar to an existing system - Quora[15]. A multidisciplinary team is created for this project. The design role is *to build the application wireframes and interface of the Q&A system.*

In parallel with this activity, the design team - Application Studio grows within APPRD department. Starting with 2011, the team is constituted not only from designers and ergonomists, but also **design researchers**. Design researchers contribute to the four quantifiable outcomes of this department Bell Labs Key Performance Indicators (KPIs): *number of patents, articles, technological transfers and innovation solutions,* having a major influence on the *number of articles.* To achieve this goal, the department starts *design research collaborations* with design schools and international departments of design research. Such collaboration - a PhD exchange, is the collaboration **Alcatel-Lucent Bell Labs France** – *Applications Studio* and **Aarhus School of Architecture** (see **Figure 87**). The goal of this collaboration of three month spent between in Aarhus and Bell Labs France[16] is *to contribute to ZKLS project with a Design-Pull proposition*, to built *joint proposals for European funding for design research* and to c*o-write papers between researchers from Aarhus and Bell Labs.*

Figure 87 Aarhus School of Architecture: students' workshop during my visit in Oct 2011 (*top*) and students' showroom (*bottom*).

Building the Knock-Knock, between Aarhus and Paris. Following the research field of Computer Mediated Communication (CMC) during the Aarhus-Bell Labs collaboration we participate to ZKLS project with a design proposition. Rather than finding *more efficient* and *rapid solutions* on how knowledge is shared and accessed in organizations, we focus on

[15] Quora is a question-and-answer website created, edited and organized by its community of users. The company was founded in June 2009, and the website was made available to the public on June 21, 2010 (techcrunch.com).

[16] I went to Aarhus School of Architecture for a month in September-October 2011 to work with Majken Rasmussen (my collaborator) and Peter Krogh (the responsible of the design department at Aarhus). Majken also came to Bell Labs in November 2011.

the qualities of communicating in a less explicit and more suggestive way and on *new aesthetics of this minimal communication*.

Firstly, we identified several critical situations in order to manage noise from knowledge, created design propositions for these situations and, we decided to explore the concept of **contextual knowledge** through a shape-changing artefact. This is how Knock-Knock is design - a minimal communication device. As presented in the paper that resulted from this collaboration (Rasmussen, Lehoux, & Ocnarescu, 2012), the device facilitates communication between two people in a *suggestive* manner. It consists of **a pair of connected physical devices** (Wi-Fi connection) that support synchronous one-to-one communication, between *two colleagues* who work close to each other but not in the same vicinity (see **Figure 88**). The device changes shape as a result of the way a person knocks on a connected device, lifting up the flaps resulting in a visual change based on haptic input. The goal is to create *an open channel for communication* and an *open space* in which the users freely personalize communication.

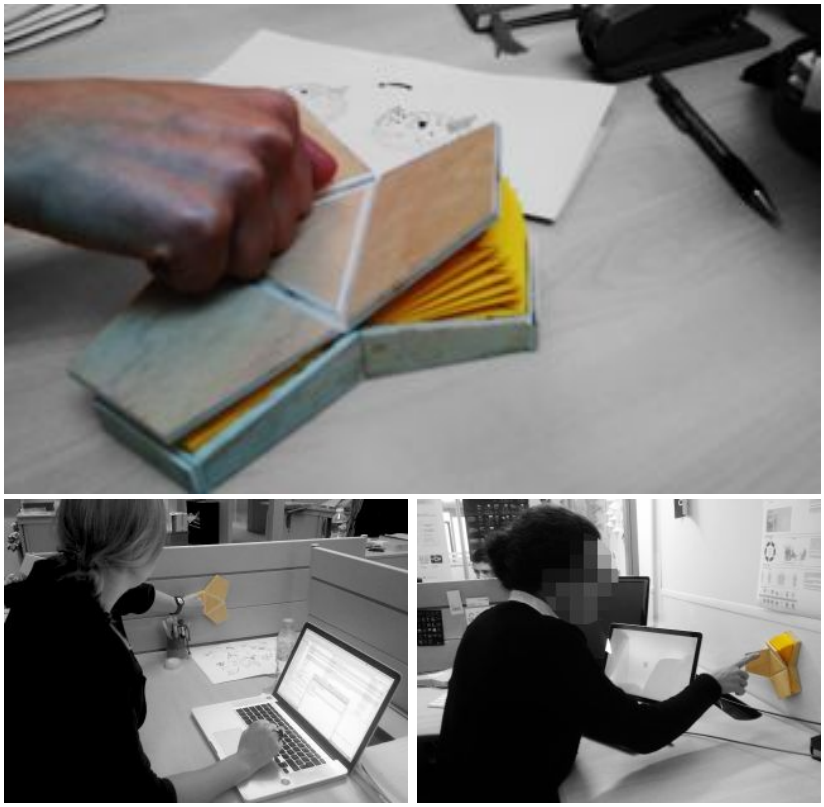


Figure 88 The Knock-Knock and its usage context: image of the device (*top*); Image of Person A using the device (*bottom left)*; Image with Person B seeing Person A message through the Knock-Knock movement *(bottom right)*.

In (Rasmussen et al., 2012) the authors underline how the communication is dependent on *scheduling*, *coordination*, *activity interruption* and how the Knock-Knock is tackling these issues in a less intrusive way. They also show different scenarios and suggest new roles for communication devices like *giving individuals the opportunity to create personalized ways to enter into and participate in communications*, and allow a more *fluent scheduling or coordination of activities.*

The Knock-Knock project and the research collaboration finish in December 2011. In parallel the ZKLS project ends almost in the same timeframe. Unfortunately these two projects do not interact. One has purely a Techno-Push approach that integrates design as tool to craft interfaces (see final result in **Figure 89**), and the other, Knock-Knock, remains a design research project finalized with an article for Designing Interactive System (DIS) 2012 conference. In the next subsection we draw an analyses of the transformation of this project into an organizational artefact. For the designers working on this device, Knock-Knock is a *communication device*. For the design managers, this object is *the result of design research collaboration*. Further on we show other roles of this project in the R&D department.

Figure 89 The application built by ZKLS team project: AskSophie is a Q&A system that encourages employees to share knowledge. Here a stand is installed near the coffee machine and in an anonymous way people can answer and ask questions.

4.2.3.2 Knock-Knock – what's next once a design project ends?

During one month of building the Knock-Knock, different types of artefacts are tested in the Open Spaces of APPRD. Paper, 3D printed and wood prototypes invaded the offices (see **Figure 90**).

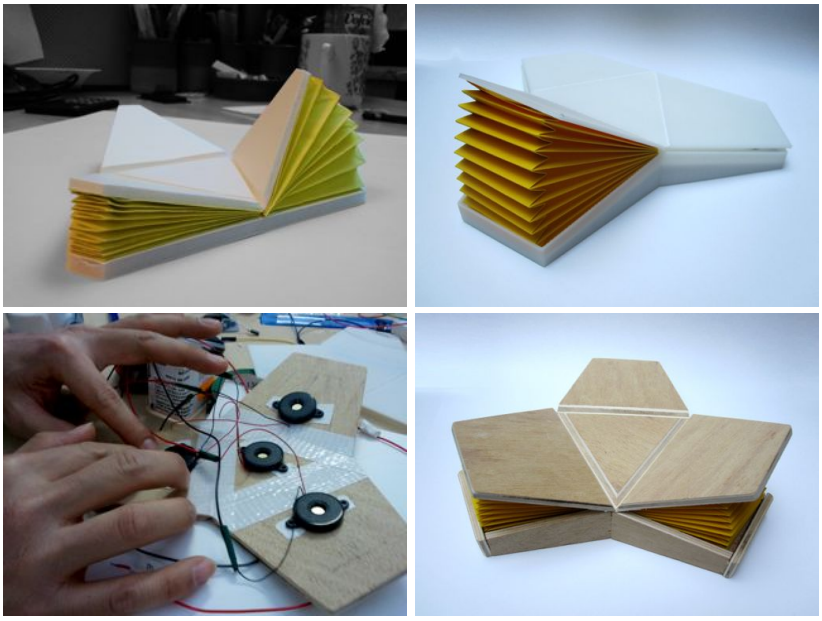


Figure 90 Different prototypes to build the Knock-Knock: paper prototype *(top left)*, 3D printed *(top right)*, wooden prototypes with electronics *(bottom)*

Figure 91 Knock-Knock in Creativ'Lab (2013)

In the same time, other spaces in the department are dedicated to rapid prototyping. A research engineer from Application Studio creates Arduino Geek Club[17] to encourage engineers to create prototypes and learn how to use Arduino[18] boards in their projects. In 2011 several projects used rapid prototyping techniques. Some of these projects become demos for Bell Labs Open Days in 2012. This event was also the opportunity to show that designers' way of prototyping could help innovation and motivate engineers to take initiative and build personal projects. In 2012 after the APPRD is closed these activities continued. **Make Innovation Tangible** – demo during the OpenDays 2012 shows prototyping techniques and examples. Knock-Knock and other examples of devices build in 2011 are exposed there.

4.2.3.3 Conclusions of the second case-study project in APPRD Bell Labs France

Today the Knock-Knock device is part of the decorum (see **Figure 91**). Placed in the Creativ'Lab at Bell Labs – creativity room, it acts as an icon, a materialization of the design culture. Like other design artefacts created in 2011 in this laboratory, **Knock-Knock brings a contrast in the Techno-Push environment** and due to the cultural difference of this field, it becomes visible. Only in this field these design objects are *original, exotic* and act **as aesthetics artefacts**. They are not artistic objects as aesthetic artefacts, but act as such through their *force of transformation* and *their influence* in the R&D department. Thus we observe a tendency of these objects to influence the working experience of researchers in this R&D department. From a more global point of view, the next part draws a taxonomy of the design culture at Bell Labs from 2008 to 2011.

Synthesis of Knock-Knock case-study (**Section 4.2.3**):

→ Design artefacts in a Techno-centred environment, become **aesthetic objects** through their *cultural difference and their original and exotic nature.*

→ They neither act as tools, nor they influence directly the outcomes of industrial projects, but they **contribute to the organisational culture and personal motivation of research-engineers**.

[17] Arduino Geek Club is created in 2011 by Fabrice Poussiere. From a personal project started in an office desk, it becomes a tool and place to create rapid prototypes. Several demos for Open Days 2011 and 2012 are built in Arduino Geek Club.

[18] Arduino is a single-board microcontroller designed to make the process of using electronics in multidisciplinary projects more accessible. Recently the Arduino boards are highly used by interaction designers.

4.2.4 A taxonomy of design culture in an R&D department

This part gives an overview of different design practices in the Applications Research Domain (APPRD) of Alcatel-Lucent Bell Labs France. The first two parts of this section showed design influence in two multidisciplinary projects. This part is not related to projects. It is rather a portfolio in which design and Techno-centred culture meet outside projects and organizational structures. From endless cantina discussion on *what is design?*, to the creation of a place for creativity, the curiosity and the astonishment that designers bring among the other Bell Labs researchers changes their practices and their working experience.

The first example is **Creativ'lab**. It is a place dedicated to creativity, but also to multidisciplinary activities like prototyping & brainstorming, and a showroom for artefacts coming from the design culture. It is built in 2009 by the design team managed by Frédérique Pain. In order to build the place and to introduce the concept in APPRD, F. Pain creates a team dedicated to this activity. Through the creation of a social event - Coming'lab, Bell Labs researchers discover what could be a Creativ'lab in their department (see **Figure 92**).

Figure 92 Coming'lab event in 2010, some of the members of the Creativ'lab team (dress-code black) discussing and presenting the concept at other Bell Labs researchers .

After this event, a place is identified to build the 'lab'. Designers draw first sketches and in several months Creativ'lab appears (see the process in **Figure 93**). Since 2010 until today, **Creativ'lab is a design outcome of the Applications Domain**. It was presented as a demo for the Open Days in 2012 and today it is used as a place for brainstorming sessions, workshops and as a showroom on the design culture. It also shows the positioning of Bell Labs on *creativity, prototyping and multidisciplinary.*

Figure 93 The building process of Creativ'lab: plan of the building (*top left*), the place, storage of files (*top right*), first sketches drawn in collaboration with Arnaud Le Cat (*bottom left*) and final outcome – Creativ'lab in 2013 (*bottom right*).

Besides Creativ'lab, engineers' enthusiasm and openness to design culture brings in the department *drawing lesson;* some of the researchers even take classes outside Alcatel-Lucent to learn *Adobe Photoshop, Illustrator and Flash*. Research engineers also learn how to *create software prototypes and use rapid prototyping* to built their technical demonstrators and create demos for the Open Days event. **Figure 94** shows an overview of *seven types of design tools and practices* of the APPRD design culture. Some of these examples are used in the design process like *rapid prototyping, software prototyping, user scenarios and cards* and *intermediary representations*. They often are transformed in new skills for the department engineers and bring in more freedom to imagine and develop their technologies. *Creativ'lab, drawing and illustration lessons* and *the endless discussion with designers* are other elements we observe in this field.

Designerly ways of doing and thinking transform the APPRD department working experience and propose new perspectives to process, engage and present their work. After a year of exploratory practice we become conscious of the design influence on Techno-centred department. The solution-based projects presented before – *TechCards, Knock-Knock, Creativ'Lab* and our theoretical interest on concepts like *Aesthetic Experience, User Experience, Experience design*, we observed the *transformative and extra-ordinary* (out of ordinary, remarkable) *nature of the interaction between engineers and designers*. In both ways this interaction created surprising encounters and finally lead us to the research question and *the proposition of a new concept*: **the aesthetic experience of an R&D department** and its relation with innovation and design culture.

Figure 94 Design culture in APPRD. *Top from left to right*: Rapid prototyping, Software prototyping, Drawing & illustration techniques, Scenarios; *Bottom from left to right*: Creativ'lab, Cards & Intermediary Representations, Discussions with designers.

4.3 What have we learned? Conclusions from the Pre-experimentation phase and start of Experimentations

The initial interest of this PhD is not related to the design influence on the working experience in an R&D department. As presented in the context (Industrial context - Section 1.1), the initial goal of this research to study design models that *framework the experience with products and in particular the aesthetic experience of products.* This initial theoretical investigation and the Action-Research approach conducted in the same time, lead us to a double theoretical interest in the first cycle of our process (see **Figure 95**).

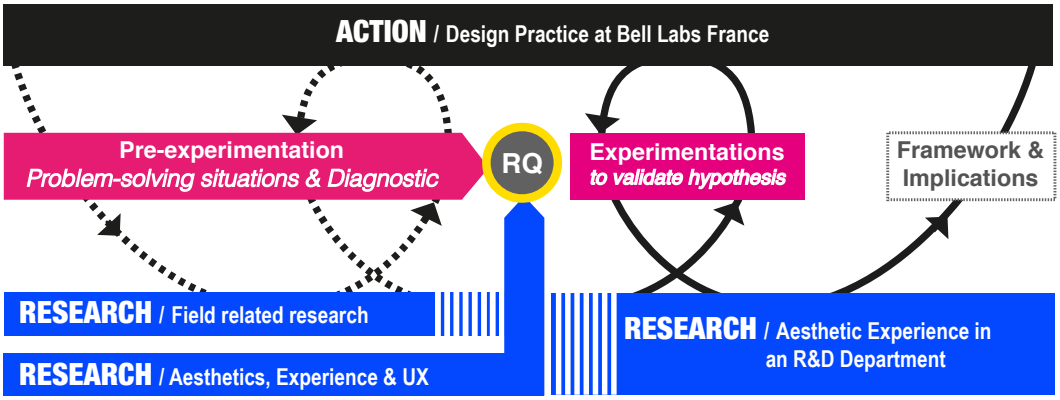


Figure 95 Research-Action approach in detail - Pre-Experimentation & Experimentations

Aesthetics, Experience and UX: Regarding the theoretical investigation on Aesthetics, Experience and UX, advancements are also made in this direction: *a theoretical description of an aesthetic experience with products*, *its dimensions* and *temporal development* - elements which are synthetized in **Section 2.2.3** Holistic perspectives on Experience and Aesthetic Experience in Design of the State of the Art. These theoretical elements are also published in an article **AEoT: An initial framework of aesthetic experience over time** (Ocnarescu et al., 2012) presented in 2011 at *Design and Emotion Conference* in London, UK.

Field Related Research: In parallel with this theoretical development, the field related research applied locally on Bell Labs projects bring in additional knowledge on *intermediary objects*, the *working experience* in this research Techno-centred department, its encounter with the *design culture* and influence of *this experience on the innovation potential of this department.* Design artefacts inspire research-engineers to new reconfigurations; they act as educative and cultural vehicles and besides their role in problem-solving situation, such artefacts also impact the

collective experience of researchers by influencing their intrinsic motivation. Therefore they become aesthetic objects through their cultural difference and their original and exotic nature and contribute to the organisational culture and personal motivation of research-engineers.

These two theoretical directions (see **Figure 95**) lead us to the creation of the research question presented in **Section 3.2** Research question, and the proposition of a new **concept**: *aesthetic experience in an R&D department* to study aesthetic experiences in real settings.

Following the second cycle of the Action-Research, further on we present two experimentations corresponding to the two hypotheses of this research. Finally these experimentations have as objective to answer the research question of our study: **How the aesthetic experience of an R&D department influences the innovation culture?**

Experimentation 1 aims to validate *Hypothesis 1*: **There is an aesthetic experience in an R&D department and it can be frameworked.** In order to approach this hypothesis, we conduct a qualitative study with 31 research engineers from Applications Research Domain (APPRD) of Bell Labs France, in order to depict the aesthetic aspects of their working experience. For this goal, we focus on the study of memorable, transformative and extra-ordinary projects of APPRD.

Experimentation 2 aims to validate *Hypothesis 2*: **There is a correlation between the aesthetic experience of Research Engineers and both the Innovation and Design culture.** In order to approach this hypothesis, we conduct a quantitative study that tests the relation between the *aesthetic experience and the innovation indicators at Bell Labs*, and the effect of the design culture on the research engineers' subjective experiences.

Figure 96 The logo of the experimentations. It represents our focus to grasp the subjective experience of APPRD research engineers.

4.4 Experimentation 1: Investigation on the aesthetic experience in an R&D department

4.4.1 Introduction

This experimentation has the goal to test the first hypothesis of this thesis: **There is an aesthetic experience in an R&D department and it can be frameworked**.

In order to investigate such concept, we present the experimentation field and the study methodology: the choice of *qualitative research*, the *interview planning*, and the *method of data analysis - Grounded Theory*. This section presents also the outcomes that result from our analysis and the discussion on the dimensions found in this field.

4.4.2 Experimentation field

We choose as terrain for this study the R&D department of Alcatel-Lucent Bell Labs - APPRD (Applications Research Domain). Our investigation is conducted in the French teams of APPRD as represented in **Figure 97**. All the participants are permanent members of APPRD from its beginning to its end.

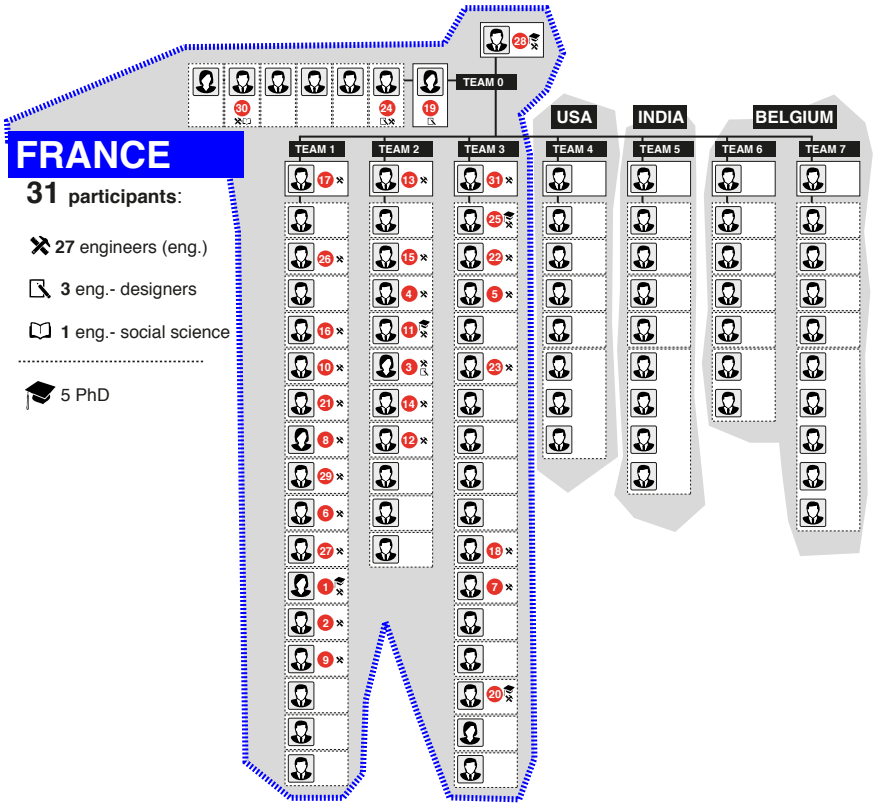


Figure 97 APPRD organizational chart from 2008 to 2012. The red circle and the identification number show the participants of the study.

4.4.3 Study methodology

4.4.3.1 Study objective

The objective of this study is to understand the aesthetic quality of research engineers experience in an R&D department. Rather than asking researchers if they experience a feeling of *wholeness or integration* during their work, we let people talk about most **memorable, extra-ordinary, transformative** projects and aspects from their department using *the definition* on Experience and Aesthetic Experience built in *the Section 2.2.1*: Living an experience.

Using Grounded theory (Strauss & Corbin, 1998) we analyse their recounted experiences and we build a first framework of *R&D most memorable and transformative experiences.* We look at the dimensions of this framework, we compare them with the dimensions of the aesthetic experience framework presented in **Section 2.2.4**: Creating a theoretical tool to observe and describe Aesthetic Experiences, and we identify the aesthetic quality of an R&D department experience.

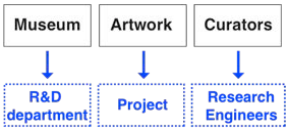
4.4.3.2 Why Grounded theory?

In our study we aim to understand the subjective experience of a 4 years department. The vast temporal length of this experience and the fact that this is an *a-posteriori* study, do not allow us to use *physiological methods or real-time evaluations* in order to measure participants responses of experiences. Physiological methods depict cognitive and emotional states by breaking down the subjective experience into parts and analyse a person reaction piece-by-piece. This highly level of details and the rather unnatural, obstructive, and heavy instruments used for these measurements (Kim, 2011) are not adapted for studying long-term experience. Therefore we are more interested in how people **remember** and **recall** this experience. *Memorability* and *consciousness* are for us first filters for the type of information we are looking for. As we presented in the state of the art, some researchers even argue that it can be observed only indirectly, *reported after the fact* (Sandelands & Buckner, 1989).

Thus we choose the direction of *interpretive social sciences.* We chose (Strauss & Corbin, 1998) Grounded theory for its power to explore people experience and to create a theory coming from the data systematically through the procedure of *open coding*. Moreover other researchers used this approach to analyse recounted experiences (Karapanos et al., 2009). This procedure is detailed in the *Analysis of the interviews* part. One could have also test the theoretical framework presented in **Section 2.2.4** through questionnaires. Instead we decided to be alert to people impressions and stories and afterwards confront the field results to the theoretical model.

4.4.3.3 Plan the interviews

The interviewed population is constituted of 31 participants, all French speakers and all members of the French R&D department. 27 are research-engineers, 3 Engineers-Designers, 1 Engineer-Social science researcher. Among the 31 persons, 5 persons are team managers and 5 of them have a PhD. All participants are permanents personnel and they took part of this department from its creation to its end. The protocol used for the semi-directive interviews is created using (Csikszentmihalyi & Robinson, 1991) interview grid adapted to our field as presented before in **Figure 71**.



Recall **Figure 71**: Correspondence between museum context and the organizational context to study aesthetic experience in an R&D department.

In our grid (see the interview grid in **Appendix A**), we follow four general topics summed as following:

i) *Job perception and the image of the laboratory,*

ii) *Rewarding aspects the research department in the last 4 years,*

iii) *The most remarkable, memorable project and its conditions,*

iv) *Discussion on other remarkable situations in the person's life.*

These topics are adaptations of Csikszentmihalyi & Robinson protocol to our field. Regarding the choice of this protocol for our study there are several observations we want to clarify. A first challenge of this protocol is its creation. Csikszentmihalyi & Robinson's protocol permits us *to use a validated tool to depict aesthetic experience.*

Secondly, even if Csikszentmihalyi & Robinson do not clearly specify in their study, this protocol is using retrospection techniques to framework aesthetic experience. Our focus on *retrospective elicitation* and *memory theory* as presented *in* **Section 2.2.2**: The objective side of subjective experiences in Design Research, gives a structure for the *iii)* part of the interview. When asking participants to describe the most memorable project in APPRD, we follow the temporal structure of an experience and its temporal phases coming from UX over time studies (Karapanos et al., 2009; Ocnarescu et al., 2012; Roto et al., 2011): *anticipation, first encounter, direct experience* and *end of experience.* Contrary of how experiences are studied in UX studies, *a project-experience usually has a defined temporal frame, a clear start and an ending.* This observation brings in questions related to the importance of a good or bad ending on projects appreciation. Studies from memory theory show that the **ending influences the recall valence of the overall experience** (Kahneman, 2011).

Thirdly, it is valuable that our investigation takes place several months after the department closure. For most of the R&D engineers, the months following the closure are *a period of reflection and repositioning.* Therefore

our questions are aligned with researchers processes of reflection and understanding of the APPRD experience.

Regarding the temporal length, an interview lasts for approximately an hour. The interviews coming from the 31 participants are *recorded* (32,7 hours), *transcribed* and *prepared* for the Grounded theory analysis. The next section presents how the data are analysed and organised.

4.4.3.4 Analysis of the interviews

We follow four steps in our analysis. Firstly, the transcripts of the 31 interviews are read with general questions in mind like "What people remember as being personally valuable from a 4 year experience in an R&D department?" "What are the conditions that trigger a remarkable project?" and "What are the elements that make this situation memorable?" This first reading made us aware of what information is useful for the study. Thus we filtered the transcripts by deleting information not relevant for this research and by creating first draft categories.

After this field impregnation the analysis was carried on four levels represented in Figure 98 selecting codes and making **concepts** (level 1), creating **categories** (level 2), redefining categories and creating **clusters** (level 3) and finally grouping clusters into **themes** (level 5).

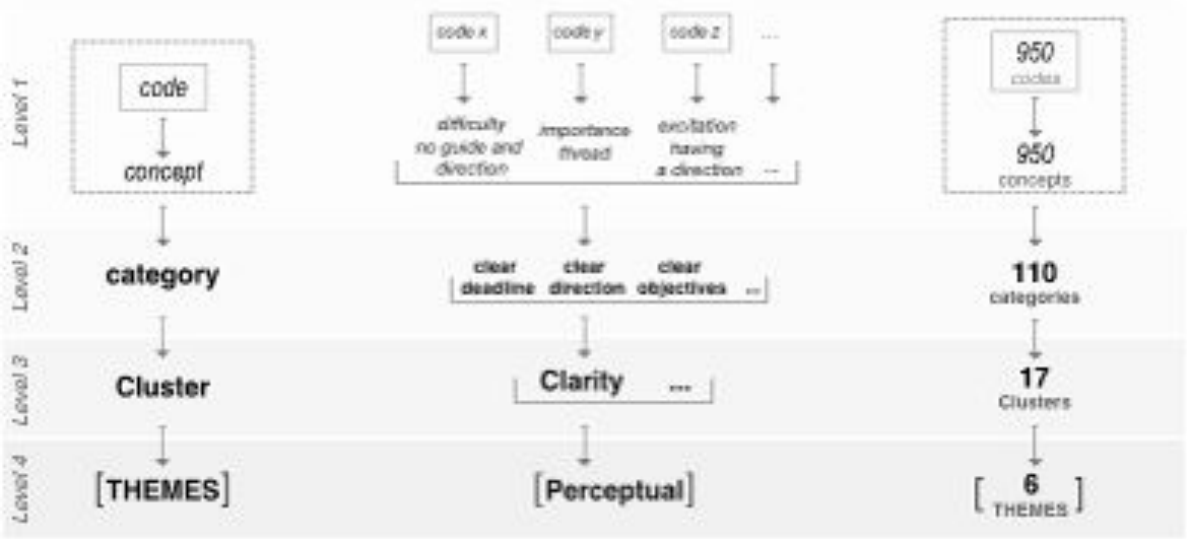


Figure 98 Data coding in **code, concept, category, cluster** and **theme** levels - a quantitative view of the Grounded Theory levels with an example.

The first pass is about reducing large amounts of data to more manageable pieces of data called **concepts**. We decided not to do a line-by-line analysis, but *a coding on a whole sentence or paragraph in order to grasp general ideas.* Strauss & Corbin suggest to use this way of conceptualizing when the researcher already has several categories and wants to code specifically in relation to them ((Strauss & Corbin, 1998), page 120). The text labelled under each concept is called a **code**. If a person talks about the same thing several times, information is organized in the same code, under the same concept. A concept is build from 2 or 3 words as in the example presented in **Figure 98**. At the end of this step we obtained around *950 different codes* and *950 corresponding concepts.*

A category is a collection of concepts with a higher abstractisation. For example concepts like: "difficulty – no guide and direction", "importance thread", "excitation having a direction" etc. are arranged in the category "clear direction". The study reveals around *110 categories* that group between 3 and 25 concepts. As the number of categories is still high we need to group our results into another level, **clusters**. This is different from the Grounded theory where researchers stop at the level of categories. The level of abstractness of the clusters is higher than the level of categories. For example categories like "clear deadline", "clear direction" and "clear objectives" are arranged in the cluster "Clarity" – see **Figure 98**. We found *15 clusters* that assembly between 25 and 80 concepts.

Before passing to the explanation of the next level, we share a comment to the quantitative view of this study. We choose to represent clusters through *the number of concepts* and not through the number of participants. For example in the "Clarity" cluster we *assembled 40 concepts* coming from 22 participants. The number of participants per cluster varied from 20 to 25 persons and so the difference is not significantly large to emphasize the importance of a cluster more than another. However clusters are not equivalent in importance. In order to show this difference, we count the number of the concepts per cluster. First hypothesis on the importance of certain clusters are build on this quantitative view.

Lastly the nature of these clusters reveals that they belong to different types of aspects of experience in an R&D lab that we call **themes**. Some of clusters are related to the four dimensions of the framework presented in Section 2.2.4, i.e. *the Perceptive, the Emotional, the Intellectual* and *the Communicative* conditions. Two more themes are added to organise aspects related to *the Collective* dimension of an R&D experience and *the Organisational* dimension of this context.

4.4.4 Results

This section consists of thematic-based codes and categories that describe the nature of an Experience in APPRD Bell Labs France. Findings are presented in two parts. In the first part we present the four dimensions of the R&D experience - **Table 14**, that are similar to Csikszentmihalyi & Robinson responses with art encounters: *the PERCEPTIVE, the INTELLECTUAL, the EMOTIONAL* and *the COMMUNICATIVE*. The second part shows the two new themes found in our terrain, *the COLLECTIVE* and *the ORGANISATIONAL* presented in **Table 15**. For each cluster, we give a definition, the number of concepts gather from the field and we present thematic-based vignettes, which offer insights into how practitioners relied the subjective aspects of experience to their work. When citing participants we use an indicator code - Id. from 1 to 31.

4.4.4.1 The Perceptive, the Intellectual, the Emotional and the Communicative

This subsection presents four dimensions that we find in our field and that are similar with those found by Csikszentmihalyi & Robinson. We synthetize in **Table 14** three levels that presents these dimensions: themes, clusters and categories. In order to arrive at this synthetic view we used mind-mapping application – *MindNode*.

Table 14 Aesthetic aspects – Perceptive, Intellectual, emotional & communicative dimensions

Theme	*Clusters (N° Concepts)*	*Categories*
PERCEPTIVE	a. **CLARITY & PERSEVERANCE (40)**	Clear roles; Clear objectives; Clear deadline; Clear direction; Clear image result; Clear process; Progression; Continuity; Perseverance; Belief; Dispersion & Focus.
	b. **WHOLENESS & INTEGRATION (42)**	Integration; Complementary; Completeness; Coherence; Perfect matching; Naming
	e. **FREEDOM (57)**	Freedom pleasure; Freedom choice; Freedom way of doing; Freedom limitations; Freedom & power; Freedom process; Freedom exploration.
	d. **CONCRETENESS (50)**	Concreteness; Production; Realization pleasure; Demo; Tangibility.
	e. **PIONEER & EXOTICITY (49)**	Exoticism; notoriety; originality; the first; new; pioneer pleasure; Do innovation; Do research, Perceive beauty.
INTELLECTUAL	f. **INTELLECTUAL EXPERIENCE (49)**	Challenge; Resolution; Discovery; Exploration; Intellectual pleasures; Reflection; Creativity.
	g. **CLOSURE (56)**	End good; End negative; Deadline; Closure.
EMOTIONAL	h. **SELF-RESONANCE (40)**	Self and work; Resonance; Research pleasure; Pleasure in work; Technical pleasure.
COMMUNICATIVE	i. **DISCUSSION & CONFRONTATION (25)**	Discussion external & experts; Confrontation; Discussion conceptual pleasure; Presentation; Discussion openness
	j. **EVOLUTION (53)**	Learning and development; Evolution; Change perspective; Transformation; Improvement; Change activities.

The PERCEPTIVE theme represents clusters related to *clarity, wholeness, integration* and *freedom* that were felt by researchers within their work. These notions are not related to how researchers perceive projects, but rather *what they felt during these projects* and *what they remember*. Other clusters in this theme regroup aspects related to *originality, need to be a pioneer* and *to create concrete things.*

a. **Clarity & Perseverance** is the perception of well-organized way of doing things and object directedness. Whether it is about clear objectives, roles or deadline, people usually criticize the lack of clarity in their work. Clarity gives them satisfaction and an appropriate environment to build knowledge and to work together. Other participants talk about belief, perseverance and progression. The will to go on and the force to arrive at an end are also important parameters for the researchers. These aspects are grouped in the same cluster even if they represent clarity or lucidity in more subtle ways like willing to pursuit a goal, to follow a direction or to solve a problem that are notions found in the Intellectual dimension.

b. **Wholeness & Integration** describes the satisfaction that comes from coherence of the ideas and interactions. This coherence is perceived as a perfect matching of different parts of the project, an imbrication or an integration of researchers' skills, professions and activities. Perceiving the progression of the project towards a unified view, but also having a depth view of each component of their work are satisfying elements for researchers. This state is described as a unified view created by different parts that are connected like a puzzle.

> "Seeing that rapidly, in 6 months time, each component progressed and thus together we made the solution to take shape. It is very pleasant; an overview and a depth view of each unit."(Id. 17)

PERCEPTIVE dimension clusters
a. CLARITY & PERSEVERANCE (40)
b. WHOLENESS & INTEGRATION (42)
c. FREEDOM (57)
d. CONCRETENESS (50)
e. PIONEER & EXOTICITY (49)

c. **Freedom** is related to the pleasure of having the appropriate space to take decisions, to manage a project in a certain way and have the power to take actionable decisions. Within the category *Freedom limitations*, freedom is opposed to efficiency as too much freedom brings unprepared exposure to external factors or stressful situations:

> "What was remarkable, shocking almost, was this way of doing very opened. I had the feeling of total freedom on the direction that we took… this is motivating, this feeling of total freedom… but also very stressing… we were always beholden to explanations, we had to argue and argue to justify our position"(Id. 1)

Almost all researchers consciously recall a feeling of freedom in their work and identify this aspect as becoming a necessity in their future work.

d. **Concreteness** cluster describes aspects related to the experience of creation, of making. This study identifies this dimension as a core dimension of a memorable experience in an R&D lab. This notion clearly differentiates the experience of art curators from the experience of researchers. The role of the researcher in a project is different from that of a person experiencing a painting. The work is finished in one case and is to be created in the other one. The relation thus is different through the engagement and the self-expression that the creator, here the researcher, puts into the work. Concreteness of things and their tangibility are properties that engage people and make them share a reality.

> "The process was complete due to the fact that well, we could have done lots of stuff on this topic, but we had this phase where we did not just had some ideas in the air, but there was a realisation, we made a demonstrator, it was satisfying; it would have been uncomfortable if we had stopped before the realisation phase"(Id.27)

e. Being the first to build something or working on something new and outstanding are elements that influence the subjective experience of researchers in the next cluster, **Pioneer & Exoticism**. It brings social and personal proudness and it is a way to mark a territory and create value for the company. Moreover the consciousness of doing innovation and doing research becomes a force and a motivational leverage:

> "I've always been interested by science… I've always been passionate by all the things related to invention, discovery and innovation; … I have lots of topics that I'm fond of, but research is something that I'm fond of for a long time" (Id. 24)

Within this cluster there are also less usual aspects for describing a working experience like visiting a prestigious research centre like NASA or presenting a demo in a UNESCO centre. We called them *exotic aspects* as they are different to each project and they bring something outlandish to the research process. Other aspects of this cluster are related to beauty in how things are done. Talking about one of the most memorable projects, a participant of this study talks about elegance, something unique and impossible to reproduce that marks and brings differentiation. These elegant elements or ways of doing, rest in his memory and are not necessarily related to efficiency or productivity, but to a subjective resonance:

> "On certain subjects, and I read dozens and dozens of papers, it's, well it's going to be part of the 2-3 papers that I will remember, even if the results are not necessarily extra-ordinary compared to others, but it's something there sufficiently differentiator for that thing to be remembered; … for me it is the exact feeling that I have when I am in front a painting in a museum, and I say here is this painting, I feel something for the painting and another person thinks it's nothing; I'm not an art expert, but I don't know, it's something visceral more than facts or

criteria; it's not about a degree of comprehension, because for example on two papers on the same topic, I can understand them both, both are scientifically good, but one is more beautiful than the other". (Id. 27)

The INTELLECTUAL dimension presents three types of responses that researchers experience in their work – three types of **Intellectual Experiences**. Firstly it comes from solving a research question or overpassing a technical challenge. Secondly it is about the excitement of discovery, of finding new things and being the first to give a meaning on a phenomenon. Finally intellectual pleasure arrives through deep exploration of ideas and thoughts. Having the time and the opportunity to understand things is for the members of this laboratory one of the most important moments of their job:

INTELLECTUAL dimension clusters	
f.	INTELLECTUAL EXPERIENCE (49)
g.	CLOSURE (56)

> "The depth of reflexion and the fact that we started always with 'the reason for' of things; when I got the job at Bell Labs, what I loved more is the fact that one gives depth to his/her actions to locate the technical development" (Id. 28)

g. Within this dimension we also place the **Closure** cluster, as this notion is more complex than a simple end or stop of an activity. Rather a temporal aspect of the experience, this notion is the conclusion of a process, a feeling of finality or resolution where the wholeness and integration culminates. Good ending comes from final results and it gives satisfaction and motivation for the next projects. However this 'proper ending' is difficult to attain:

> "We never know how to finish because it is difficult to define the final object, … we all know that at some point the project is going to stop; generally it stops because it's let down or it stops due to external constraints" (Id. 23)

The EMOTIONAL theme regroups emotional responses of researches. Emotional engagement and resonance with self-aims and self-expression make projects memorable. The personal ideas and interests and their relation with the organisational goals are also evoke by researchers in the **Self-Resonance** cluster. The usefulness of a personal skill for the company raises engagement in work. One of the participants talks about the feeling he had when he could write something that lived him for some time:

EMOTIONAL dimension clusters	
h.	SELF-RESONANCE (40)

> "{Name of a project} was an occasion to write something that inhabited me… it was a real sensation, especially when it was recognised; it was that sensation of power, give form and body, find a way to legitimise a thing that inhabited me, that was in me" (Id.30)

Also their personal engagement in projects depend on the time and energy spent on these activities:

> "I was strongly engaged because it was a project that was given to me to build and to manage and I spent lots of time and energy; not reaching the level of {name of another project}, but in terms of intensity" (Id. 25)

The COMMUNICATIVE theme gathers aspects related to the satisfaction that comes from discussing, confronting ideas and evolving. These discussions have different purposes: whether they give an intellectual pleasure - conceptual discussion, whether they validate some ideas, or they enrich the interlocutors' knowledge. The discussion is a transformative and inter-individual process. It involves the desire to learn something new and having a good interlocutor is mandatory. One of the researchers describes this dialogue as a tennis match:

COMMUNICATIVE dimension clusters
i. DISCUSSION & CONFRONTATION (25)
j. EVOLUTION (53)

> "Actually I prefer to play with someone that is a little bit better than I am; this helps me to development myself; it's the same thing in research, if I discuss with someone that is not in my field, it's like in tennis when you're playing with someone that is way better than you: you'll understand nothing, there is no game and you have nothing interesting. However if I have someone working in the same field but a little bit better than myself, I can understand, I can send him some tennis balls, and there we have discussion, and there we have an interesting match."(Id.17)

j. **Evolution** cluster describes the importance of aspects like evolution, transformation, technological improvement and learning that gives researchers satisfaction within their work. It is not only about the need and the curiosity to know more, but also the urge to become a specialist in the field and attain an Excellency level. This desire might also come from the historical background of this laboratory and its scientific culture. However due to the industrial context and the organisational changes that occurred within the 4 years in this department, some of the researchers also describe the difficulty they have in achieving this goal.

> "This is a the problem of working in an environment that keeps on changing the topics each three months; and I did not become a specialist in anything … nor did I attain the excellency level" (Id.2)

However these changes also brought new perspectives in this techno-centred environment. Meeting designers and human science specialists, "non-technical persons" as the engineers called them, made the researchers understand new roles and practices and also transformed them.

> "The thing that marked me in {name of the department} was to work with persons that are not technical; I do not know if this gave me pleasure, but it's something that transformed me … I've already work a little bit with designers and ergonomists, but this time I put a particular attention

on this matter; today I wouldn't integrate so much their work in common papers, if I wasn't confronted to such situation" (Id.2)

In this subsection we present four of the dimensions found in our study on aesthetic experiences in an R&D department. These dimensions show the richness of the subjective experience of researchers and its similarities with an aesthetic experience in other contexts. Further on we show two additional field-specific dimensions of an R&D experience.

4.4.4.2 The Collective and the Organisational

Memorable situations and remarkable projects are also related to other factors, less conventional for the theory of aesthetics. Our results suggest that within a *collective environment* there is a **collective experience**. Working together creates a *synergetic movement* and the social experience like *knowledge sharing* and *demo presentations* engages researchers and transforms them. Finally *the organisational aspects* are also highly represented in this study. Due to a prestigious history of Bell Labs, the subjective experience of researchers is highly influenced by the culture that surrounds them. **Table 15** presents these two themes and the correspondent clusters.

Table 15 New aspects of the Aesthetic Experience in an R&D department – the Collective and the Organisational dimensions

Themes	*Clusters (N° Concepts)*	*Categories*
COLLECTIVE	a. **COLLECTIVE ACTING (41)**	Collective actions; collective motivation; collective results; collective decision; multidisciplinary.
	b. **SYNERGY (29)**	Synergy; togetherness; relation; federation; cooperation.
	c. **SHARING (14)**	Sharing experience; show realizations; show demos.
ORGANISATIONAL	d. **IMPACT & INFLUENCE (72)**	Impress company audience; business impact; company impact; impact real people; impact social impact; contagiousness; persuasion; influence.
	e. **CORPORATE LAB CULTURE (84)**	Lab name influence; research impact; resonance company; results culture; hierarchical relation.
	f. **IMAGE (23)**	Professional image; internal image; exterior image.
	g. **RECOGNITION (54)**	Recognition aspects; external recognition; internal recognition; management recognition; appreciation; feeling useful; feedback; scientific recognition.

The COLLECTIVE dimension gathers clusters related to COLLECTIVE ACTING. The fact that researchers lived similar experiences with same conditions like organisational constraints, motivations and results brings unity in teams. This mechanism of collectiveness is working as a social need and not having similar conditions brings frustration and the feeling of sacrifice:

> "So I sacrifice a certain number of freedoms in order to do that thing… and that's frustrating; if you are in this pipeline and you tell yourself 'I'll give up this freedom', and finally around you, people are not in the same mood, that's kind of hard." (Id. 12)

b. Within **Synergy** cluster we find similarities to the **Wholeness & Integration** aspects presented before but at a collective scale. Synergy is it about a cooperative interaction, federation and togetherness that create an enhanced combined effect. It is perceived when people are working on the same direction and their actions are interlinked perfectly to create a common goal.

> Researchers talking about a memorable project: "because we had a multidisciplinary synergy, a visible and tangible engagement of the persons " (Id. 19) and "we had the satisfaction of being in a group of people that advanced together"(Id. 16)

This synergy brought intensity in the relation and created a connection that persists even once the project is over. Once researchers lived an intense experience in which they invested energy and a large amount of time and work, a close relation is created and used in future projects:

> "We were very close, I think that there is a relation, now when I see {name of researcher}, we have something, and with {another name of researcher}, I mean we really shared something intense together, a shared experience that we created" (Id. 13)

COLLECTIVE dimension clusters
a. COLLECTIVE ACTING (41)
b. SYNERGY (29)
c. SHARING (14)

Some of the researchers with technical background found the experience with design teams rich and transformative. For others the actual experience of working together was not important and they were not influence by the character and the exotic skills of the other member of the project. The most important thing was the progress and the results of the project:

> "I think that one has to work with people that helps the project; otherwise, I don't care if they are fascinating or not since I can do the project." (Id. 8)

c. **Sharing** is related to how people show their work to others. Demos and presentations are important for this aspect. A demo represents a tangible result of one's work. Some researchers perceive it as an intellectual exercise: "*what I like is to demonstrate that an unsolved problem that we're not sure to solve, we succeed in solving it*" (Id.4). The Open Days of Bell Labs are one of the major events that concern all the researchers in this industrial laboratory. Within this context, presenting the work and demonstrators to external partners and future clients is a stressing constraint for some researchers and is a satisfying activity for others:

> "I have an important technic role… to create demonstrators; to present, yes, I like to present to others but not really in front of everybody,

and the big presentation, I do not any shows, I like to develop and talk about what I've done, but in an environment where I know people… Open Days is stressing" (Id. 18) "Everyday when you arrive at work you know that there is a chance of one out of 20 that someone will tell you that someone is coming and you have to present a thing and you have to look convincing and passionate… me, I like doing this!" (Id. 2)

The final theme of this study, ***the ORGANISATIONAL*** brings clusters that are related to needs in organisations. However the particularity of this cluster is the fact that the R&D lab has both a research culture with a long history and an industrial culture.

ORGANISATIONAL dimension clusters	
d.	IMPACT & INFLUENCE (72)
e.	CORPORATE LAB CULTURE (84)
f.	IMAGE (23)
g.	RECOGNITION (54)

d. **Impact & Influence** cluster describes researchers need to influence and to create an impact for the company. There are different types of impact like social impact, internal impact and external impact also a general category that shows a tight connection between the degree of impact and memorability. The more researchers have an influence on a project, the more they remember that project. In our context influence is manifested thought the transmission of an idea towards superior levels or among colleagues:

"If we succeed in having our own satisfaction, of being pleased with our research work, if we succeed having a certain number of discussions without a real transfer, but simply a slight influence… implementing influence takes time, one has to democratise a little bit the subject in order to persuade and it's a matter of timing also, to be at the right place, at the right time"(Id. 27)

One other category related to this last aspect is contagiousness. Motivation and demotivation are viral in working places. Working with determined and motivated persons brings cohesion in teams.

"When I knew that those persons were in the project, that motivated me even more… they are people that are fond of what they're doing and they are pleasant also". (Id. 3)

e. **Corporate Culture** underlines the importance of the name of Bell Labs and how this name influences the activities and the culture in research teams. Some researchers consider themselves as being part of a big family with a long tradition, other find this relation rather stressing. The culture of this laboratory that had lots of scientific rewarding establishes a high level of research that today is difficult to attain.

f. Due to the industrial context, the way the company is seen by its partners and future clients is identified as an important concern for managers but also for the researchers. **Image** cluster is the feedback of how researchers are perceived by the others, both internally, in their teams, and also externally, with their partners and clients. Becoming a

researcher in this industrial lab changes the way people see themselves and also how they interact with external persons.

> "The huge impact that comes more from Coué method {autosuggestion} than of anything else…; I am a researcher at Bell Labs, the impact is that I started doing research; before I was in a research centre and I was doing what I thought was called research… but I started reading and writing papers since we became Bell Labs" (Id. 30).

Also working with designers and sociologies brought constant questioning on the skills of some engineers. During the 4 years there are several people that attended design classes and reconverted. 4 of the 31 researchers' interviewed changed their profile from engineer to designer-engineer and sociologist-engineer.

g. The final cluster **Recognition** describes the nature of recognition needed by this laboratory. Some of the researchers belong to the academic community, therefore the scientific recognition is important. Others talked about an internal recognition that is also related with the internal image: how people are appreciated and seen by their colleagues and their managers.

This subsection shows the last two dimension of the Aesthetic Experience that we find in our qualitative study. We believe that these two dimensions are also important factors of the aesthetic quality of researchers interactions and feelings in work. They are subtly connected with the four dimensions presented in the previous subsection - *PERCEPTIVE, EMOTIONAL, INTELLECTUAL,* and *COMMUNICATIVE*. However their particularity lays in their manifestations as reactions to the organizational frame. In the next section we present all the dimensions of this study and expose a first discussion of Experimentation 1.

4.4.5 Discussion of Experimentation 1

4.4.5.1 Towards an empirical framework of an Aesthetic experience in an R&D department

Figure 99 presents an overview of the 6 themes and the corresponding clusters found in our field. We represent in grey colour the dimensions and the categories that already are present in the theoretical framework presented in **Section 2.2.4**: Creating a theoretical tool to observe and describe Aesthetic Experiences. The new clusters and categories that this study reveals are represented in dark colour. The size of the cluster and the number inside represent the number of concepts found in our field.

A first confrontation of our results shows that there are local similarities between the aesthetic experience of museum professionals and

the experience in an R&D lab within the first four themes. Most dimensions existent in (Csikszentmihalyi & Robinson, 1991) are also found in our terrain with few differences in proportion and context.

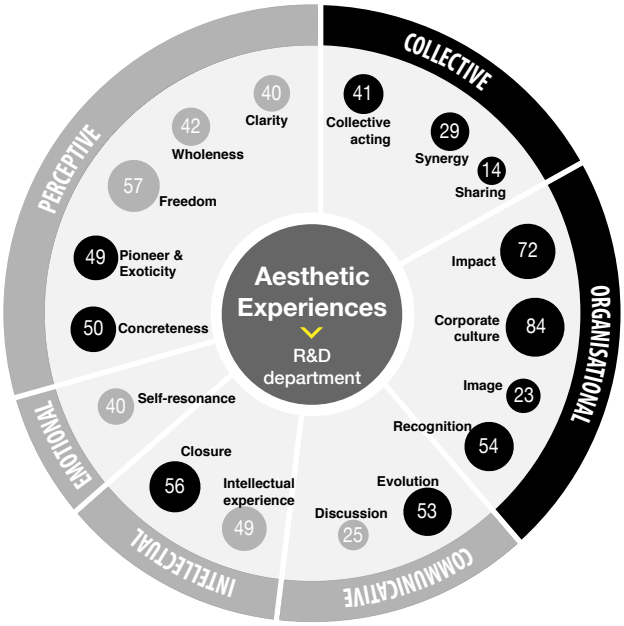


Figure 99 Results overview: the six themes and the correspondent clusters of an Aesthetic Experience in an R&D department

Further on we show an overview of the six dimensions of the aesthetic experience in an R&D department and we make a comparison between the researchers experience with the aesthetic experience of museum professionals from Csikszentmihalyi & Robinson study.

The Perceptive dimension is the most complex dimension of our study. It regroups notions of *Clarity, Wholeness, Integration, Freedom* and *Beauty perception* that are also states of mind found in the literature on Aesthetic experience. The difference with the Perceptive response of the museum curators is contextual. For example the *Physicality and the Objecthood* of an artwork, i.e. the fact that a painting is original and not a reproduction, corresponds in our field with the *need to be Pioneer, Concreteness* and *Exoticity pleasure*. These notions describe originality in the context of an R&D lab. Being the first to invent a new technology or to register a patent are ways in which the researchers' uniqueness is manifested.

The emotional dimension of our study is less rich than in the museum context (only one cluster with 40 concepts), where in Csikszentmihalyi & Robinson study it represents the major part of the responses. The particularity of the *self-resonance* in an R&D lab is the fact that numerous participants talk about mixing personal interests in their

working activity since they become members of this laboratory. Some of them discover personal research topics that resonate with their interests and curiosity. Then, these *personal topics,* and not the episodic projects, become meaningful for researchers. This mechanism is somehow similar to the relationship between museum curators and certain artworks. It is a long-term relation that is changing over time and becomes richer in personal involvement and resonance. Due to the short period of this research domain, i.e. 4 years, a global frustration come from the fact that researchers arrived to the point when they identified a personal topic, but they had to stop due to organisational reasons.

The intellectual dimension of researchers is very similar to the intellectual experience of museum curators. One of differences of the two fields is the need of researchers *to close* activities and projects. As presented in Findings section, *Closure* is a very important step in projects, as it is an exercise of resolution usually accompanied by a feeling of finality. As the experience with an artwork is not habitually seen as process that is ending, this condition is not something art professionals talk about. The notion of Closures brings interesting questions that are discussed in the next section.

The Communicative theme needs also clarifications with regard to our study population. For researchers, discussing and confronting their work is a way to evolve. The project is an opportunity to learn something new and to develop new skills. Therefore, *the project is an environment for personal and technical development.* For museum professionals this dimension is a way to connect to the work and its context, to understand social conditions of its birth and finally to better resonate with the artwork. However in both studies the notion of dialogue over time is present whether it is about career evolution or evolution within the relation with an artwork.

The Collective dimension of an R&D experience is something new in the framework of aesthetic experience. With conditions as *Collective acting, Synergy* and *Sharing,* this aspect could lead to rethinking the aesthetic experience from a new perspective. In the Discussion section, we develop first suggestions and implications of this aspect.

Finally, ***the Organisational*** aspect of the experience is the last dimension found in our field. We decide to include this aspect in our framework as it constitutes the context in which R&D experiences occur and therefore we need to understand it in depth. One of the biggest clusters of this dimension and of this study itself is *Corporate culture.* The past of this laboratory and its powerful image influence researchers' experience in the same way as the name of a painter influences people experience with the painter's artworks.

Further on we discuss these dimensions in regards with theories coming from literature and we emphasize the particularity of subjective experiences in an R&D department.

4.4.5.2 Discussion Experimentation 1

The findings of this research suggest that there are six dimensions of the aesthetic experience of an R&D lab: *the Perceptive, the Intellectual, the Emotional, the Communicative, the Collective* and *the Organisational.* The significance of this research study is that it revalidates four of the dimensions of aesthetic experience proposed by (Csikszentmihalyi & Robinson, 1991). Doing so this study reveals connexions with theoretical frameworks on the subject from Aesthetics literature (Beardsley, 1982; Dewey, 1934) and it empirically validates some of the conditions proposed by these theories. For example Beardsley conditions *Object directness, Felt freedom, Active discovery* and *Wholeness* are also found in our study in the following clusters respectively: *Clarity, Freedom, Intellectual experience* and *Wholeness.* Having four conditions attained confirms the **aesthetic character of the experience** (Beardsley, 1982). However this first result looks at experience from a collective scale and not at an individual level. The clusters presented before gather the responses of 22 and 24 persons out of 31 persons; a further quantitative study on the conditions found in the field could validate and consolidate this first outcome.

Concerning the differences with the aesthetic experience of museum professionals, the aesthetic experience of researchers brings new notions to the framework presented in the first section of this paper. Within *the Perceptive* response, the object that is perceived in an R&D lab is any tangible outcome of the design process or even the project itself. Beauty is related to logic, or describes a way in which things come to life. Concreteness is a new specific notion of our terrain and it is the materialization of a thought into reality. The experience of making has itself an experiential quality. From this perspective we look at the experience in an R&D lab as **the experience of makers / doers** and we raise two points. Firstly, knowledge concerning the relation between the experience of making concrete things and the importance of this experience for researchers and their work is limited. There are few studies that discuss similar topics. For example, the prototyping activity and particularly low-fidelity prototyping impacts learning, progression and creative ability (Gerber & Carroll, 2012). Other researchers like Bodin Danielsson is studying the impact of tangible artwork and artefacts and shows the importance of concrete outcomes to personalize the workspace and by these means to give a sense of *aesthetic control.* This aesthetic control brings *coherence at individual and group level* and is close related to satisfaction in work and productivity (Bodin Danielsson, 2011).

Secondly we find that a discussion on the population of this study in comparison with museum professional could also bring knowledge on the experience of making. Museum professionals are *specialized agents* (Bourdieu, 1987); they are not final users like the mundane audience of museums. Researchers might also be classified in this category as they follow general line of the organization. However they create knowledge and artefacts - their artwork, and therefore are also creators. In our case the laboratory culture is both an institution of consecration due to the history and prestige of this laboratory, but also the place where the artwork is produced.

The *Intellectual* response within the R&D experience brings a new notion into a theoretical focus: ***Closure***. Results show that the quality of a project experience depends on the ending of the project and therefore the action of finalizing activities is mandatory to researchers. Similarly (Kahneman & Riis, 2006) talk about the difference between *experiencing* and *recalling an experience* and show how the ending of an activity influences memory and experience recalling. Moreover Dewey talks about the necessity of Closure to complete the total experience (Dewey, 1934). However from the theoretical point of view we lack of understanding of what could be the Closure of an Aesthetic experience with a painting. If projects have a temporal structure, what could be the temporal structure of an Aesthetic Experience over time and particularly how such experience ends?

Another specificity of this terrain brings new questions to the concept of aesthetic experience, enlarging the field to new dimensions such as **the collective aspect of the experience**. Understanding how the collective acting could bring the aesthetic character to an experience is new. Our results show that collectiveness influences individual experience and we find the same mechanisms of *Wholeness* and *Integration* described before but at a *collective scale*. Cooperation, federation and togetherness are important elements described by people to describe remarkable interactions. Multidisciplinary is seen more as a goal than a result. In such technical centred environments, the designer or human science specialist is a new actor that brings new challenges in the working experience. Researchers and managers are convinced on the necessity of such collective practice however they are not satisfied of the results they experienced. Even though working with individuals having other skills brought frustration in respect with final results, multidisciplinary brings a new perspective to look at things and rich discussions.

Finally **the organisational** aspect makes us aware of the connection between these concepts and the organisational needs and motivations theories. Influence in corporation was also identified as a relatedness need by (Alderfer, 1969). Together with acceptance and confirmation, influence

is a social esteem need in organisations. It involves relationships with significant others and its satisfaction depends on a process of sharing and mutuality. The connection between needs and the aesthetic experience conditions is also an important point of this study. Questions connecting **needs and the aesthetic conditions** still remain unanswered even if Maslow pyramid on human emotional needs (Maslow, 1971) has a level called the *Aesthetic need* – need of symmetry, order, and beauty. The aesthetic experience is more complex due to its transformative nature and its self-transcendence quality.

4.4.5.3 Limitations of the qualitative study

The nature of the limitations of this study is highly depended on the specificity of our field. Further on we explain several limitations and unexpected effects of our interviews. The first one is related to *the influence of Bell Labs image*. The second one *discusses the influence of the department closure on the experience recall.* Lastly, we show several aspects of the recounted experiences of researchers on *emotion and experience temporality.*

- **The effect of Bell Labs image**

In the cluster **Corporate culture**, we present the influence of the name of Bell Labs for the APPRD researchers. Our findings show that there are *15 research engineers* for whom the image of Bell Labs is related to *positive feeling* in their work. This feeling brings in a positive responsibility, a perspective change and the proudness of belonging to a symbolic and powerful structure. Other *4 participants* consider that the *name of Bell Labs is an imposture* that arrived from one day to another. They find that the name introduces a negative competition and a too high Excellency level. Other *5 persons* have *an ambiguous feeling* as they consider that the today Bell Labs is different from its prestigious. Finally, for other *5 persons,* the image of Bell Labs has no impact in their work. These aspects show the ambivalent influence of Bell Labs image on the working experience of APPRD members. Both a motivational leverage as a pressure element, the name of the laboratory particularizes our study. This observation needs further investigations in other R&D environments.

- **Experience & Memory recall – the bad ending effect**

The APPRD department is closed in January 2012. Our study is conducted in June 2012, several months after the end of this activity. During the interviews we observe an overall feeling of frustration and dissatisfaction of researchers due to the unexpected organisational decision. We believe that this general feeling also influences the way people talk about their experience in this R&D department. Recent studies in memory theory detailed in the State of the Art show the complex

relation between *memory and experience*. Kahneman shows the impact of ending of an experience on how people remember that experience and create the memory self (Kahneman, 2011). Moreover a negative ending for an experience usually brings in a negative diagnostic for the overall experience. We do not know how the ending of APPRD influences these results, but we believe that there is a relation between these elements.

On the contrary, conducting this study several moths after the department closure, in a period of reflection and retrospection for the Bell Labs researchers might be considered as an advantage for the aim of our investigation.

- **Recounting experiences – the effect of temporality, emotion and experience**

In the third part of our interview, we ask participants to describe a project that made them live a non-ordinary situation whether positive or negative and that changed them, transformed them and that rests in their memory as a significant situation. We also guide participants to follow a *temporal structure*: on the beginning of the project - the first encounter, then focus on the personal experience in the project, and finally how the project ended. For the experience reconstructing, a recent tool for retrospective elicitation - like **i-scale** developed by (Karapanos et al., 2012), and the recent results coming from experience retrospective methods would have been an interesting direction to investigate. However for this first study, our choice is to reproduce the same protocol as (Csikszentmihalyi & Robinson, 1991) in order to compare our results with those coming from museum contexts.

Regarding the temporal evolution of recounted experience, we found little useful information to reconstitute a global structure of a project-experience. Usually the beginning of projects is not significant or at least not emotionally significant. The end of projects however is an important variable. The majority of participants talk about a negative project-experience when projects are not ended. They felt frustration when projects are not properly ended.

Finally we also encountered difficulties during several interviews due to the intense emotions that the interview brings to research engineers. When they are asked to recount *non-ordinary, memorable, transformative project-experience*, several researchers describe complex interaction between management and how these relations affect them. These emotions show the intense emotional life in organisations, with complex relations and feelings. This remark brings in two observations:

→ Firstly, the intense experience recalling might influence the experience. The fact that people relieved an experiences through recounting – experience as a story (Forlizzi & Ford, 2000) might trigger a

more in-depth *reflection process and awareness*. And we show in the State of the art, the *after the event* processing influences how experience is captured in memory (McCarthy & Wright, 2007).

→ Secondly, we hardly could transcript intense emotional states and finally our data lost the emotional intensity expressed in the interviews. Still, we also believe in the role of **interviewers** to take into account these emotional parameters while the data analyse. Grounded theory seems to be the appropriate qualitative approach that takes into account such effects.

4.4.5.4 Validation of Hypothesis 1

Hypothesis 1 explores the existence of an aesthetic experience in an R&D department. We investigate the dimensions of an aesthetic experience in a qualitative study at Alcatel-Lucent Bell Labs. Using Grounded theory to analyse the responses of 31 participants, we find six themes that describe researchers most memorable and transformative experiences: *the Perceptive, the Emotional, the Intellectual, the Communicative, the Collective and the Organizational*. The first four themes are similar to the four dimensions of aesthetic experiences found by (Csikszentmihalyi & Robinson, 1991) with several differences due to the environment context. The last two themes, *the Collective and the Organizational* are new dimensions that describe the complexity of researchers' working experience. The richness of these new themes and their connection with the other dimensions, lead us to integrate them in the final framework of this study. This final framework - **Figure 99**, validates the first hypothesis of the thesis: **there is an aesthetic experience in an R&D department and it can be frameworked**.

4.4.6 Conclusion of Experimentation 1

The goal of the first Experimentation is to investigate the first hypothesis of this study regarding *the existence and the framework of an aesthetic experience in an R&D department*. This hypothesis is validated through a **retrospective and qualitative study.** *31 research engineers from Application Research Domain (APPRD)* from Alcatel-Lucent Bell Labs France recount their subjective experience during the four years of existence of this department. The data are analysed using Grounded Theory.

The study finds *the four dimensions* of the theoretical framework presented in Section 2.2.4: *the Perceptive, the Emotional, the Intellectual and the Communicative*. Besides these four dimensions, our analysis reveals two other major aspects of the subjective experience of researchers:

the collective and the organizational. The corresponding conditions of these two dimensions show their importance and their inclusion in the framework of an aesthetic experience in an R&D department.

The next section – Experimentation 2, continues our research process through the investigation of the second hypothesis of this study, on the relation of the dimensions of aesthetic experiences found in our field and the innovation and design culture.

4.5 Experimentation 2: Influence of aesthetic experience in an R&D department on innovation and design culture

4.5.1 Introduction and objectives

In Experimentation 2 we consider the second hypothesis of this thesis: **There is a strong correlation between the aesthetic experience of Research Engineers and both the Innovation and Design culture**. As shown in **Section 3.3.2**, we divide this hypothesis in two sub-hypotheses and therefore in this part we investigate two directions.

The first direction investigates *the relation of the aesthetic experience with the innovation culture*. Our hypothesis proposes that these two concepts are correlated. Therefore we aim to understand *how the conditions of this experience are related to the innovation indicators of Bell Labs – Key Performance Indicators (KPIs)*. The second direction explores the influence of design to create an aesthetic experience. The examples shown in Pre-Experimentation section suggest that there is a *strong correlation between the aesthetic experience of researchers and the design culture* they experienced during the four years of existence of this department.

Further on we describe the *experimentation field* of this study, *the methodology of our examination* – the protocol creation and the analysis, and finally *the results and the discussion of this investigation*.

4.5.2 Experimentation field

In order to respond to this hypothesis, we conduct **a quantitative study with 30 research engineers from APPRD Bell Labs**. The participation requirements are similar of the first study: the research engineers selected are permanent members of APPRD France from 2008 to 2011.

We also want to underline a particularity of this population. The major part of the participants also took part in the Experimentation 1. Some of

them are already familiar with the concept of Aesthetic Experience due to the numerous discussions and presentations made during the development of this PhD. These interactions and discussions bring valuable information on the participants' awareness and personal reflection on the subject. For us is a way to gather personal data and analyse their state of mind in depth. Moreover the Research-Action approach proposes *a participative framework between the researcher and the participants.* A good Research-Action approach requires a strong engagement of both sides.

4.5.3 Study methodology

4.5.3.1 Plan the questionnaire

Sub-hypothesis 2.1: The first goal of this experimentation is to understand the correlations between **innovation indicators at Bell Labs**: *number of publications, patents, technological transfers and breakthrough solutions*, and **the conditions found in our framework on Aesthetic Experience** – Experimentation 1. In order to understand this relation we analyse 54 projects at Bell Labs (see part B of the questionnaire grid in **Appendix B**).

Recall **Figure 99**: Aesthetic Experience conditions in an R&D department.

→ **Analysis of projects (part one)**: In a questionnaire, each participant identifies 3 most memorable, important projects and responds to a grid in which every condition from **Figure 99** is translated into a question related to a specific project as following:

CLARITY >> *Have you experienced in this project a feeling of clarity in the objectives of the project, organization and roles definition?*

All the conditions found in our first study are transformed in questions and each participant answers these questions three times for the three projects that s/he chooses. At the end of the study we have 90 analyses of projects.

→ **KPIs for projects**: In order to compare the experiential conditions with Alcatel-Lucent KPIs, we need the KPIs per project. The company does not have this type of information classified by project, but an overall sum of these indicators per year. In order to match this type of information with projects, we interview all the team managers from France and distribute the annual amount of outcomes per project. The task is rather difficult, as a large amount of patents are not directly related to any projects. Eventually we succeed in having a list with the *54 projects and the corresponding number of publications, patents, technological transfers and breakthrough solutions.*

Sub-hypothesis 2.2: The second goal of this experimentation is to understand **the influence of design culture** in this department and more

Recall **Figure 94**: Design culture in APPRD

precisely **on the aesthetic experience of researchers**. The *taxonomy of design culture* presented in the Pre-Experimentation - **Figure 94** is a first base to understand this relation. In continuation of the grid presented before on the aesthetic experience conditions, the questionnaire also raises questions related to the design influence on the 54 projects.

→ **Analysis of projects (part two)**: For each project we want to know if the research engineers work with designers, if design has an influence on the project and if so, what tools and methods are used in that particular project. Therefore from this questionnaire we obtain 90 responses that characterise projects in terms of Aesthetic Experience and design influence. Moreover the match with KPIs per project indicator gives us an appropriate amount of data to investigate. For the questionnaire answers, we used a Likert scale from 1 to 6, where 1 represented 'not-at-all' and 6 represents 'a lot'.

→ **Analysis of the importance of aesthetic experience dimensions**: Besides this view on projects, we are interested in more general aspects on aesthetic experiences conditions. Consequently, at the end of the questionnaire, we add a part on the importance of the aesthetic experience conditions in work. The participants had to vote from 1 to 6 on a Likert scale the aesthetic conditions presented as following:

CLARITY >>	*It is important to have a clear role in what I am doing, that I clearly see where I go and what I do.*

Moreover we also add three questions related to design culture and it impact in the department, on the designers' tools and methods used by participants in their work - see part C in **Appendix B**).

Finally, from this last part of the questionnaire, we gather 30 responses corresponding to the 30 participants on what they considered to be the most relevant aesthetic characteristics in their work and what they learn from the design culture. In total the questionnaire lasts between 15 and 20 minutes for both the project–related questions and the general conditions of researchers' working experience.

4.5.3.2 Analyse data

We analyse data using *correlation matrices* between the aspects relevant for investigating our second hypothesis. The correlation matrices are calculated using **Pearson (n)** function in XLSTAT.

In order to calculate the relation between *innovation indicators and aesthetic experience conditions in projects* we prepare the data as following: for each project that appears several times among the 90 project-responses we make a mean of the aesthetic experience criteria. Finally the correlation

matrix between these variables is calculated on 35 projects among the 54 possible projects. The other 19 projects are not chosen by any participant of the study. The project selection in itself is an indicator of the projects popularity in this R&D department.

The correlation matrices related to the relation between aesthetic experience conditions and design influence, are calculated directly on the 90 project-responses. However, among these 90 project-responses, we consider only the projects in which the engineers worked with designers. They are 37 in all that represent 15 projects from the 54 projects. Additional analyses are made in order to understand more subtle influence of design in APPRD. The following section presents the results of these correlations.

4.5.4 Results

4.5.4.1 Investigation of sub-hypothesis 2.1: correlation between innovation indicators and aesthetic experience

In order to study the correlation between the **aesthetic experience (AE) conditions** found with Grounded theory and the KPIs per project produced by the APPRD department between 2008 and 2011, we present the corresponding correlation factors in **Figure 100**. The lines of the matrix represent the four types of KPIs: *number of publications (NPu), number of patents (NPa), number of technological transfers (NTran), number of breakthrough solutions (NBS)*. The columns correspond accordingly to the aesthetic experience conditions: *Clarity (CLA), Wholeness (WHOL), Freedom (FREE), Self-Resonance (SELF-R), Intellectual challenge (INT_CHA), Transformation (TRA), Perseverance (PERS), Intellectual exploration (INT_EXP), Sharing (SHA), Closure (CLO), Good start (STA), Rhythm (RHY), Name (NAME), Synergy (SYN), Beautiful (BTF), Influence (INF), Concreteness (CONCR), Pioneer (PIO), Exoticity (EXO), Industrial importance (IND_R), Personal importance (PERS-R)*.

	Aesthetic Experience conditions																				
KPIs	Variables	CLA	WHOL	FREE	SELF-R	NT_CHA	TRA	PERS	NT_EXP	SHA	CLO	STA	RHY	NAME	SYN	BTF	INF	CONCR	PIO	EXO	IND_R	PERS-R
	NPu	-0.078	-0.090	0.103	0.011	0.077	-0.030	-0.095	0.127	0.077	-0.025	0.086	-0.123	0.095	-0.060	-0.102	0.105	-0.141	0.011	-0.054	0.007	-0.171
	NPa	0.315	0.298	**0.482**	0.287	**0.414**	0.189	0.197	0.294	0.214	-0.275	**0.398**	0.189	-0.085	0.226	**0.359**	0.045	0.217	**0.352**	0.057	0.046	0.133
	N° Tran	0.210	0.152	0.234	0.237	0.119	0.310	0.293	0.158	0.277	0.204	0.043	0.171	0.048	0.172	0.063	0.080	0.194	0.231	0.048	0.331	0.004
	N° BS	-0.176	-0.198	-0.265	-0.043	-0.292	-0.203	-0.207	-0.168	-0.114	0.088	-0.055	-0.095	0.152	-0.169	-0.219	**-0.344**	-0.224	-0.261	-0.006	-0.055	-0.194

Figure 100 The correlation coefficients between the innovation indicators and both the aesthetic experience and design influence

The variables that have a correlation coefficient in the matrix between 0.3 and 0.5 are *medium correlated*, and those that exceed the 0.5 are *highly correlated*. In **Table 16** we present the medium and high correlation

coefficients of the matrix. The majority of these correlations are moderate. Regarding the *publications* they are not related to any AE conditions. The *patents* however are in medium correlated to different dimensions of AE. *Freedom* and *intellectual challenge* are the most important of these dimensions and they are not related to any design influence and freedom almost attains a highly correlated values (0.482). Further on the correlation coefficients that relate the number of technological transfers to other variables like *transformation potential* and *company relevance* are rather low. The number of breakthrough solution is medium correlated negatively to researchers influence in the project.

Table 16 The medium and high correlation coefficients between KPIs, AE conditions and design influence

KPIs Bell Labs	AE conditions
Number of Publications	x
Number of Patents	Freedom (0.482) Intellectual challenge (0.414) Good start (0.398) Beautiful project (0.359) Pioneer feeling (0.352) Clarity (0.315)
Number of Technological Transfers	Transformation (0.310) Company Relevance (0.331)
Number of Breakthrough Solutions	Influence (-0.344)

Further on a second analysis is conducted. As projects are not equal in timeframe and number of participants, we introduce in our data *a contextual indicator*. We normalize the KPIs on two variables: **number of persons** that participated to the project and **number of months of the project.** With these new KPIs, we recalculate the correlation matrix of the AE conditions and design influence – see **Figure 101**. Except some coefficients, we obtain similar results with those present in **Table 16**. We discuss these results in the next section – Discussion of Experimentation 2.

Aesthetic Experience conditions

		CLA	WHOL	FREE	SELF-R	INT_CHA	TRA	PERS	INT_EXP	SHA	CLO	STA	RHY	NAME	SYN	BTF	INF	CONCR	PIO	EXO	IND_R	PERS_R
New KPIs	NPu	-0.22	-0.10	0.12	0.06	-0.01	0.00	-0.18	0.06	0.06	-0.20	-0.15	-0.29	0.21	-0.03	-0.17	-0.03	-0.24	0.02	-0.10	0.01	-0.08
	NPa	0.26	0.26	**0.40**	**0.35**	**0.39**	0.21	0.21	0.29	0.04	-0.15	0.24	0.02	0.03	0.17	0.21	-0.02	0.07	0.40	-0.14	0.02	0.08
	Ntran	0.05	0.06	0.13	0.15	0.12	0.24	0.24	0.22	0.21	0.21	-0.03	0.17	0.07	0.06	0.00	0.09	0.25	0.27	0.01	0.29	-0.05
	NBS	-0.22	-0.25	**-0.31**	-0.05	**-0.31**	-0.26	-0.27	-0.21	-0.17	0.09	-0.06	-0.10	0.19	-0.20	-0.25	**-0.37**	-0.27	-0.28	-0.06	-0.08	-0.23

Figure 101 The correlation coefficients between the **normalized innovation indicators** and both the aesthetic experience and design influence (**New KPIs**: KPIs per project, per person and per month)

4.5.4.2 Investigation of sub-hypothesis 2.2: correlation between aesthetic experience and design culture

The second goal of the Hypothesis 2 consists in understanding *the relation between the subjective experience of researchers and the design influence in their work*. The results of the correlation matrix are calculated over *the projects in which engineers worked with designers*. **Figure 102** shows that there is no direct correlation between the AE conditions and the design influence for the design collaboration projects. However we observe that two other variables are medium and highly correlated for these projects: *company relevance*[19] *and personal relevance*[20]. This means that *the projects in which people worked with designers are important both for the people as for the company.*

		Aesthetic Experience conditions																	
	Variable	Cla	Whol	Free	Self-R	Int chal	Trans	Persev	Int exp	Share	Clos	Start	Rhyt	Name	Syn	Beau	Inf	Conc	Pio	Exo
Project value	Comp re	**0.495**	**0.503**	**0.599**	**0.537**	**0.644**	**0.517**	**0.590**	0.229	**0.428**	**0.419**	**0.627**	**0.757**	**0.545**	**0.500**	**0.687**	**0.729**	**0.492**	**0.726**	**0.567**
	Perso re	**0.504**	**0.424**	**0.638**	**0.830**	**0.660**	**0.608**	**0.611**	**0.422**	**0.501**	0.105	**0.561**	**0.551**	**0.460**	**0.406**	**0.577**	**0.493**	**0.447**	**0.682**	**0.578**
Design influence	DCol	-0.089	0.137	0.179	0.108	0.106	0.227	-0.057	-0.044	0.115	-0.146	-0.042	-0.064	0.258	0.093	0.094	-0.023	0.070	0.084	0.040
	DInf	-0.151	0.121	0.122	0.097	0.056	0.217	0.033	0.113	-0.003	-0.215	-0.081	0.005	0.311	0.124	0.205	0.127	0.051	0.116	0.099

Figure 102 Correlation coefficients between *AE conditions*, *design influence* and *project value* (for company and for self) for the design collaboration projects

In order to test this result, we look now at the projects with poor or non-existent design collaboration. We calculate the correlation matrix on 51 project-responses (corresponding to 30 projects) and we obtain the following result: **in the project with no design collaboration, the variables *company relevance* and *personal reverence* are lower correlated with AE conditions than in design collaboration projects** (see comparison between **Figure 102** and **Figure 103**). This result shows that *there is a relation between the design influence and the subjective experience of researchers.* However these two correlation matrices do not show it directly. In order to understand this result, we look at the correlation matrix coming from the part C of our questionnaire on general aspects of aesthetic experience (AE) conditions and design influence in the R&D department. Among the 30 responses gathered in this part, we chose to study the persons that worked with designers.

		Aesthetic Experience conditions																	
	Variables	Cla	Whol	Free	Self-R	Int chal	Trans	Persev	Int exp	Share	Clos	Start	Rhyt	Name	Syn	Beau	Inf	Conc	Pio	Exo
Project value	Comp rel	0.167	0.118	0.177	0.216	**0.555**	**0.584**	**0.455**	**0.549**	**0.522**	**0.467**	0.247	**0.317**	**0.417**	**0.428**	**0.487**	**0.518**	**0.336**	**0.503**	**0.454**
	Perso rel	**0.327**	**0.311**	**0.461**	**0.519**	**0.515**	**0.433**	**0.599**	**0.551**	**0.361**	0.216	0.272	**0.475**	**0.395**	**0.417**	**0.748**	**0.580**	**0.410**	**0.611**	**0.460**
Design influence	DCol	-0.179	-0.241	-0.199	-0.082	-0.107	0.004	-0.027	-0.094	0.030	0.012	0.019	-0.028	-0.002	0.089	-0.153	-0.197	-0.190	-0.113	0.073
	DInf	-0.218	**-0.334**	-0.102	-0.029	-0.155	-0.118	0.060	-0.014	-0.170	-0.063	-0.058	0.029	0.037	-0.004	-0.162	-0.144	**-0.276**	-0.103	0.093

Figure 103 Correlation coefficients between *AE conditions*, *design influence* and *project value* (for company and for self) for the projects with no collaboration projects.

[19] Company relevance is the perception of research-engineers on the importance of a project for the company

[20] Personal relevance represents the importance of a project for an APPRD member.

There are 18 persons that participated in design collaborations. We calculate the correlation matrix on these 18 responses and we obtain mostly highly correlated coefficient between these persons and the AE conditions (see **Figure 104**).

		Aesthetic Experience conditions																	
	Variable	Wholen	Freedon	Transfo	Self-Res	Closure	Intellect	Commu	Clarity	Intellect	Perseve	Beauty	Influenc	Synergy	Collecti	Sharing	Project	Concret	Pioneer
Design influence	DCol	0.265	0.060	0.342	0.199	0.325	0.086	0.226	**0.518**	**0.476**	0.306	-0.083	-0.140	**-0.570**	-0.435	-0.053	**0.633**	0.055	0.044
	DInf	0.082	0.186	**0.713**	**0.649**	0.131	0.346	**0.639**	0.251	**0.574**	0.068	0.283	0.425	-0.118	0.134	0.143	0.436	-0.021	0.203
Design culture elements	Rapid P	-0.038	-0.136	**0.518**	0.360	0.320	0.296	**0.536**	0.147	0.414	-0.031	0.238	0.161	0.265	0.132	0.335	0.213	0.300	0.130
	Softwar	0.038	**-0.622**	0.077	-0.264	0.242	-0.025	-0.019	0.130	-0.076	-0.250	-0.119	-0.036	0.435	0.198	0.180	0.160	0.407	-0.281
	Creativ	-0.336	0.118	0.235	0.444	-0.065	0.121	0.217	0.102	0.045	0.172	0.327	**0.632**	-0.046	0.304	-0.159	0.267	-0.147	-0.022
	Drawing	-0.131	0.231	**0.508**	**0.635**	0.177	0.180	**0.545**	0.092	0.261	0.215	0.271	0.444	-0.234	-0.122	0.041	**0.497**	-0.171	0.242
	Cards	-0.156	-0.033	0.373	0.336	0.257	0.126	0.395	0.081	0.189	-0.047	0.142	0.240	0.136	-0.033	0.276	0.343	0.241	0.020
	User-sc	0.061	-0.326	**0.564**	-0.081	0.209	0.197	0.427	0.030	0.182	-0.200	-0.190	0.029	0.261	0.112	0.379	0.256	0.318	-0.150
	Discuss	-0.131	0.304	0.434	0.323	0.109	0.212	0.460	0.262	0.262	0.151	0.213	0.258	-0.150	-0.030	-0.052	0.213	-0.274	0.065

Figure 104 Correlation coefficient between AE conditions and Design Influence for the APPRD members working with designers

This means that the **people that worked with designers felt four of AE conditions** during their working experience: *transformation, self-resonance, communication and intellectual exploration*. But are these four conditions found in **Figure 104** the most significant conditions of AE in general? Among the all the conditions of an AE, which ones are the most important for APPRD members?

To answer this question we calculate the AE value of each condition by summing up the number of people considering that condition as important (i.e. voting for 5 and 6 in the Likert scale). **Figure 105** shows the most important AE conditions for the APPRD members.

AE value	*Transfor mation*	*Communica tion ideas*	*Intellectual exploration*	*Recog nition*	*Intellectual challenges*	*Clarity*	*Syner gy*	*Free dom*	*Self-Reso nance*	*Perseve rance*	*Sharing*	*Business impact*	*Closure*	*Concret eness*	*Whole ness*	*Beauty*	*Pioneer*	*Collective action*	*Social impact*	*Influe nce*	*Project Name*
	24	24	24	24	23	22	21	19	19	19	19	19	18	18	17	17	17	14	14	13	6

Figure 105 The importance of AE conditions for the 30 participants of the study

The four most important are *transformation, communication, intellectual exploration* and *recognition*. This result shows that *transformation, communication and intellectual exploration* **are AE conditions highly correlated to design influence for engineer researchers.** Besides, they are three of the four most important conditions that the participants chosen as desirable in their work. This result is not related to projects, but rather describes the design influence at an organizational scale.

The next part discusses these results, concludes on the second hypothesis of the study and present first limitations and perspectives on this quantitative investigation.

4.5.5 Discussion Experimentation 2

4.5.5.1 Correlation between aesthetic experience conditions and innovation

The first part of the 2nd hypothesis investigates the relation between the AE dimensions and conditions and the four innovation indicators of Alcatel-Lucent Bell Labs. From the four innovation indicators, *several Aesthetic Experience conditions seem medium correlated to the number of patents.* Besides, among all the four innovation indicators, *the number of patents is also the most significant outcome of APPRD.* This observation shows the cultural aspect of this R&D department focused on an engineers' and Techno-centred culture more than a research culture, for example (number of patents versus number of publications).

PATENTS: Among the four innovation Key Performance Indicators (KPIs), *the number of patents* has the most significant correlation coefficients with AE conditions. This observation might be explained by showing the context in which patents are built in APPRD. Generally patents are not directly related to projects. They are more dependent on the social interactions between people working together in projects. In general, the decisions on the patents ideas and belong to research engineers. Moreover patents' authors are gratified with prices and money.

It is interesting to look at the AE dimensions correlated to the number of patents: Freedom (0.482), Intellectual challenge (0.414), Good start (0.398), Beautiful project (0.359), Pioneer feeling (0.352) and Clarity (0.315). **Freedom, intellectual challenge, clarity** and **pioneer-feeling** resonate with the context of patents creation. Several researchers have an idea during a coffee break[21] or creativity session[22]. The intellectual experience of solving a problem or proposing something new motivates them to develop this idea. Moreover, no direct pressure forces them to develop this idea. A patent is created from their meeting and social interaction. These four AE conditions belong to the PERCEPTIVE and INTELLECTUAL dimensions of the aesthetic experience framework.

The other two conditions, **beautiful project** and **good start** are two variables that we add into Experimentation 2 questionnaire. These two variables do not come from Experimentation 1 framework. In order to understand their meaning in relation to the number of patents in APPRD, we present them as following:

[21] One of the participants in Experimentation 1 explained how with other colleagues at Bell Labs developed a patent from a simple coffee break discussion.

[22] Another participant in Experimentation 1 was responsible to organize creativity session for patents creation. This was another frame in which patents were created in APPRD.

- *"Beautiful project"* → with this variable we want to understand **how beauty is perceived and defined in projects** – i.e. what is a beautiful project in AE conditions?

- *"Good start"* → Participants of the qualitative study, usually talk about the necessity of closure of a project. We show in the State of the Art that the first phases of interaction with a product are also important for the overall experience. Therefore we add in the Experimentation 2 the variable *good start*. Our aim is to understand **what means a *good start* in a project**.

From the correlation matrix calculated on the 90 project-responses, we find definition of these two notions (see **Figure 106**):

Beautiful project

Concreteness	*Intense Rhythm*	*Pioneer*	*Personal relevance*	*Wholeness*	*Intellectual challenges*	*Perseverance*	*Influence*	*Clarity*	*Transformative*	*Synergy*	*Company relevance*	*Freedom*	*Self-Resonance*	*Intellectual exploration*
0.69	0.68	0.66	0.66	0.65	0.65	0.65	0.64	0.61	0.59	0.58	0.57	0.57	0.55	0.53

Good start

Intense Rhythm	*Clarity*	*Perseverance*	*Intellectual challenges*
0.62	0.53	0.47	0.47

Figure 106 A definition of "Beautiful project" and "Good start" variables in APPRD projects - correlation coefficients for the 90 project-responses of Experimentation 2.

The beautiful project condition is highly correlated to the fact that in a project, *researchers could make concrete things, have an intense rhythm, live a pioneer feeling, self-relevance with personal objectives and wholeness. The intellectual challenge, the feelings of a willpower and influence, clarity* etc. are also AE conditions that are highly correlated to this notion. This analysis shows the importance of the notion of beauty due to the high number of AE conditions strongly correlated to this variable.

The notion of *good start* is less correlated to the AE conditions and we selected only the four most significant correlation coefficients to describe it. A good start is about *an intense rhythm, perception of a clarity, willpower and intellectual challenge.*

Regarding patents, the medium correlation coefficient with *good start* and *beautiful project* do not allow us to carefully explain of this influence. A possible explanation could have been that concreteness condition is important in the patents creation (due to the strong correlation with beautiful), but the correlation coefficient between the number of patents and concreteness is low (0.217). We assume that these two variables are *medium correlated to patents, due to the indirect relation between patents with clarity, intellectual challenges, pioneer-feeling* discussed before.

The second analysis with normalized KPIs (see **Figure 101**), finds three AE conditions medium correlated with the number of patents: *freedom (0.40), self-resonance (0.35) and intellectual challenge (0.39)*. Self-

resonance seems also an interesting AE condition for the context of patent creation: ideas on patents come from discussions and personal curiosities of researchers to test different algorithms. This last insight, and looking the AE conditions importance for APPRS members at a large scale (**Figure 105**), *we identify the following four significant conditions for this KPI:* **intellectual change, clarity, freedom and self-resonance**. To conclude, **the number of patents** *is medium correlated with these AE conditions.*

PUBLICATIONS: Using correlation matrices we do not find significant influence between the number of publications and the aesthetic experience conditions. The qualitative study – Experimentation 1, shows relations between the INTELLECTUAL dimension, like *Intellectual Exploration, wholeness, intellectual exploration, clarity* and the fact that research-engineers write publications, but our quantitative analysis does not show such relation. The lack of such dependence in the quantitative study might be interpreted in several ways

A first interpretation could be: *the exercise of writing an article is less memorable than designing patents.* The low number of APPRD members having a PhD, supports this assumption – 5 persons among the 30 participants of the study. Writing publications is new activity for most of the APPRD research-engineers. The publication culture is brought by the history of Bell Labs, the existence of an internal journal like Bell Labs Technical Journal and also by the existence of a publication KPI. Further on this observation asks new questions: *how can be frameworked the state of mind of writing* and *how important is this activity for the overall experience and experience recall*?

Additionally to this analysis, the second investigation with normalized KPIs we find a medium correlation between the number of publication and *design collaboration (0.302)* as presented in **Figure 107** - *Design collaborations (D-COL), Design Influence (D-INF), Rapid prototyping (RP), Software prototyping (SP), Creativ'lab (CLAB), Drawing & Illustrations (ILLST), Cards & intermediary representations (CARDS), User scenarios (USC) and Discussions with designers (DISC).*

Design influence

New KPIs	D-COL	D-INF	RP	SP	CLAB	ILLST	CARDS	USC	DISC
NPu	**0.30**	0.24	-0.02	0.14	0.09	0.20	0.05	0.04	0.23
NPa	-0.20	-0.18	0.03	-0.06	-0.20	-0.22	-0.10	0.19	-0.10
Ntran	-0.18	-0.21	-0.11	0.16	-0.07	-0.20	0.07	0.10	-0.17
NBS	**0.31**	**0.39**	0.22	0.26	**0.51**	**0.46**	**0.86**	**0.45**	0.27

Figure 107 The correlation coefficients between the KPIs and the design influence in projects

Table 17 shows that number of publication of the four French teams of APPRD department. The arrival of *design researchers in APPRD France*

raises the total number of articles eligible to Alcatel-Lucent. This is an unexpected result for our study on the design influence in an R&D department. This table also underlines the low number of publication in comparison with the numbers of research engineers. Even if Bell Labs come with a strong research culture, the high number of patents shows that engineers' culture is even stronger.

Table 17 Number of publications eligible to Alcatel-Lucent KPIs in 2010 and 2011

APPRD France teams	N° Publications 2010	N° Publications 2011
Engineering team 1	1	4
Engineering team 2	1	4
Engineering team 3	2	6
Design team	3	9

TECHNOLOGICAL TRANSFERS & BREAKTHROUGH SOLUTIONS: Regarding the last two KPIs, the low number of these indicators during the four years of APPRD - *7 technological transfers and 2 breakthrough solutions*, in comparison with the 54 projects analysed, do not allow us to interpret the results coming from correlation matrices. Moreover, the projects related to these outcomes are diverse and different from one another. The number of persons involved, their temporal framework and the AE conditions. Some are popular project like SW that is chosen by 7 participants in our study, others are less known projects in the department, like ICX that is chosen by one participant. However both these project succeed in transferring technologies to business divisions. A more in-depth analyse per project might bring in new insights on the relation between these types of KPIs and AE conditions.

4.5.5.2 Correlation between aesthetic experience conditions and design culture

Regarding the relation between the design culture and AE conditions, we build our analysis in two steps: *an investigation of these aspects on projects* (part B of the questionnaire) and a second investigation on more general aspects of the *working experience with designers* (Part C of the questionnaire).

In order to understand the design influence in projects, we analyse the projects in which research-engineers worked with designers. No directly connections between AE conditions and design culture are observed. However on projects having design collaborations, the two variables *Company relevance* and *Personal relevance* are highly correlated with AE conditions (see **Figure 102**). This result leads us to the following observation for the part B of the questionnaire: **design culture relation with AE conditions is not directly seen in analysing projects.**

A second investigation is conducted to understand this relation at a larger scale (Part C of the questionnaire). When looking at the persons working with designers, we find several correlations between **design influence** variable and **four AE conditions**: *transformation, self-resonance, communication and intellectual exploration*. Three of these conditions are also found as the most important for all the participants of the study: **transformation, communication and intellectual exploration** (see **Figure 104**). This result of our analysis shows that the **three most important conditions of the Aesthetic Experience are highly correlated to the design culture**, and **that design culture influences these conditions**. Further on we show what are the design tools and practices that *the researchers learned* during the four years of APPRD that are highly correlated to these AE conditions - **Table 18**.

Table 18 Aesthetic experience conditions correlations with elements of the Design culture

AE conditions	Design culture – tools & practices
Transformation (Evolution)	User-scenarios (0.564), Rapid prototyping (0.518), Drawing & illustration techniques (0.508).
Communication ideas (Discussion)	Rapid prototyping (0.545) Drawing & illustration techniques (0.536)
Intellectual exploration	Rapid prototyping (0.414)

→ **Transformation,** meaning also *evolution* or *a way to arrive at a self-fulfilment*, is an important aspect of an Experience as presented in the definition built in the State of the Art – **Section 2.2.1**. Design culture relation with this dimension can be explained by the professional *reconversions* that took place in APPRD, the creation of Arduino Geek club and the *usage and appropriation* of design tools. We find high correlated coefficients between *transformation* condition and *user-scenarios (0.564), rapid prototyping (0.518) and drawing & illustration techniques (0.508)*.

→ **Communication of ideas** is related to the notion of *confrontation and discussion* as a way to evolve, but also as a way to achieve validation and recognition. Design influence help APPRD researchers to better express themselves. Our study shows that *drawing & illustration techniques* and *rapid prototyping* are correlated with this dimension (*0.536* and *0.545*).

→ **Intellectual exploration** shows the importance of a *deeply experience of thought*. This intellectual state is also an exercise of imagination and exploration that researchers felt in their research projects. From among all design tools and methods, *rapid prototyping* seems to be the highest correlated design variable with this condition (*0.414*). From

the structural framework and definition of aesthetic experiences presented in the State of the Art - **Section 2.2.3**, the *narrative* dimension of design culture might bring in such intellectual experience. This result in relation with design culture could be explained through the fact that *design thinking* help these people to question and challenge their ideas more deeply.

Finally we want to evoke an interesting result on the influence of design in this department. In the part C of our questionnaire, we ask engineers to choose the design tool or practice they learned to use during their work with designers. The most popular design activities are the following: *software prototype*, *Creativ'lab*, *user-scenarios* and *designers' discussion* (see **Table 19**). For a future use in their work, the most voted design practices are *software prototypes* and *discussion with designers. Rapid prototyping* is chosen with only 2 votes and *Drawing and illustration techniques* is not voted by any participant. Therefore these elements do not correspond to the elements of the design culture presented in **Table 18**. This observation implies *the need of research engineers to collaborate and interact with designers.* Consequently the design culture does not act only locally in APPRD projects and interactions, but also develops a need of research engineers to benefit from design collaborations in the future.

Table 19 Criteria of design influence and questionnaire responses

Criteria of design influence	**Responses** (from a 6 point Likert scale we count the responses of 5 & 6 – *a lot & extremely*, and present the results in numbers and percentage)
The most influential design culture element for a chosen project	**Software prototyping (39 responses): 44%** **Discussions with designers (23 responses): 26%** **User-scenarios (18 responses): 20%** **Drawing & illustration techniques (16 responses): 18%** Creativ'lab (11 responses): 13% Rapid prototyping (10 responses): 11% Cards & intermediary representations (6 responses): 7 %
Design tools or practices learned during APPRD	**Software prototyping (12 persons): 40%** **Creativ'lab (11 persons): 37%** **User-scenarios (11 persons): 37%** **Discussions with designers (11 persons): 37%** Drawing & illustration techniques (8 persons): 27% Cards & intermediary representations (3 persons): 10 % Rapid prototyping (3 persons): 10 %
The design practice **useful in future projects**	**Software prototyping (8 persons): 27%** **Discussions with designers (6 persons): 20%** **Creativ'lab (4 persons): 13%** Rapid prototyping (2 persons): 7% User-scenarios (2 persons): 7% TechCards (1 person): 2% No response (9 persons): 30%

4.5.5.3 Limitations of the quantitative investigation

The limits of the quantitative investigation are related to the specificity of conducing a study in an R&D department. The following limitations are related to the study population and data gathering.

- **Study population – the effect of department specificity & design collaborations**

The quantitative study is conducted on 30 R&D research engineers from the Application Research Domain from Bell Labs. This fact brings in an effect of APPRD specificity that might not be found in another R&D lab. Still, this aspect also means that participants share similar organisational conditions.

Even so, we observe differences in researchers' response regarding design collaboration. Not all the APPRD members work with designers. Therefore in our analysis, we analysed only the responses of people taking part in design collaborations. 12 of the participants work very little with designers, 5 of participants occasionally take part of design collaboration and only 13 have the opportunity to collaborate with designers. This remark divides in two parts our population and the number of data for the correlation matrices. Moreover the difference between the variables indicating the intensity of design collaboration and design influence (i.e. the Likert coefficient between 1 and 6) is mostly 1 (in module) and 0. This means that *the more a research engineer works with a design, the more she/he is influenced by the design practice.*

- **Effect of insufficient contextualised KPIs**

The first sub-hypothesis is investigated by analysing APPRD projects. For each project, we obtain the corresponding number of patents, publications, etc. However patents and even publications are not really related to the project-frame. Some ideas come outside this frame during informal discussions and meetings. Moreover a period of four years seems too long for team managers to match each patent and publication within a specific project and context. This observation raises questions related to *what could be a perfect frame to analyse these indicators.*

A more precise description and classification of the 54 projects might bring a better understanding of their connexion with the Bell Labs KPIs. For example a 3 person-project that lasts for six months, and that produces several publications and patents might be considered as a very profitable project regarding its *potential and resources.* Such an analysis focusing on projects structure could permit a more subtitle comprehension between innovation criteria and the other variables: AE conditions, design influence etc.

Concerning the low number of technological transfers and breakthrough solutions, the correlation analysis seems not to be

appropriate to deeply understand the relation between these indicators and AE conditions. Correlation matrices are chosen due to the large amount of data - 19 AE conditions, 7 design culture elements etc. Additional explorations, using other statistical tools, like **regression** analysis or **Principal Component Analysis** (PCA) analysis, might show more in-depth details and aspects like: an analysis on the participants' profiles regarding design influence and AE conditions, a classification / typology of projects etc.

4.5.5.4 Hypothesis 2 - a partial validation

Hypothesis 2 and its sub-hypotheses are tested during Experimentation 2. **Sub-hypothesis 2.1** investigates the relation between aesthetic experience and innovation through the analysis of *correlation between Bell Labs Key Performance Indicators (KPIs) - number of publications, patents, technological transfers and breakthrough solutions and AE conditions.* **Sub-hypothesis 2.2** investigates the relation between *design culture and aesthetic experience in a Techno-centred environment.*

Regarding Hypothesis 2.1, the quantitative study shows a medium correlation between **AE conditions**: *intellectual change, clarity, freedom and self-resonance* and **number of patents**. Patents are not related to the project frame, but rather personal and group initiatives, stimulated by the project social frame. For the other innovation indicators in relation with AE conditions, our study finds low correlation coefficients. With these in mind we conclude that **sub-hypothesis 2.1 is partially validated**.

Hypothesis 2.2 tests the relation between AE conditions and the design tools and practices of the design culture. The results of our analysis show that the *AE conditions are not correlated to design culture elements in projects.* However the **three of the most significant AE conditions**: *transformation, communication of ideas and intellectual exploration* **are highly correlated to design** at the department scale. This results shows the design influence on the overall department experience and **validates the sub-hypothesis 2.2 of our study**.

4.5.6 Conclusion of Experimentation 2

The goal of the second Experimentation is to investigate the correlation between the aesthetic experience conditions and both innovation and design culture in an R&D department. We conduct a quantitative study with 30 research engineers at Alcatel-Lucent Bell Labs France. Firstly, the results of this study show a medium correlation between **the number of patents and four AE conditions**: *intellectual change, clarity, freedom and self-resonance* (see **Figure 108**). These findings partly validate the relation between aesthetic experience and innovation. Secondly, our analysis finds **strong correlation coefficients between three of the four most significant AE conditions and design influence**. This result also shows the corresponding design practices that brought this influence on the AE conditions (see **Figure 108**) and validates the sub-hypothesis regarding the design culture influence and aesthetic experience.

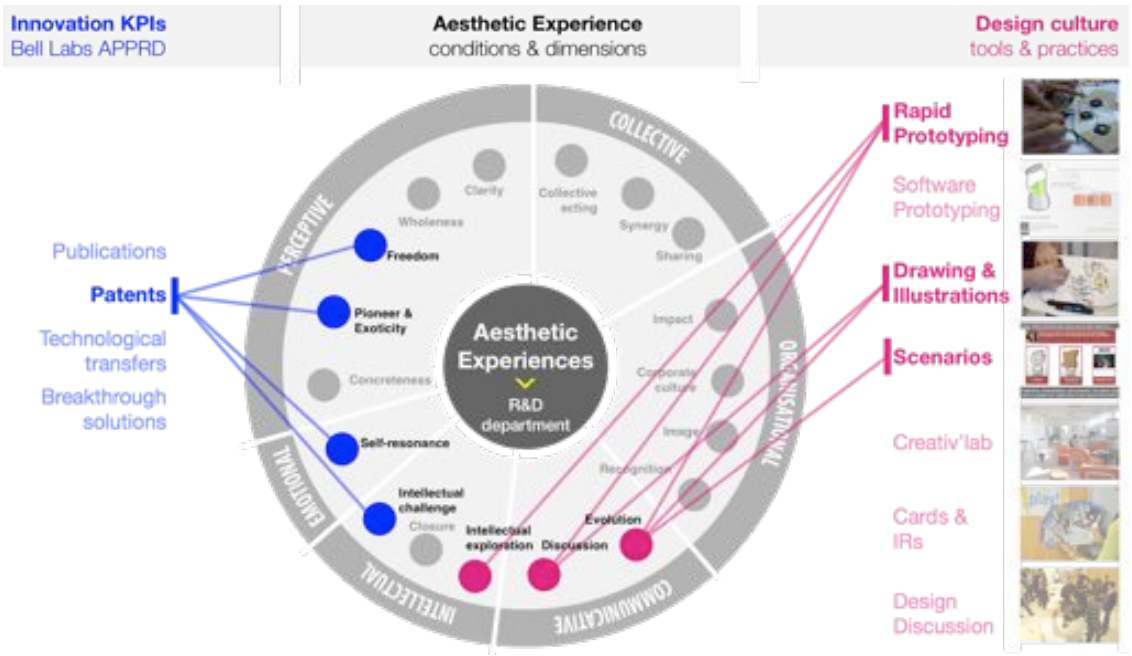


Figure 108 Representation of the results coming from Experimentation 2. *Left:* Key Performance Indicators (KPIs) of Bell Labs and their correlation with aesthetic experience conditions; *Middle*: The theoretical model found in Experimentation 1; *Right:* The design culture elements correlated to aesthetic experience conditions.

4.6 Synthesis of experiments

In section 4, we conduct an Action-Research in two cycles. **In the first cycle**, called *Pre-Experimentation*, we gather knowledge as practitioners in several projects at Bell Labs. This knowledge enable us to understand aspects of the working experience in a Techno-centred R&D department, its encounter with the design culture and finally to build the research question and the hypotheses of this thesis (see **Figure 109**).

The second cycle of the Action-Research presents two experimentations (Experimentation 1 and Experimentation 2) investigating to the two hypotheses of this research. The experiments enables us to **build a theoretical framework that observes and describes long-term Aesthetic Experience in real settings**, in an R&D department - *validation of Hypothesis 1 through Experimentation 1.*

Experimentation 2 shows the relation between **research-engineers' experience and the innovation indicators** (Sub-hypothesis 2.1) and **depicts the elements of the design culture that influence the aesthetic experience in the R&D department** (Sub-hypothesis 2.2).

Based on these results, both qualitative and quantitative, in the next section we build a framework of aesthetic experiences in R&D environments and show the contribution of this thesis.

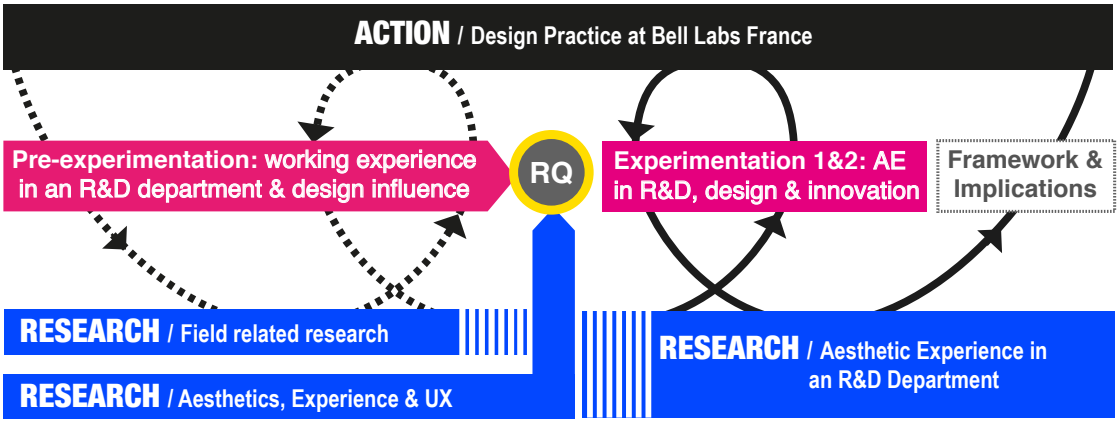


Figure 109 The experimental strategy of this thesis through an Action-Research approach in two cycles.

5 Contributions

Thesis Contributions & Design Implications

5 Thesis Contributions & Design Implications

5.1 Introduction

Section 5 presents the theoretical, methodological and empirical contributions of this thesis. The first part of this section presents four contributions of our study. From **a methodological** point of view, our research proposes **a sequential procedure to study long-term experiences in real settings** through the study of a new concept, the Aesthetic Experience of an R&D department. This concept creates a transition between UX – *User Experience* and CX – *Concepteurs Experience* in the design process and proposes a methodology to build a holist framework of experiences in a particular context.

From **a theoretical** point of view, we propose a **descriptive framework of Aesthetic Experience** in an organisational environment and we show similarities and differences with other frameworks on aesthetic experiences coming from literature. Another theoretical contribution is related to the **new qualities of design artefacts in a Techno-centred environment**. As intermediary objects and boundary negotiation artefacts, the force of these elements lays in their cultural difference and the generation of new usages and adaptions in their work. Finally our study questions the measurement design, innovation culture and subjective experience in work, and proposes **new directions to evaluate design influence, memorability and transformation in projects**.

The second part of this section suggests first implications for design to create aesthetic experience in an industrial context and constitutes **the empirical contribution** of this study. We propose three axes: *implications for working environments, implications for intermediate objects and implications for the design process* as a generative frameworks that operationalize the results of our study.

5.2 Methodological & theoretical contributions

5.2.1 A sequential methodology to study experiences in real settings

By introducing a new concept – *Concepteurs Experience* (CX), we explore and study *the concept of Experience at a larger scale.* More than UX or aesthetic experiences in museum contexts, CX concept comes from an **Action-Research study** looking at **long-term experiences** through the

lens of **retrospective elicitation**. We emphasize in the following lines the specificity of our contribution.

The study field is a **real setting**. In order to understand people's experiences in this terrain we use **retrospective elicitation**. However, even if retrospective elicitation and the knowledge coming from *memory theory* are powerful methods and good alternatives to longitudinal studies, the *complexity of long-term experiences in real settings* with *organizational aspects* and *individual and collective* motivations, demand an additional knowledge on this field. This observation implies that **the researcher studying such a concept to be *immersed* in the field**.

In order to do so, we use an **Action-Research approach**. Working with research engineers at Bell Labs permits us *to understand the field and to gain precious insights for data interpretations.* Furthermore this procedure is accompanied by a **Grounded Theory** analysis, in which the researcher's implicit knowledge is mandatory in the creation of clusters and dimensions on the studied concept.

We also use **an interview and questionnaire grid** on aesthetic experiences coming from social interpretive sciences (Csikszentmihalyi & Robinson, 1991) and we adapt it to our field. This validated protocol, in which we also integrate knowledge presented in the State of the Art on aesthetic experience and experience measurements, allows us to create a suitable tool to depict long-term aesthetic experience in an unconventional environment.

All these points are graphically represented in **Figure 110**. This representation shows that the study per-se has a temporal structure developed in three steps: *Action-research, Qualitative study and Quantitative study.* In order to study an experience developed over several years, we propose a first phase in which the researchers are immersed in the field to understand subtle specificities and local phenomena (Pre-Experimentation phase in this thesis). Once this information acquired, the researchers are ready to conduct the interviews and questionnaires and finally to analyse and interpreted data coming from the field.

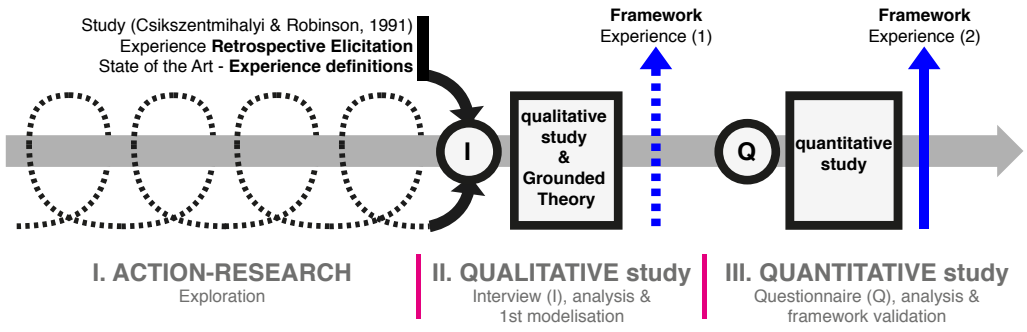


Figure 110 A sequential methodology in three steps (*Action-Research, Qualitative study and Quantitative study*), to study long-term Experiences in real settings.

5.2.2 A framework of Aesthetic Experience – a new context and new dimensions

Regarding the theoretical contributions of thesis, we propose a **descriptive framework** of *aesthetic experience in a working environment* (see **Figure 111**). Scholars in organizational management compare the psychology of an aesthetic experience triggered by artworks with specific feelings of work (Sandelands & Buckner, 1989). Others researchers coming from sociology like (Strati, 2005, 2010) use artworks to trigger aesthetic responses in work and through *this aesthetic approach* they study the organizational life. However little research is conducted to identify **the aesthetic dimensions of work feelings.** *Is an aesthetic experience in art-related contexts similar with an aesthetic experience in a working environment*? Our study shows that **there exists an aesthetic experience in an R&D department and that it is similar to the experience of museum professionals with artworks on four dimensions**: *the perceptive, the intellectual, the emotional and the communicative*.

The holistic view proposed by our study also emphasizes **new dimensions of the aesthetic experience**. Two of these dimensions could be considered new types of experience per-se: **the Collective Experience** and **the Experience of makers**. Our study shows that the feeling of *synergy* or *of collective action* impacts the research-engineers appreciation of their work. These elements are important aspects of the organisational life in R&D departments. Regarding the second aspect, the Experience of makers, this element is specific to the study population. Research-engineers create prototypes and demos and the design process brings in engagement and motivation. Studies underline the effects of **prototyping** in organisations. (Gerber & Carroll, 2012) shows that the psychological experience of low-fidelity prototyping allows practitioners to *reframe failure as an opportunity for learning, supports a sense of forward progress, and strengthens beliefs about creative ability*. (Buchenau & Suri, 2000) coined the tern *experience prototyping* to emphasize the experiential aspects of intermediate representations to successfully (re)live or convey experiences with a product, space and system in the design process. In our study the *concreteness of things and their tangibility are properties that engage people and make them share a reality*. Moreover, from a larger point of view on Experience, future studies could investigate how these two dimensions (the collective experience and experience of makers) influence the product experience and users' engagement.

Our study underlines other aspects that impact the subjective feelings of research-engineers - **the organisational aspects**. These aspects represent the context of the R&D experience. In the same way as the context, in UX frameworks, is defined by *the organisational/social setting,*

meaningfulness of the activity, voluntariness of use, etc. in which interaction occurs (Hassenzahl & Tractinsky, 2006), we find other aspects that influence people's experiences in an R&D department. *Impact, influence and recognition* show the connection between the achievement of an experience and needs fulfilment. This direction is further on developed as a proposition for this thesis perspectives. Finally, the laboratory history and research culture also impacts the working quality of the department. As shown in the limitation of the qualitative study (**4.4.5.3**), for most research-engineers the image of Bell Labs brings a positive feeling in their work. The research culture transforms people having an engineer profile towards a complementary research-engineer profile.

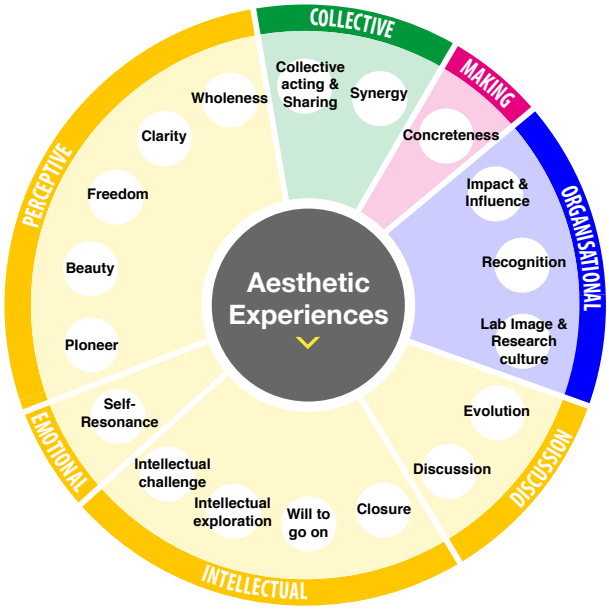


Figure 111 The empirically validated model of Aesthetic Experiences proposed in this thesis – dimensions and conditions.

5.2.3 Design artefacts – cultural vehicles and the aesthetic quality

Our study also shows new attributes for the design culture artefacts. Besides their role in the design process, the examples presented in Pre-Experimentation section, suggest that design artefacts have *a transformative power and inspire to new reconfigurations.*

As intermediary or boundary negotiating artefacts, design artefacts materialize ideas and concepts and propose a sharing reality for the actors of innovation (Boujut & Blanco, 2003; Mer et al., 1995; Vinck, 2009). In these sense they are **transformative**. In our study we investigate this quality at a larger level and we show that *design artefacts transform the*

actors of innovation in a Techno-centred department and bring a new culture. During the four years of Application Research Domain (APPRD), 6 research engineers acquired a double profile – engineer-designer, and globally the department members learn to use several design tools like *software prototypes* and *user-scenarios*. In our quantitative study we show that these two design tools are the most influential elements of the design culture for APPRD projects (see **Table 19**). Engineers also appreciate the *discussions with designers* and understood the value of *Creativ'lab*, the creativity place build by the design team in 2009, at the beginning of the department. Moreover engineers' encounter with design culture creates a need for *design collaborations* in the future. *Software prototyping*, *discussion with designers* and *Creativ'lab* are desirable elements in future projects.

The second quality of design artefacts lays their *inspiration and generative* power. As boundary negotiation artefacts that introduce new manifestations in the design process like *inclusion, compilation, structuring,* and *borrowing* (C. P. Lee, 2007), design artefacts in APPRD inspire the actors of innovation to new adaptations and usages - exaptations (Labrune, 2007) in the organisational life. They are *cultural vehicles* as they *teach* the research engineers elements of the design culture in action. As shown in Pre-Experimentation examples, TechCards inspire the actors of innovations to new reconfigurations. This process of appropriation and adaption underlines the interest of research engineers towards design culture artefacts. The cultural demarcation of these artefacts and the Techno-centred department makes these objects *extra-ordinary*. Their force is related to this specific context, as only in this field they contrast. In this sense *they are aesthetic* as they bring a new perspective and become memorable due to their difference. A future study might investigate the role of *aesthetic intermediary objects* by exploring the aesthetic principles presented in the first part of the State of the Art – **Section 2.1.2** The aesthetic appreciation – from psychology to design.

5.2.4 Aesthetics, design and innovation culture – directions for new measurements

KPIs for multidisciplinary R&D teams: This thesis brings in the R&D department of Bell Labs a questioning on the measurement of the design influence in projects and more generally on the innovation culture. In our study we also explore the connexion between *Key Performance Indicators* (KPIs) – patents, publications, technological transfers and breakthrough solutions and *design culture elements* – prototyping techniques, intermediary objects, discussions with designers and dedicated spaces to creativity and design practices. Nevertheless, *are these KPIs suitable to measure the relation between design and innovation potential*?

The Action-research nature of this thesis opens discussions on how to measure multidisciplinary activities in an R&D department. The new multidisciplinary team created at Bell Labs after APPRD, Acceleration Platform (AxP), proposes in 2013 new KPIs to evaluate their success. These KPIs presented in **Table 20**, are new propositions to measure multidisciplinary success in an R&D department. *Innovation culture dissemination* is one of the indicators of success and it refers to the team capacity to influence other organisations (Organisations inspired by our practices[23]). The young usage of such factors might still be contested. However they show the necessity of rethinking the indicators of innovation potential measurement in complex processes of R&D departments. Further on we discuss other directions for these quantifications.

Table 20 New KPIs for Acceleration team at Bell Labs France - *February 2013* (translated from French to English; information regarding names of departments and specific projects are omitted due to confidential reasons).

KPI	Quantification	Low Objective	High Objective
Client satisfaction	→ Written testimony CEO level	**1**	**3**
	→ Satisfaction survey	**80%**	**100%**
Recognition	→ Common project with research domains	**1**	**3**
	→ AxP client with a demand superior to	**…€**	**…€**
	→ Commercial projects, demand superior to	**…€**	**…€**
Visibility	→ Actions for external communication	**2**	**3**
	→ End of xxx project with high impact	**1**	**1**
Impact Strategic projects	→ Public research & Public Communications	**1**	**3**
	→ New clients	**1**	**2**
Innovation culture dissemination	→ Organisations inspired by our practices	**1**	**2**
	→ Offer an innovative approach	**80%**	**100%**

Towards KPIs for design: At a larger scale several scholars emphasize the influence of design to foster innovation potential in R&D departments (Brown, 2009; Masson et al., 2006). In our study we observe that several conditions found in our field are similar with (Rao & Weintraub, 2013) assessment tool for the innovation culture (see **Figure 112**). This table shows the relation between the design culture and the innovation culture in a Techno-centric R&D department. *Evolution, Discussion, Collective acting, Intellectual exploration* and *Concreteness* are experiential conditions found in our field, directly influenced by the design culture. We also identify specific design practices that are related to these specific conditions in both the qualitative and quantitative investigation (see **Table 18** in which *intellectual exploration*, for example, is related to *rapid prototyping*).

[23] *Our practices* in **Table 20** mostly refer to design-based tools and techniques like *Prototyping*, *Visualisation & illustration* for business modelling, need identification and open-innovation.

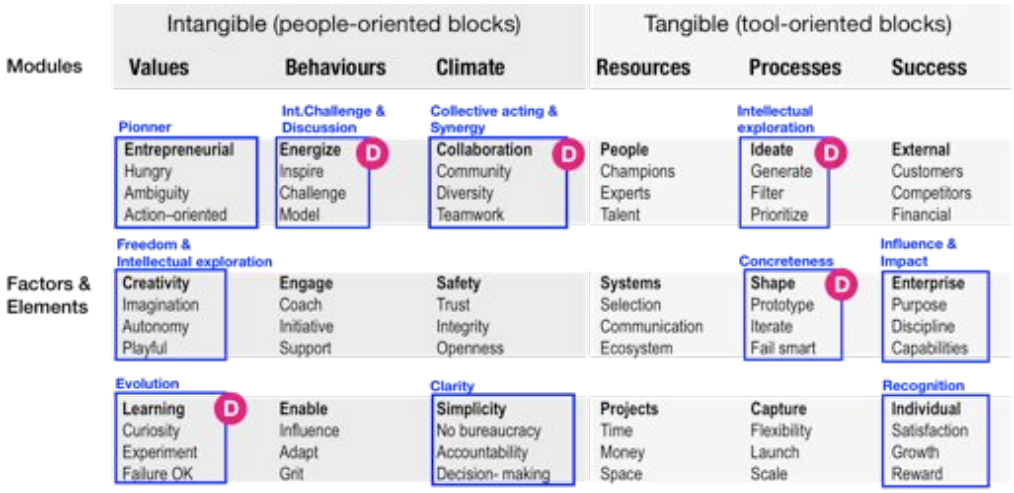


Figure 112 Innovation culture framework of (Rao & Weintraub, 2013) and Aesthetic Experience & Design conditions found in our study (*in blue* are the corresponding AE conditions and the *'D'* shows the conditions influenced by design)

Besides this analysis, we also show in **Table 19**:

→ criteria for design influence in projects - *Software prototyping, Discussions with designers, User-scenarios* etc.

→ the design influence on the overall experience of APPRD members - *Software prototyping, Creativ'lab (11 persons), User-scenarios* etc.

→ the researchers' desirability to use design collaborations (*Software prototyping, Discussions with designers, Creativ'lab* etc.) in the future.

Table 19 is a contribution of our study as it gives first directions to deeply understand the design influence in an R&D department. Identifying and quantifying similar factors shows a quantitative view of design influence in an R&D department and proposes new direction to calculate a design influence factor for innovation projects.

Moreover we identify two types of design influence: a local influence per project and a more global impact – the influence of design in an R&D department. The next subsection presents in more depth the notion of KPI per project that is used in our quantitative study.

KPIs per project & new project dimensions: Through this study we also introduce the notion of *KPIs per project*. At Bell Labs, KPIs are calculated each year. Therefore the historical generation of these outcomes is lost. In our study we chose to explore the project frame in order to understand the subjective aspects of research-engineers and innovation indicators. Moreover researchers' relation with their work passes through project-experiences and therefore overall experience in the department is a sum of project-experiences.

The first observation is related to the number of patents and publications per projects. We observed that these two types of outcomes are not directly related to projects, but *the project frame triggers social interactions that impact the number of patents.*

Secondly, we also observed the powerful image of several projects at Bell Labs. For example in the qualitative study, Arduino Geek club is the most desirable project in APPRD (7 votes), while only 2 participants of our study take part in the project. The second most desirable is Virtual Director (6 votes), a Belgium project, and thus not directly related to the French department. *Desirability* seems not to depend on the participation rate but more on *the image of a project and its original approach.*

In the same way *memorability* and *transformation* are other attributes that describe the personal interest of research-engineers and their subjective experience in projects. We believe that such indicators are important to follow in an R&D department for *their force to influence the memory reservoir of the department* and *the industrial imaginary* (Musso, Ponthou, & Seulliet, 2005). Our study identifies these three notions as project attributes and we define them in **Table 21**. Further investigations could explore these notions and deeply understand the role of influential projects for the organisational culture and the personal engagement of research-engineers.

Table 21 Project attributes issued from our study

Project attributes	Definitions
MEMORABILITY	*The capacity of a project to rest in the department memory as an example, a source of learning experience or an extra-ordinary project that brings in originality and a new perspective.*
DESIRABILITY	*The capacity of a project to attract engineers due to its topic or originality and to motivate resources for its development.*
TRANSFORMATION	*The capacity of a project to transform the persons participating to its development or/and the organisational culture.*

5.3 Designing aesthetic experience for innovation culture – design implications for industry

Beyond the mere observation of these terrains and the analysis of their characteristics, we think that designers need to understand how the modification of some variables might transform the working environment in order to facilitate aesthetic experience and openness to innovation culture. Therefore in this section we present operationalize insights of the theoretical framework built in this study (i.e. **Figure 111**). **More**

generally, how designers can turn these insights into actionable daily practices for the stakeholders of innovation?

(Löwgren, 2013) suggests a way to connect *design practice* – i.e. artefacts, and *academic research* –theory and frameworks, through the notion of *intermediate knowledge*. In order to create it, the author proposes several tools and methods like *patterns, experiential qualities, strong concepts,* and *annotated portfolios*. Following this approach, **Table 22** presents first implications that link theory to practice in order to *facilitate an aesthetic experience in an R&D lab through design and for an innovation culture*. In practice, we connect the empirically grounded framework to experiential qualities and instructions for three practical fields: **Working environments, Intermediary objects** and **Design process**. These three dimensions are built following key points that people pointed out in both the quantitative and qualitative study, and our field experience gained during the first cycle of the Action-Research approach.

Experiential qualities for working environments: Researchers and design practitioners explore the influence of offices design in order to create *work experiences* (Bodin Danielsson, 2011) and argue that the physical and psychological spaces of an organization work in tandem to define the effectiveness of the people within it (Brown, 2009). Looking at the dimensions found in our study, conditions like *Self-Resonance, Freedom,* and *Intellectual exploration* could be suggested through the design of working environments as presented in **Table 22**. As an example, Creativ'lab quantitative analysis presented in **Figure 104** shows that this environment is correlated with AE conditions like *Self-Resonance* and *Influence* in APPRD.

Experiential qualities for intermediary objects: In same direction with the contribution on intermediary objects as *cultural vehicles and aesthetic objects*, in **Table 22** we proposes a consolidation of the aesthetic features as objects attributes. An interesting perspective on this matter could be the investigation of the effect of aesthetic features (presented in **Section 2.1.2** The aesthetic appreciation – from psychology to design) for intermediary objects.

Table 22 First implications for design to trigger an Aesthetic Experience in an R&D department and influence the innovation culture.

N°	AE Conditions	Implications for **Working Environments**	Implications for **Intermediary Objects**	Implications for **Design Process**
1	**Clarity**	Dedicated places to specific activities with *no exterior disturbance*; *one room per project*; display finalities, planning and objectives.	Concrete representations of work progression; use aesthetic features for simplicity and clarity in design.	Continuous awareness of the process and direction; represent process steps with *clear finality* and *regular objectives revision* through *rituals and milestones*.
2	**Wholeness & Integration**	Dedicated place to have a *global view* on the process, tools, actors etc.	*Overall representation* of tasks; *Visual coherency* to all outcomes.	Global view on final deliverables; show imbrication of skills & outcomes like a puzzle.
3	**Freedom**	Non-conventional furniture to stimulate *free expression*; balance working - casual environment.	*Adaptable, flexible, malleable, multisensory* etc. artefacts.	Encourage *personal exploration &* hacking culture; no access limitation in working environment (night, weekend); *flexible desk*.
4	**Pioneer & Exoticism**	Represent *new disciplines, discoveries, hot topics, and trend analysis* in specific environments.	Use aesthetic features for *unfamiliarity and ambiguity* in artefacts.	Encourage *new ideas and their translation in products*; work with *new actors* (artists, atypical users etc.) to bring a *new culture* & inspiration.
5	**Intellectual Experience**	Environments and environmental contents for *intellectual challenge, exploration and stimulation* (libraries).	Encourage the use of *concrete outcomes to represent intellectual challenges and exploration*.	Encourage discovery, intellectual challenge and exploration in specific phases of the process through competitions, conferences etc
6	**Closure**	Limitation in space and time; show-room; valorisation website.	Invitation to conclude projects with concrete *outcomes, a video or demonstration*.	*Closure* phase in projects; systematic *visibility of outcomes*, *final presentations and documentation*.
7	**Self-Resonance**	Balance between *intimate and open places*; environmental appropriation.	Artefacts that encourage *personal expression*; replace conformism in medium and tools for self-expression	Foster personal and professional development by giving time to *personal projects*.
8	**Discussion & Confrontation**	Conversational areas to motivate discussion; possibility *to switch on/off individual communication* channel.	Artefacts that incite discussions and confrontation; *unfinished prototypes*.	*Systematic presentations and discussion* (workshops, conferences, social events); *intra-hierarchical* discussion.
9	**Evolution**	Environmental incitation to learn new skills and methods; Showroom.	Represent *history & documentation* of intermediary objects.	Skill assessment after each project; Encourage conferences trainings; discuss history of projects, past failure and errors.
10	**Collective Acting & Sharing**	Share same environmental constraints and tools for team project;	Team-building techniques; social artefacts; Means to freely share projects and ideas (website, open source programs); documentation.	Transparency, same objectives and constraints Reserve time during project for sharing; open process for Open Innovation; Open Days event etc.
11	**Synergy**	Place for *free meeting*; display of common goals and values.	Artefacts and techniques for collective challenge; serious gaming.	Complementarity and skills imbrication; understand professional attraction and synergetic collaboration; Rituals.
12	**Concreteness**	Place for rapid prototyping; *show results* - articles, patents, and inventions *as concrete outcomes*.	*Different medium & rich representations*; materials like wood, plastic, 3D printed materials etc.	Encourage prototyping culture throughout the whole process; *reduce creativity sessions for low-fidelity prototyping sessions*.
13	**Impact & Influence**	Micro, macro display of people's impact for the company and industry; showroom.	Show objects with impact and how they become company products.	Encourage projects that resonate with company values, understand how impact is created.
14	**Lab Image & Research Culture**	Environments that create *iconic representations of company values* – industrial imaginary; legibility of values through logo and discourse internally and externally.	Organizational *artefacts to translate cultural values:* logo, branding, website, leaflet etc.; Restitution of the company image in websites, design principles in intermediary objects.	Coherence between company values and projects; internal understanding the lab culture and external promotion; *Visibility, coherence between company values, image and people's role*.
15	**Recognition**	Show contributions (daily patents, publications, etc.); show *recognition through bliss environments.*	Platform to *promote results to exterior and interior diffusion*; contributions as project blueprints.	Encourage individual and collective results; rituals for internal recognition.

For example to achieve the *Clarity* condition for intermediary objects, one can use principles like *Maximum effect for minimum means, Familiarity, Prototypicality* (presented in **Table 3 Aesthetic properties** for products – a theoretical overview with examples. Using aesthetic features for the outcomes of research-engineers might bring in engagement and more personal resonance. As we saw, the TechCards due to their form and layout, they were *used, adapted* and *became a cultural artefact* that inspired the creation of similar artefacts and new usages in parallel projects. They are now part of the organisational culture and the language of researchers, helping them to articulate the collective memory of the R&D department.

Guidelines for the design process: Besides designing working places and intermediary objects, a more global view on the project might be suitable to operationalize the AE conditions. For *Clarity* condition for example, clarity and transparency in the process, implies that the team members to have a clear view on the overall process. Several APPRD engineers participating in the qualitative study suggest the use of *rituals* and miles-stones in the process to achieve *Clarity* condition. Moreover, a global view on the process should take into account the collective scale of the experience in an R&D department.

Regarding the information presented in **Table 22**, we are aware *of the necessity of validating these empirically gathered aspects.* However, we believe that this table could be adapted to new environments, not as an a-priori matrix but as *a grid to reflect on how to create situated and contingent directions towards aesthetic experiences.* Therefore the information within might be different depending on the context. For the moment this table provides first possibilities for crafting aesthetic experiences in an R&D department and shows how conditions can be translated in practical implications for design to create an innovation culture.

Finally, even if design might try to facilitate such experience, we are aware of the complexity of the notion that we study. Aesthetic experience remains still a non-guaranteed feeling. However we believe that **awareness and the aesthetic attitude** is something to be learned. As (Sandelands & Buckner, 1989) suggest, we could imagine courses on work appreciation like there are courses of art appreciation. (Dreyfus & Eisenberg, 1986) analyse the aesthetic of the mathematical thought and suggest that aesthetic should be part of the mathematical education. **Consciousness and perseverance** are key elements for the awareness of aesthetic experiences and might constitute the fundamental elements towards meaningful and rich experience in work.

5.4 Summary of the contributions

Further on we present a synthesis of the five key contributions of the study - methodological, theoretical and empirical, in the perspective of both scientific and industrial communities:

→ A sequential methodology to study experiences

From a methodological point of view, our research proposes a sequential procedure to study long-term experiences developed in real settings. We propose a three steps structure to framework aesthetic experience: **Research-Action, Qualitative study and Quantitative study**. This methodology uses knowledge coming from User Experience measurements and a *validated protocol to depict Aesthetic Experience in art-related contexts* adapted to new field. Moreover this proposition is built during the investigation of a new concept, the Aesthetic Experience of an R&D department. This concept creates a transition between **UX** – *User Experience* and **CX** – *Concepteurs Experience*.

→ A framework of Aesthetic Experience – a new context and new dimensions

From a theoretical point of view, we propose a **descriptive framework of Aesthetic Experiences in real settings**. Our contribution lays in the description of the concept of aesthetic experience in an unconventional environment usually studied for optimizing productivity and efficiency. Our framework revalidates the four dimensions of aesthetic experience coming from literature: *Perceptive, Intellectual, Emotional and Communicative* and shows specificities of these dimensions in a working environment in comparison with museum or art-related environments. Moreover our study describes new experiential aspects like *the collective experience* and *the experience of makers* and *the organisational* and shows the importance of these elements for the success of a rich and memorable experience in an R&D department.

→ Design artefacts – cultural vehicles and the aesthetic quality

Another theoretical contribution is **the quality of design artefacts as cultural vehicles** in a Techno-centred environment. These artefacts transform the actors of innovation and inspire them to new reconfigurations of these artefacts in their work. From this point of view they are *extra-ordinary, unique* and therefore **aesthetic** due to the quality of the relations they trigger in the innovation process.

→ Aesthetics, design and innovation culture – directions for new measurements

A final theoretical contribution of this thesis is the application of several aspects we find in our study into directions for **new measurements of the innovation culture**, **design and subjective judgments in R&D departments**. We show how design is related to a measurement tool of innovation culture. We also discuss **new KPIs** proposed at Bell Labs in 2013 that implicitly use some of the elements of this research and open the discussion on *the measurement of multidisciplinary impact in an R&D department*. Lastly we define three notions to describe projects value in an R&D department: **desirability, memorability and transformation**. Besides the classic view brought by KPIs, these elements emphasize the power of influential projects to built an industrial imaginary of an R&D department and to create the organizational culture.

→ Designing aesthetic experience for innovation culture – design implications for industry

The empirical contribution of this study proposes an **operationalization of the theoretical framework of the R&D experience** on three axes: *working environments, intermediary objects, guidelines for the design process*. We constitute a **grid of reflexion** on how to create situated and contingent directions towards aesthetic experiences in an R&D department. These practical implications for design are built on the knowledge acquired during the Action-Research approach conducted in our study. Further validation of these elements could bring *a generative nature to the theoretical framework of Aesthetic Experience*.

6 Conclusions

Thesis Conclusions & Perspectives

6 Conclusions and Perspectives

6.1 Conclusions

This thesis focus on the study of **aesthetic experience in an R&D department** and questions *the role of design culture to influence the outcomes of the innovation process and the working experience of research-engineers* in a *Techno-centred environment*. In accordance with the recent interest of the design community in Experience Design and User eXperience (UX), we propose that aesthetic feelings are existent in unconventional environments, usually studied for optimizing productivity and efficiency, like working environment.

By applying an **Action-Research approach**, we initially get immersed into the experimentation field during a phase of *Pre-experimentation*. This first step, in which we conduct several solution-based design projects and the initially proposed a descriptive framework of aesthetic experience drawn from psychology and pragmatic philosophy, shows first directions for the development of the concept of this thesis: **the aesthetic experience in R&D department and the role of design that impact the research-engineers working experience**. To enrich and validate this framework, we conduct two studies with research-engineers from Application Research Domain (APPRD) from Bell Labs. Experimentation 1 concerns the *existence and framing of the aesthetic experience of 31 department members during the four years of APPRD*. Experimentation 2 focuses on *the relation between the aesthetic feelings and the innovation indicators and design culture influence*.

Subsequent qualitative and quantitative analysis finally yields to a descriptive framework of aesthetic experience in an R&D department composed of seven dimensions. Four of these dimensions - *Perceptive, Intellectual, Emotional and Communicative* are also found in a similar study regarding the aesthetic experience of museum curators. Additionally, our investigation depicts new experiential aspects like *the collective experience* and *the experience of makers* and shows the importance of these elements for the success of a rich and memorable experience in an R&D department. Regarding the conditions of these dimensions, the quantitative study shows that: *transformation, communication of ideas, intellectual exploration, recognition* and *intellectual challenges* are the five most important conditions of research-engineers experience during the four years. Secondly, results show that the aesthetic experience is correlated to the number of patents, and that dimensions like *transformation, communication of ideas, intellectual exploration* are influenced by the design culture - *rapid prototyping, drawing & illustration and design scenarios*. In addition along with the aesthetic

experience of research-engineers, we illustrate the relation between **design and innovation culture** and show directions to measure the design influence and subjective feelings in projects through the introduction of attributes: *desirability, memorability* and *transformation*.

Original research advancements are pushed in several areas: (1) the exploration of an emerging topic of the today research that framework users' experience with products, the proposition of a transition from the **UX** - *User Experience* to **CX** - *Concepteurs Experience*, the experience in the design process; (2) we also propose a **sequential methodology to study long-term experiences in real settings** that joins Action-Research approach and retrospective reconstruction; (3) the investigation and framework of **aesthetic dimensions** *in the working experience on an R&D department*; (4) the analysis of the **encounter between a Techno-centric culture and a design culture** and the influence of design on the subjective feelings; and finally (5) the relation between **subjective feelings and innovation indicators**.

6.2 Perspectives

Future research could address the following issues: the **validation of the design implications of the aesthetic experience conditions** proposed in **Section 0** and their relation with the innovation culture; the investigation of the relation between **rich experiences in the process** and their influence on **the users' experiences** resulting from the design process; the relation between **aesthetic experience and the human needs**; further explorations on the experience temporality with a focus on the notion of **closure**, and finally the relation between **the experience temporality and the aesthetic experience conditions**.

6.2.1 Validation of the design implications of the aesthetic experience dimensions and their influence on the innovation culture

In **Section 0** we propose three directions to operationalize the AE conditions found in our field: *working environments, intermediary objects and guideline for the design process*. Future studies could operationalize these design implications and understand their impact for the innovation culture. In order explore this direction, we propose the following procedure as represented in **Figure 113**.

We suggest a first diagnostic following (Rao & Weintraub, 2013) grid *to measure the innovation culture* and a *questionnaire on aesthetic experience conditions and design influence* as the one used in Experimentation 2. This

first diagnostic will show the initial conditions of the working environment, i.e. before applying the design implications from **Table 22**.

Afterwards, we propose an Action-Research approach in multidisciplinary teams to explore the design implications for *intermediary objects* and *working environments*. Depending on the researchers' role in the process, in this phase one could also explore the AE implications and *guidelines for the design process*. The experience as a designer at Bell Labs, teaches us that 6 months could be an appropriate temporal frame for a first contact with the field and for applying the first phase of exploration of Action-Research.

After this exploratory activity, a second phase of evaluation (2nd diagnostic in **Figure 113**) will show **what elements of the design process have changed due to the design implications** used in the Action-Research approach. One could apply this evaluation several times in the process in order to understand the influence of the design implications on the innovation culture. Moreover an analysis on the number of KPIs during this process might offer new insights on innovation measurement and the subjective aspects of the working experience.

Figure 113 Methodology for validation of the design implication of the Aesthetic Experience, design and innovation culture influence

6.2.2 From a rich CX to a rich UX: 'Experience Triggers'

Few of the recent studies of user experience propose generative methods that give guidelines to designers on how to craft rich user experiences. The challenge regarding UX predictability lays in the early representation of design artefacts, both ***flexible*** **in the operationalization of UX qualities, as** ***rigid*** **to preserve key characteristics being intact in the final prototype** (E. Law, 2011). Our interest in the research-engineers subjective experience – *Concepteurs Experience* (CX) brings in a question of the **CX causality on the UX**. This

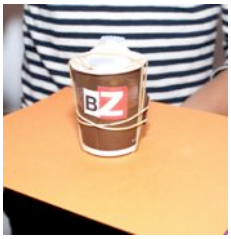


Figure 114 Example of an Experience Trigger for the human need 'Security-Control'. The *Bol-Zen prototype* is an accompanying cup that reassures its user and gives confidence.

causality, from CX to UX, might be a generative method for rich user experiences. In other words, our assumption implies the possibility to *transfer the experiential aspects from the design process to the user.* Approaches like *probes* (W. W. Gaver et al., 2004), *extreme personas* (J. P. Djajadiningrat, Gaver, & Fres, 2000) and *participatory design*(E. B.-N. Sanders & Westerlund, 2011) show how subjectivity and **experience inspire designers when they encounter rich experiential material**.

In order to investigate this assumption, we propose a continuation of the CX concept through the notion of **Experience Triggers**. We describe and *Experience trigger* as following:

An Experience Trigger is a design object or situation embedding a theory related to UX. The trigger is created by an UX expert, usually an experience designer, and it is used by the design team in the design process as an experiential evoker. Finally through the interaction with the trigger, the design team lives a memorable experience and acquires the experiential knowledge to design rich experience products and services.

First explorations of this concept are already tested in a workshop at Flupa UX Day in June 2013[24]. This workshop presents the concept of *experience trigger* to the practitioners' community, and creates first triggers from a recent UX theory exploring human needs. For each human need, the workshop participants design experiential objects that further on could be used in the design process as *experiential evokers* (see **Figure 114**). A future workshop at IHM 2013 conference, explores the fourth phase of the *experience triggers process* (see **Figure 115**) – how experience triggers aspects can be embedded in future products and services[25].

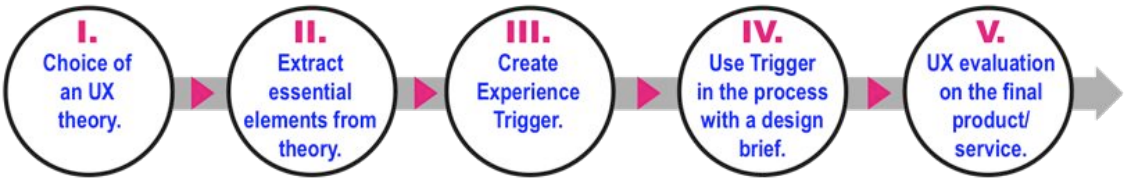


Figure 115 Experience Trigger process.

[24] See the workshop detail ***uxday.flupa.edu***; the workshop title (in French): *Concevoir pour l'expérience utilisateur (Design the UX).*

[25] See the call for paper proposal for the IHM'2013 workshop at ihm13.bordeaux.inria.fr/programme/gt/workshop-5-design-for-user-experience/

We believe that these first attempts continue the concept of experience in the process – CX, developed in this thesis, and might propose useful insight on the **UX generation** for practitioners and design researchers. More specifically the Aesthetic experience conditions found in this thesis might be transformed in *Aesthetic Experience Triggers.*

6.2.3 Aesthetic Experience & human needs

In our study on the aesthetic experience of research-engineers at Bell Labs, we identified several AE conditions similar with the **human needs in organizations**: *influence, impact and recognition*. This observation shows the connection between *experience, organisational needs and motivations theories.* Alderfer defines the **Relatedness need** in organizations as the necessity of workers to be involved in relationships with significant others. This aspect implies the need of *sharing, mutuality, acceptance, confirmation, understanding and influence* (Alderfer, 1969). This notion is also similar with the condition *Collective acting* of the **Collective experience**. This observation brings in questions related to the relation between **Experiences** and **need fulfilment**.

Moreover recently it is shown in the UX community that *need fulfilment is linked to hedonic quality perceptions, but not as strongly to pragmatic quality - perceived usability* (Hassenzahl, Diefenbach, & Göritz, 2010). A future study might investigate more in-depth relation between the human needs and the conditions and states of mind of aesthetic experience. Such research could propose a new perspective to redefine the *Aesthetic need* proposed by (Maslow, 1971) beyond **the need of symmetry, order, and beauty**. The aesthetic experience is more complex due to its transformative nature and its intellectual and emotional quality.

6.2.4 Experience temporality & AE conditions

Concerning the temporal development of the experiences, we emphasize the importance **Closure** as an important temporal phase for users' experiences with products. In our study we investigate *the project-experience* of research-engineers. This notion forces us *to look at experience as a boundary situation* – an experience with a clear beginning and an end. Memory theory underlines the importance of ending to form the *memory self* (Kahneman, 2011; Miron-Shatz et al., 2009). Dewey's concept of Closure is an important element that brings *clarification and elucidation to a situation and that gives to that situation the quality of an Experience* (Dewey, 1934). (Sandelands & Buckner, 1989) talk about the importance of *boundary* to aesthetic experiences. These boundaries make possible to look at an artwork or situation *openly in a finite space and time*. Therefore

the ending and the temporal boundary is an essential moment in the experience development. This direction resizes questions related to the *length of an Experience*. When an experience with a product is over? And if an experience is a story with a beginning and an end, how such a story influences new experiences? Usually, in UX research we find studies investigating early phases of Experience like *anticipation*. However, for the moment little research deeply analyses the **influence of Closure for User Experience**.

Finally, regarding the temporal development of the aesthetic dimensions of an experience, a future study might investigate the correlation between *the temporal phases of an Aesthetic Experience - anticipation, orientation, incorporation and identification* (Karapanos et al., 2009) to aesthetic experience conditions. Is there an order on the aesthetic experience conditions and a matching with the temporal phases of experiences in order to live meaningful and rich experiences?

7 References

7 References

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8 Appendix

8 APPENDIX

8.1 Appendix A: Interview grid for Experimentation 1

The purpose of this interview is to find out what are the qualities of the experience[26] of the members of the APPRD Domain related to the projects they are involved in and also the conditions and the process in which their personal experience evolved over the 4 years of this research domain, from 2007 to 2012. Further more we would like to test our hypothesis on the influence of designers in this environment and the impact of this discipline on the APPRD members' experience. We particularly study all the projects on which these people worked during the 4 years and the working-relations developed over time.

Type of survey: Semi-directive interviews of 1h-1h30.

Number of people: 31 persons

i. Background and career information

1. We'd like to start out by getting an idea of how you came to be in your position in Bell Labs. Perhaps you could give me a brief sketch of the course of your career, maybe beginning with your education and leading up to your position in APPRD domain.

- How was it that you first became interested in this profession?
- What was the image of Bell Labs for you?
- What did you know about the activity that you were doing in APPRD before and how did you succeed in having your position? What was your motivation to join one of the APPRD Domain teams?

2. Could you explain a little about your position here?

- What was the name of your team?
- With whom did you work with?
- What was you role in the team and what was the role of the persons you were interacting with?
- What you were doing exactly in this team: long-range aspects and day-to-day?

[26] The term *experience* is defined as a non-ordinary situation lived through a project. This situation is a memorable one,that modified the person in a conscious and unique way.

- How would you define your job and your position at Bell Labs?
- What is a {researcher, engineer,… the title s/he defined before} for you?

3. Here it is a list of projects that we manage to cluster from APPRD domain.

- Could you let us know the projects you worked on *(an "x" for projects that he/she worked on)*.
- Are there any projects that you would have liked to work on (an "o" for projects that (s)he would have liked to work on)? Why they are valuable for you? (in general, we are after some kind of idea about goals and values; also, try to disentangle scholarly from personal/ aesthetic)
- With whom did you interact during these projects?

ii. Rewarding aspects the research department

4. One last question: What aspects of your work here do you find most rewarding or most satisfying? Why? *(probe for aspects of challenge, meaning)*

- What aspects of working on the projects of APPRD were most rewarding?
- Perhaps you could talk about something you've done recently in APPRD to illustrate this.

iii. Experiential aspects

5. Perhaps we could now change focus somewhat. I wonder if you could talk a bit about your experience within a project or a set of projects form APPRD. What I mean by that is to talk about a project that made you live a non-ordinary situation whether positive or negative and that changed you, transformed you and that rests in your memory as a significant situation? (*that provided you a particularly strong experience*)

(Note: if response is impersonal and/or focused on the audience, probe for the presumed nature of the researchers experience, then focus on the personal – i.e. " What about your own experience of/within this project?")

- Perhaps you could begin by describing your initial response to the project.

- What do you think that it was about this experience that makes it particularly memorable?
- Did your experience change in any other way? (was there any evolution on how you perceived a certain situation?)

6. Do you have this kind of experience often? Across all these experience, what kinds of things seem similar to you? *(probe for: situations or types of work and experience)*

7. Do you have this kind of experience in context other than work related contexts or the APPRD projects? What is the main difference between these two contexts that which one is more special to you?

8. If we could focus on your work again, do you feel you have experienced projects in this way throughout the entire course of your career, or is this something that you have had to develop (*like a skill),* or that has changed somehow through your lifetime?

Do you think that there was been particular experience that helped you develop either some special skills or general sensibilities to certain research themes, projects or even research?

iv. Discussion on the conditions of the experience

9. So far we've talked mostly about your own interaction with different projects. Do you think that the experience varies depending:

- the persons you've working with;
- a multidisciplinary team;
- the intermediary objects you've created;
- the role that you have in the project;
- the company's name and fame;
- management;
- or some other factor?

10. What do you think a good experience could bring to a company as ALU? Is this experience important?

11. Do you think that there is an optimal way of interacting with or experiencing projects in a research domain as APPRD?

- Do you think there are any essential conditions for such an optimal experience?
- If you could have complete control of all the elements involved, how do you think you would go about arranging the ideal project experience?

8.2 Appendix B: Questionnaire grid for Experimentation 2

PART A

1. Informations personnelles :

Nom et prénom :

Age :

Intitulé de votre poste en APPRD:

Manager : oui / non

Domaine de spécialisation :

Années d'expérience dans le domaine :

2. Pour commencer

a) Nous vous prions d'encercler sur la liste des projets, les projets sur lesquelles vous avez travaillé.

b) Choisissez : 3 projets que vous trouvez les plus importants, qui ont compté pour vous ou dont vous avez envie de discuter.

Note :

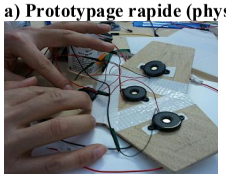
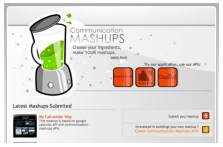
Cette page va être tout de suite marquée avec un identifiant personnel et va être détachée du reste du questionnaire pour que votre nom reste anonyme.

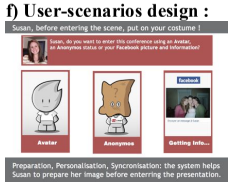
Il n'y a pas des réponses bonne ou mauvaises pour les questions qui suivent ; elles sont construites pour refléter vos perceptions et réponses subjectives. Il doit être rempli de manière spontanée ! Cela va prendre environ 20 minutes de votre temps.

Partie B. NOM PROJET : ……

		Pas du tout ---	Très peu --	Peu -	Un peu +	Beau coup ++	Extrêmement +++
1.	Est-ce que dans ce projet vous avez constaté de la **clarté** dans les objectifs du projet, l'organisation et la définition des rôles?	☐	☐	☐	☐	☐	☐
2.	Est-ce que vous avez eu un sentiment de **cohérence et d'intégration** entre les différent parties de projet (comme une sorte de puzzle qui se mettait en place face à vous) ?	☐	☐	☐	☐	☐	☐
3.	Vous êtes vous senti **libre** dans ce projet ?	☐	☐	☐	☐	☐	☐
4.	Est-ce que ce projet **a fait résonnance** avec des objectifs personnels ?	☐	☐	☐	☐	☐	☐
5.	Est-ce que ce dans ce projet vous avez **dépassé des challenges intellectuels**?	☐	☐	☐	☐	☐	☐
6.	Est-ce que ce projet vous a **transformé** ? Est-ce qu'il a changé votre façon de travailler en équipe ou de vous situer dans les futurs projets ?	☐	☐	☐	☐	☐	☐
7.	Est-ce que vous avez ressenti un **volonté de poursuivre** le projet jusqu'au bout, une volonté de voir sa progression ?	☐	☐	☐	☐	☐	☐
8.	Est-ce que ce projet vous a permit de vous épanouir **intellectuellement** par l'**exploration** des sujets de recherche en profondeur?	☐	☐	☐	☐	☐	☐
9.	Est-ce que ce dans ce projet vous avez pu **partager** et **confronter** votre travail avec les autres?	☐	☐	☐	☐	☐	☐
10.	Est-ce que **la fin** du projet a été satisfaisante pour vous ? Est-ce que d'après vous c'était un projet qui s'est bien fini ?	☐	☐	☐	☐	☐	☐

		Pas du tout ---	Très peu --	Peu -	Un peu +	Beau coup ++	Extrêmement +++
11.	Selon vous, est-ce que le projet a bénéficié d'**un bon début**?	☐	☐	☐	☐	☐	☐
12.	Selon vous, est-ce que le projet a eu un **rythme** intense ?	☐	☐	☐	☐	☐	☐
13.	Est-ce que **le nom** du projet était important pour vous?	☐	☐	☐	☐	☐	☐
14.	Dans la relation avec vos collègues, avez-vous eu des moments de **synergie** et avez vous vécu quelque chose de fort ensemble ?	☐	☐	☐	☐	☐	☐
15.	Est-ce que ce que vous pouvez dire que c'était **un beau projet**?	☐	☐	☐	☐	☐	☐
16.	Est-ce que vous avez pu **influencer** vos collègues avec des idées ou des façons de faire dans ce projet?	☐	☐	☐	☐	☐	☐
17.	Est-ce que vous avez pu faire des choses **concrètes, tangibles** dans ce projet?	☐	☐	☐	☐	☐	☐
18.	Est-ce que vous avez eu le sentiment d'être **un pionner** dans votre domaine en participant à ce projet?	☐	☐	☐	☐	☐	☐
19.	Est-ce que vous avez expérimenté des **plaisirs 'exotiques'** dans le cadre du projet (p.ex. travailler dans un lieu connu ou prestigieux, rencontrer des personnalités etc.)?	☐	☐	☐	☐	☐	☐
20.	Est-ce que ce projet a été important pour l'entreprise ?	☐	☐	☐	☐	☐	☐
21.	Est-ce que ce projet a compté personnellement pour vous? Si oui, pourquoi ?	☐	☐	☐	☐	☐	☐
22.	Est-ce que vous gardez un souvenir:	☐ positif		☐ négatif		☐ ambigu	

		Pas du tout	Très peu	Peu	Un peu	Beaucoup	Extrêmement
		---	--	-	+	++	+++
23.	Dans ce projet, est-ce que vous avez travaillé avec des designers ?	☐	☐	☐	☐	☐	☐
24.	Est-ce que le design et la pratique des designers a eu une influence dans ce projet ?	☐	☐	☐	☐	☐	☐
25.	Evaluez importance dans le projet des objets et pratiques suivants :						
	a) Prototypage rapide (physique) : 	☐	☐	☐	☐	☐	☐
	b) Prototypes software : interface & wireframes : 	☐	☐	☐	☐	☐	☐
	c) Creativ'lab :	☐	☐	☐	☐	☐	☐

	Pas du tout	Très peu	Peu	Un peu	Beaucoup	Extrêmement
	---	--	-	+	++	+++
d) Pratiques dessin et illustrations :	☐	☐	☐	☐	☐	☐
e) Outils de travail comme TechCards, CreaCards, etc.	☐	☐	☐	☐	☐	☐
f) User-scenarios design : 	☐	☐	☐	☐	☐	☐
g) Discussion avec les designers :	☐	☐	☐	☐	☐	☐

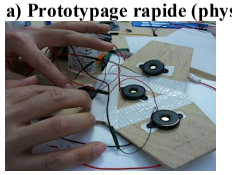
h) Autres choses que le design et les designers ont apporté dans le projet :

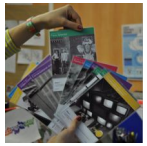
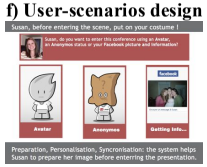
-
-
…

Partie C. Evaluer **l'importance** dans votre travail des critères suivants:

		Pas du tout ---	Très peu --	Peu -	Un peu +	Beau coup ++	Extrême ment +++
1.	**Intégration & Imbrication** *C'est important que les choses s'imbriquent comme un puzzle.*	☐	☐	☐	☐	☐	☐
2.	**Liberté** *C'est important d'être libre dans mon travail.*	☐	☐	☐	☐	☐	☐
3.	**Transformation** *C'est important que j'évolue dans mon domaine.*	☐	☐	☐	☐	☐	☐
4.	**Résonance émotionnelle** *C'est important que ce que je fais résonne avec mes objectifs.*	☐	☐	☐	☐	☐	☐
5.	**Clôture du projet** *C'est important de finir les projets proprement, avoir une vraie fin.*	☐	☐	☐	☐	☐	☐
6.	**Dépassement, challenge, résolution problèmes** *C'est important d'avoir des challenges scientifiques et d'être capable de trouver des solutions.*	☐	☐	☐	☐	☐	☐
7.	**Communication** *C'est important que je communique et je confronte mes idées.*	☐	☐	☐	☐	☐	☐
8.	**Clarté** *C'est important d'avoir un rôle clair dans le projet, ou que je vois clairement où je vais dans un projet.*	☐	☐	☐	☐	☐	☐
9.	**Exploration intellectuelle** *C'est important que j'explore des sujets et je vais en profondeur.*	☐	☐	☐	☐	☐	☐
10.	**Volonté, persévérance** *C'est important que je veuille arriver à quelque chose à tout prix.*	☐	☐	☐	☐	☐	☐

		Pas du tout ---	Très peu --	Peu -	Un peu +	Beau coup ++	Extrême ment +++
11.	**Beauté du projet** *C'est important que je voie quelque chose de beau, d'élégant, d'extraordinaire dans la façon dont le projet se déroule.*	☐	☐	☐	☐	☐	☐
12.	**Influence** *C'est important que j'influence mes collègues avec des idées ou avec une façon de faire.*	☐	☐	☐	☐	☐	☐
13.	**Synergie** *C'est important je ressens une synergie quand je travaille avec mes collègues.*	☐	☐	☐	☐	☐	☐
14.	**Action collective** *C'est important qu'on fasse et qu'on ressente tous la même chose.*	☐	☐	☐	☐	☐	☐
15.	**Partage** *C'est important que je partage mon travail ou mes idées avec les autres.*	☐	☐	☐	☐	☐	☐
16.	**Nom projet** *Le projet sur lequel je travaille port un nom qui fait sens pour moi.*	☐	☐	☐	☐	☐	☐
17.	**Concrétude** *C'est important de faire des choses concrètes, tangibles.*	☐	☐	☐	☐	☐	☐
18.	**Pionnier** *C'est important que je travaille sur un sujet comme pionnier dans mon domaine .*	☐	☐	☐	☐	☐	☐
19.	**Reconnaissance** *Mon travail est reconnu.*	☐	☐	☐	☐	☐	☐
20.	**Impact business** *C'est important que ce que je fasse a un impact pour l'entreprise.*	☐	☐	☐	☐	☐	☐
21.	**Impact social** *C'est important que ce que je fasse a un impact pour la société.*	☐	☐	☐	☐	☐	☐

		Pas du tout ---	Très peu --	Peu -	Un peu +	Beaucoup ++	Extrêmement +++
22.	Dans vos pratiques, est-ce que vous avez travaillé avec des **designers** ?	☐	☐	☐	☐	☐	☐
23.	Est-ce que le design et la pratique des designers a eu une **influence** sur vos pratiques et façons de faire ?	☐	☐	☐	☐	☐	☐
24.	Plus précisément, parmi **ces objets et activités**, quelles sont ceux que vous avez appris et/ou utilisés :						
	a) Prototypage rapide (physique) : 	☐	☐	☐	☐	☐	☐
	b) Prototypes software : interface & wireframes :	☐	☐	☐	☐	☐	☐
	c) Creativ'lab :	☐	☐	☐	☐	☐	☐

		Pas du tout ---	Très peu --	Peu -	Un peu +	Beaucoup ++	Extrêmement +++
	d) Pratiques dessin et illustrations :	☐	☐	☐	☐	☐	☐
	e) Outils de travail comme TechCards, CreaCards, etc. 	☐	☐	☐	☐	☐	☐
	f) User-scenarios design : 	☐	☐	☐	☐	☐	☐
	g) Discussion avec les designers :	☐	☐	☐	☐	☐	☐
	h) Autres choses : …						
25.	Parmi les exemples ci-dessus, **le quel conserveriez-vous** si vous ne deviez en garder qu'un à l'avenir ?						

SYNTHESIS OF THESIS IN FRENCH

INTRODUCTION GENERALE

I. Objectif de la recherche

Cette thèse CIFRE fait partie de la science de conception. Elle explore le concept de l'**Expérience Esthétique dans le processus de conception**. La recherche s'aligne avec des études récentes qui abordent cette notion du point de vue des utilisateurs - Expérience Utilisateur (UX), le Design de l'Expérience, etc. La différence avec ces études est la population cible. Dans notre recherche le focus n'est pas porté sur l'utilisateur final, mais sur l'**ingénieur-chercheur dans un département R&D** et son expérience subjective dans des projets et des activités de recherche. En tant que praticiens de design, notre objectif est de comprendre la relation entre **le design, l'innovation** et cette **expérience subjective** dans le processus de conception.

Suivant ces directions, cette thèse a les objectifs suivants:

→ modéliser le concept de l'**Expérience** et l'**Expérience Esthétique** dans des contextes réelles, dans le but d'*observer*, de *décrire* et finalement de *générer* ce type d'expériences mémorables.

→ étudier *l'influence de la culture design* sur l'**expérience des ingénieurs-chercheurs** dans un département R&D;

→ explorer la relation entre *la culture design* et *la culture de l'innovation* dans un département techno-centré.

II. Problématique

Étant donné que l'expérience esthétique est un sujet d'un intérêt croissant pour la communauté du design, plusieurs études examinent ce concept pour mesurer et prédire l'expérience des utilisateurs avec des produits ou comprendre le développement de l'appréciation esthétique dans les milieux artistiques. Cependant, beaucoup d'études dans la recherche en design se focalisent sur les *modèles informationnels de traitement de la perception esthétique*, tandis que d'autres, qui tiennent compte de la *nature holistique* de l'expérience esthétique, proposent généralement *des cadres théoriques provenant de la philosophie difficilement adaptables aux situations réelles.* Encore moins d'études discutent *l'évolution temporelle de l'expérience esthétique.*

Par conséquent, il y a un manque à combler pour comprendre les conditions et les dimensions de l'expérience esthétique, dans une perspective holistique, dans des contextes réels et des environnements qui ne sont pas liés aux œuvres d'art et aux contextes de musée. Également, il est nécessaire de développer un cadre descriptif pour observer la qualité esthétique de vivre une expérience au fil du temps. En outre, des récents recherches des sciences de gestion suggèrent que l'étude des expériences esthétiques dans les organisations ouvre à des

nouvelles expériences et attitudes dans cet environnement qui sont essentielles pour les organisations qui s'appuient sur la motivation tels que les institutions de recherche et les laboratoires.

Ainsi, notre question de recherche est liée à l'expérience esthétique des ingénieurs-chercheurs dans un département R&D et à la relation entre cette expérience subjective et la capacité à innover et à la culture de l'innovation. De plus, à cause de la différence culturelle entre la culture design et une culture techno-centrée des départements de R&D, nous nous interrogeons sur le rôle de design à influencer ce type d'expérience subjective et son pouvoir de transformation sur la culture organisationnelle.

III. La méthodologie de recherche

Afin de mener notre recherche, nous utilisons une **approche de Recherche-Action**. Le caractère industriel de cette thèse, et l'expérience en tant que praticien en design dans le domaine de recherche Application Research Domain de (APPRD) d'Alcatel-Lucent Bell Labs France, apporte un riche terrain d'expérimentation.

Le premier cycle de la Recherche-Action, appelée **Pré-expérimentation**, dure entre 12 et 18 mois. C'est une phase d'exploration. Du point de vue théorique, cette phase consiste à prendre deux directions. D'un côté un état de l'art conçu pour la résolution des problèmes de conception dans les projets d'APPRD, et de l'autre un état de l'art lié aux concepts de l'expérience et l'expérience esthétique (voir **Figure 1**). Les connaissances empiriques et théoriques acquises durant cette première phase nous permettrons de construire la problématique et les hypothèses de la thèse (RQ dans **Figure 1**).

Le deuxième cycle de Recherche-Action consiste à **tester les deux hypothèses de cette recherche**, la construction du cadre théorique de l'étude et proposer des premières implications pour la conception des expériences esthétiques grâce à la culture design et à la culture de l'innovation.

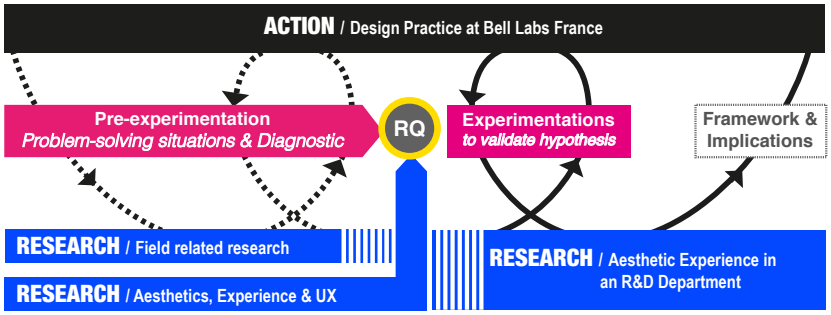


Figure 1 La méthodologie de recherche de la thèse

IV. Contributions et Originalité

Nous présentons brièvement les principales contributions méthodologiques, théoriques et pratiques de l'étude.

1. Un cadre holistique de l'expérience esthétique

D'un point de vue théorique, nous proposons un cadre descriptif des expériences esthétiques dans un contexte non conventionnel : **un département R&D.** Notre cadre revalide les dimensions de l'expérience esthétique en provenance de la littérature et montre les spécificités de ces dimensions dans un environnement de travail et de conception. De plus, notre étude décrit de nouveaux aspects expérientiels tels que *l'expérience collective, l'expérience des bricoleurs* ('makers', 'doers' en anglais) et des aspects de l'organisations qui influencent le succès d'une *expérience riche et inoubliable dans un département R&D.* Enfin, nous proposons également des premières implications design pour opérationnaliser les dimensions trouvées dans notre étude sur trois directions: les environnements de travail, les objets intermédiaires et le processus de conception.

2. Une méthodologie séquentielle pour étudier le concept de l'expérience en situation réelle

D'un point de vue méthodologique, notre recherche propose une *procédure séquentielle pour étudier les expériences à long terme en situation réelle.* Comme il est indiqué dans l'état de l'art, la mesure de l'expérience à long terme est un sujet d'intérêt pour la communauté de la recherche en design. Nous utilisons une structure méthodologique en trois étapes: une *première étape de Recherche-Action* suivie *par un étude qualitative* et *un étude quantitative.* En outre, cette recherche crée une transition entre UX – l'expérience utilisateur et CX – l'expérience des concepteurs.

3. Artefacts de la culture design - véhicules culturels à qualité esthétique

Une autre contribution théorique analyse la qualité des objets de la culture design et des objets intermédiaires faits par des designers. Dans un environnement techno-centré, ils sont des *véhicules culturels.* Grâce à leur différence culturelle, ces objets transforment les ingénieur-chercheurs en les incitant à créer des nouveaux objets et des usages dans leur travail. De ce point de vue, ils sont *extra-ordinaires* (hors du commun), *uniques* et donc *esthétiques* - leur force et leur visibilité résident dans leur différence culturelle avec le contexte technique des départements R&D.

4. L’expérience esthétique, le design et la culture de l'innovation - orientations pour des nouveaux indicateurs

Une contribution d’ordre pratique de cette thèse est l’exploration des nouveaux indicateurs de la culture de l'innovation, du design et de l’expérience subjective dans les départements R&D. Nous analysons la relation entre les outils et les pratiques design et de la culture de l'innovation. Ainsi nous proposons de nouvelles orientations pour mesurer l'influence des *projets mémorables et désirables* dans les départements R&D.

V. Structure du document

Ce document de thèse se divise en six chapitres: Contexte, Etat de l’art, Problématique et Hypothèses, Expérimentations, Contributions et Implications pour le design, Conclusion et Perspectives. Le chapitre I introduit le contexte industriel et académique. Dans le chapitre II, nous avons établi un état de l’art portant sur les concepts de l’Esthétique, Expérience, l’Expérience Esthétique et des théories correspondantes dans la recherche en design, la psychologie, la philosophie and les sciences de gestion. Le chapitre III formule la problématique et les hypothèses de cette thèse. Dans le chapitre IV, deux expérimentations ont été proposées afin de tester les hypothèses de cette thèse après une phase de exploration - Pré-expérimentation. Le chapitre V porte sur les principaux apports de la thèse en mettant avant des perspectives scientifiques et industrielles. Le chapitre VI se poursuit par une conclusion générale qui récapitule les principaux points clefs de la thèse. Il se conclue par une discussion à propos des orientations de recherches futures.

AVANT-PROPOS, AVANT-EXPÉRIENCE

Le 10 mars 1876 est l'année de l'invention du téléphone par Graham Alexandre Bell. "Mr. Watson, come, I want to see you!" (M. Watson, viens, je veux te voir) furent les premiers mots qui ont passé le fil qui séparaient le fameux chercheur de son assistant Mr. Watson. Et quand M. Watson est apparu devant Bell, ce dernier a compris qu'il venait d'inventer le téléphone.

Nous pouvons juste imaginer l'expérience forte qu'il a du ressentir à ce moment précis. C'est ce type **d'expérience forte, extraordinaire, mémorable**, qu'on appelle **expérience esthétique** qui nous intéresse de comprendre dans le contexte d'un département de recherche du processus de conception. La problématique porte sur la **liaison entre cette expérience esthétique des chercheurs et l'innovation**. Cette thèse reste dans la culture de Graham Alexander Bell car elle se déroule au sein de Bell Labs, à presqu'à 150 ans de l'invention de téléphone. Il s'agit d'une thèse CIFRE réalisée au sein de l'équipe User Experience Design, conduite par Frédérique Pain. Le support académique est apporté par le Laboratoire Conception Produits Innovation (LCPI) d'Arts et Métiers ParisTech sous la direction d'Améziane Aoussat et Carole Bouchard, ainsi que par Dominique Sciamma de Strate Ecole de Design.

1 Context

Ce chapitre présente le contexte industriel et académique de cette thèse CIFRE et les principaux sujets de cette recherche. Nous expliquons donc à la fois la demande industrielle et son inscription dans le contexte industriel de l'industrie des télécommunications aujourd'hui et le rôle de design comme vecteur de changement sociétal et pour les entreprises.

1 CONTEXTE

1.1 Contexte industriel

La découverte du téléphone transforme le XX siècle. L'industrie télécom vit des grandes évolutions avec l'arrivée de l'internet et la télécommunication mobile. Nous sommes en pleine troisième révolution industrielle (Rifkin, 2011). Depuis 2007 le nombre des personnes qui utilisent internet a doublé, et le nombre de souscriptions mobiles a été multiplié par 8 (voir Tableau 1). En même temps la crise économique pousse l'industrie télécom à s'inventer et à innover constamment (Musso, 2008). En 2006, la 4eme génération des R&D amène un changement d'approche de l'innovation - le passage d'une approche Techno-Push à une approche Market-Pull. Cette nouvelle approche amène d'autre acteurs dans la chaine de l'innovation: chercheurs en science humaines, psychologues, ergonomes et designers (Musso, 2008).

Figure 2 101 Gadgets That Changed the World © JAMIE CHUNG (2011)

Tableau 1 ITU Avril 2013 statistiques sur l'évolution des communications mobiles et d'Internet (www.itu.int).

	2005	2006	2007	2008	2009	2010	2011	2012*	2013*
Personnes qui utilisent internet (millions)									
Monde	1,024	1,151	1,365	1,556	1,747	2,023	2,273	2,497	2,749
Suscriptions téléphonie fixe (millions)									
Monde	1,243	1,261	1,254	1,249	1,253	1,228	1,204	1,186	1,171
Suscriptions actives téléphonie mobile (millions)									
Monde	N/A	N/A	268	422	615	778	1,155	1,556	2,096
Pourcentage des personnes qui utilisent internet (% per pays)									
France	42.87	46.87	66.09	70.68	71.58	80.10	79.58	N/A	N/A
USA	67.97	68.93	75.00	74.00	71.00	74.00	77.86	N/A	N/A
Allemagne	68.71	72.16	75.16	78.00	79.00	82.00	83.00	N/A	N/A
Chine	8.52	10.52	16.00	22.60	28.90	34.30	38.30	N/A	N/A
Japon	66.92	68.69	74.30	75.40	78.00	78.21	79.53	N/A	N/A

** : estimations; N/A : (not available) pas disponible.*

Figure 3 Bell Labs ages: technic, client, user - adapted from (Guern, 2013).

En 2008 Alcatel et Lucent fusionne et Bell Labs devient le centre de recherche du nouvel acteur en télécom - Alcatel-Lucent. La naissance de la 4eme génération des départements de R&D favorise l'apparition d'un département multidisciplinaire au sein de Bell Labs, Applications Research Domain (APPRD). Ce département est composé de plus de 100 chercheurs situés en France, Belgique, USA et Inde qui travaillent sur des axe de recherche comme l'internet des objets, les réseaux sociaux, l'immersion à distance. Autour de toutes ces problématiques de recherche en télécommunications situées à l'ère de l'internet 2.0 (l'ère de la collaboration de l'interaction sociale en ligne), la figure de l'utilisateur devient le concept phare pour APPRD. Et pour la première fois aux Bell Labs, l'utilisateur apparaît comme une figure proche de l'innovation - à voir dans **Figure 3** l'évolution de

Bell Labs de l'ère *technique*, suivie par l'ère du *client* et enfin celle de l'*utilisateur* (Guern, 2013). La figure complexe de l'utilisateur amène donc en 2009 le design, et d'autres disciplines de sciences humaines, dans ce département de recherche. L'impact du design dans le département est porté sur deux axes:

- un axe autour de **l'expérience utilisateur,** avec la création d'une équipe design conduite par Frédérique Pain : User Experience Design (UXD),

- un axe sur les dimensions esthétiques et les moyens d'expression des designers qui amènent une nouvelle valeur pour l'innovation dans un contexte à forte culture technique.

La thèse CIFRE commence en 2010 sur ces dimensions esthétiques liées à l'expérience des équipes pluridisciplinaires dans le contexte de la conception et de l'innovation.

1.2 Contexte académique

Les différentes transformations dans l'industrie télécom montre ce que Lévy et Jouyet appellent la transition vers *une économie de l'immatériel* ((Lévy & Jouyet, 2006) cité par (Musso, 2008)). Dans cette nouvelle dimension la notion d'**expérience** est le concept phare pour l'innovation et la création de valeur pour tout type de produit et service. Ce concept est identifiée aussi par des économistes renommés comme Pine et Gilmore qui soulignent l'importance d'aller plus loi que la création des produits et des services, vers la scénarisation des expériences mémorables (Pine & Gilmore, 1998) – voir **Figure 4**.

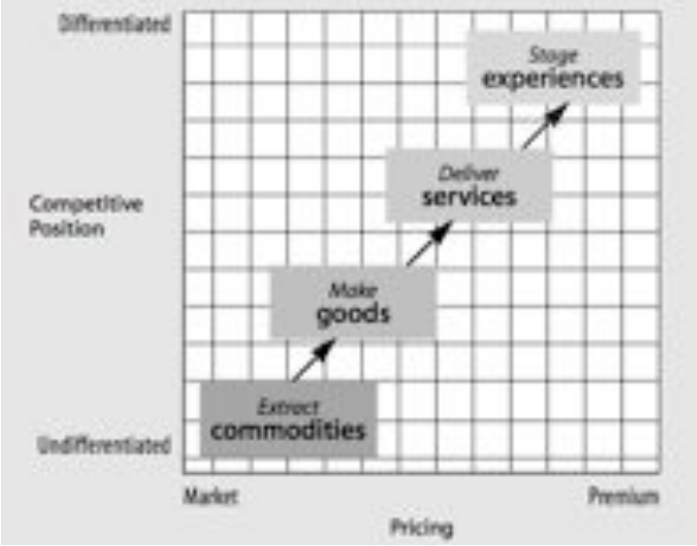


Figure 4 Une nouvelle economie : Experience Economy (Pine & Gilmore, 1998).

Dans le contexte de la convergence de l'Internet et de la Communication nous pouvons nous questionner sur le rôle de nos futurs produits, qui peuvent **aller plus loin que l'optimisation fonctionnelle, c'est à dire vers l'amélioration de la relation entre les personnes et les objets de communication**. « Dans un monde où

la praticité et la fonctionnalité peuvent être garantis, l'esthétique des nouveaux objets techniques doit fournir une nouvelle expérience dans notre quotidien ainsi que de nouvelles dimension poétiques » (Dunne, 2008). C'est le design qui est la discipline la plus appropriée pour réfléchir aux dimensions esthétiques de l'expérience. C'est ce que nous montre le designer Hayeon Yoo en changeant l'interaction avec des objets banals. Par exemple, il utilise un GPS comme un artefact personnel dans lequel on garde le nom des personnes qu'on rencontre, et qui nous indique la direction et la distance jusqu'à ces personnes (voir **Figure 5**).

Figure 5 GPS d'un telephone (*Haut*); Compass Phone de Hayeon Yoo (*Bas*). (www.hayeonyoo.com)

Concernant le laboratoire d'accueil de cette thèse, LCPI a été un pionnier de la recherche vers la modélisation et l'optimisation de la conception et de l'innovation (Aoussat, Christofol, & Coq, 2000; Aoussat, 1990). L'intégration de nouvelles professions dans le processus de conception (ergonomes, psychologues, designers, ingénieurs etc.) est une direction de recherche de LCPI. Le défi consiste à déterminer comment les nouvelles professions pourraient coopérer ensemble, pour répondre à ces concepts complexes comme **Kansei engineering**, **le design émotionnel** (Emotional Design) et plus récemment le design d'expérience (Experience design) (Bouchard et al. 2008, 2009) - **Figure 6**.

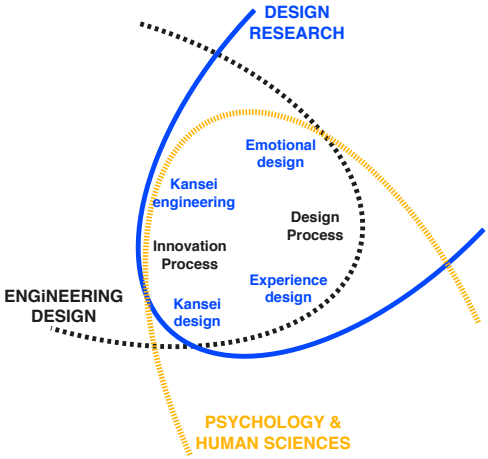


Figure 6 Le Laboratoire CPI thématiques de recherche et champs académiques.

Même si l'efficacité et la rapidité d'exécution sont les premiers objectifs de la recherche à LCPI, aujourd'hui d'autres aspects plus subjectifs sont pris en compte dans la conception comme la *relation sensorielle entre les concepteurs et les représentations physiques* (Bouchard & Aoussat, 2002). En outre, *ces représentations et les objets* créés par les designers sont liés à une culture particulaire (design culture) et un processus pragmatique de faire des idées concrètes (Mat Hunter, 2010). Cette nouvelle culture amène de la subjectivité dans l'équipe de conception et influe sur l'expérience globale de conception. Dans cette thèse nous nous intéressons aux **nouveaux rôles des représentations intermédiaires issues de la culture design qui vont**

au-delà de l'optimisation du processus de conception, vers une nouvelle perspective d'aborder l'innovation dans un contexte pluridisciplinaire tel que le département APPRD d'Alcatel-Lucent Bell Labs France (voir **Figure 7**).

1.3 Conclusions

Dans un contexte actuel de compétitivité industrielle, proposer de nouvelles façons de collaboration et coordination est un facteur clé pour l'innovation. Dans les départements de R&D de l'industrie télécommunication, les designers amènent une nouvelle culture pour la création des futurs produits et services. Dans cette direction, la problématique industrielle de cette thèse est la suivante : **Comment le design avec ces pratiques liées à l'esthétique et à l'expérience esthétique peut changer l'habitude de travail des chercheurs d'un département pluridisciplinaire?**

Figure 7 Les objets intermédiaires dans un environnement pluridisciplinaire.

L'applicabilité industrielle des connaissances de ce projet de recherche CIFRE est construit avec une approche de Recherche-Action (Liu, 1992, 1997) dans laquelle, le chercheur se trouve souvent entre l'immersion dans les projets de Bell Labs et la littérature sur des différents thématiques de recherches identifiées (voir **Figure 1**). Pour mieux comprendre ces thématiques de recherche le chapitre suivant présente l'état de l'art de cette recherche.

2 Etat de l'art

Ce chapitre présente l'état de l'art de la thèse autour des concepts phares de cette recherche : l'expérience esthétique, la culture design et la culture organisationnelle dans un environnement pluridisciplinaire.

2 ETAT DE L'ART

La Figure 8 propose une **représentation graphique de l'état de l'art** en deux parties. La partie A regroupe **les études sur** l'esthétique, l'expérience et l'expérience esthétiques, aussi que les différents approches d'études qui viennent de la recherche en design, de la psychologie et de la philosophie. Dans la deuxième partie, **pour contextualiser le concept de l'AE dans notre terrain**, nous présentons **des recherches liées à l'esthétique dans les organisations et le rôle du design pour la collaboration et l'innovation**.

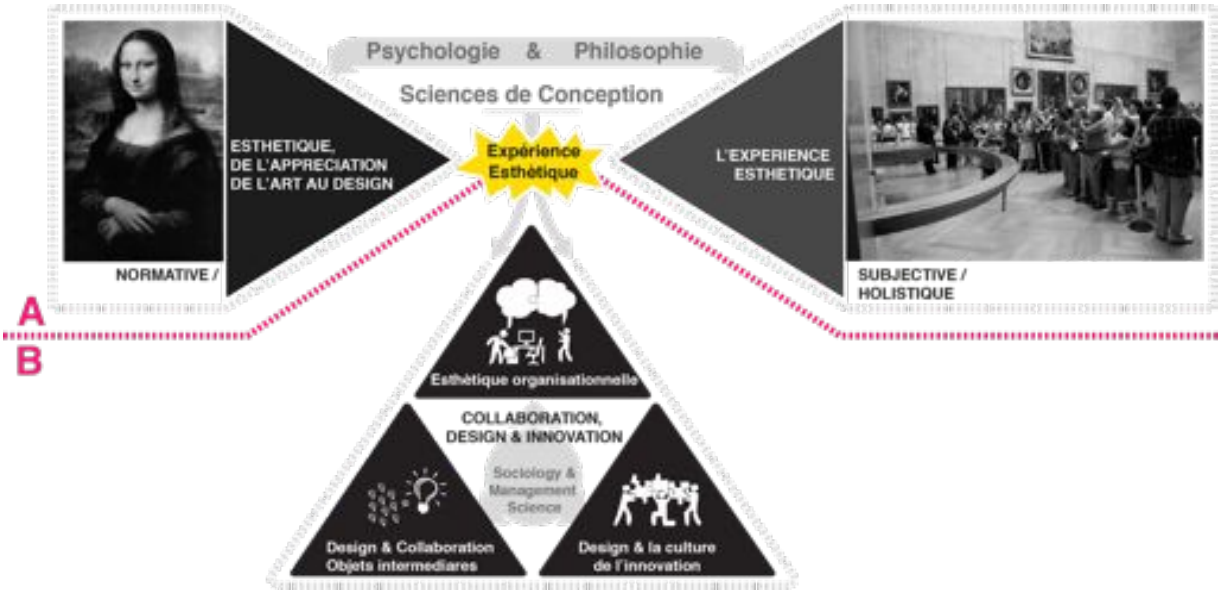


Figure 8 Représentation graphique de l'état de l'art divisée en deux parties. A) Etudes sur l'esthétique et l'expérience esthétique; B) Etudes sur la collaboration, le design et la culture de l'innovation.

2.1 Esthétique et expérience esthétique

2.1.1 Point de vue des sciences de conception

Du point de vue de la recherche en science de conception et design, l'évolution de **l'Esthétique** et de **l'Expérience Esthétique** est étroitement liée à l'évolution de la recherche en design. Pour qu'un produit soit perçu comme esthétique, il doit suivre des principes et des **propriétés esthétiques** (Bouchard, Kim, & Aoussat, 2009; Hekkert & Leder, 2008; Hekkert, 2006; Lidwell, Holden, & Butler, 2010). Ces principes et propriétés s'appellent **normatives. Elles sont visuelles** (comme le Gestalt ou les principes issus de la psychologie de la forme), **formelles** (comme l'effet maximum avec le minimum des moyens - l'économie formelle de l'Ipod Shuffle), et doivent posséder les **attributs de l'interactivité** (Djajadiningrat, Matthews, & Stienstra, 2007; Lim, Lee, & Kim, 2011).

Figure 9 L'Esthétique et l'Expérience Esthétique dans la conception: *l'approche normative* et *l'approche subjective*.

C'est la somme des propriétés qui définissent *un objet esthétique*. Cependant l'évaluation de ces propriétés est étudiée d'une façon statique et objective, qui ne prend pas toujours en compte le contexte et l'appréciation dans le temps. Hassenzahl sépare **les approches normatives et liées au jugement** de **l'approche expérientielle**. Les deux premiers se concentrent sur les attributs descriptifs qui étudient ce qui est jugé pour être beau ou pas. L'approche expérientielle utilise une approche holistique, plus globale pour étudier les expériences esthétiques (Hassenzahl, 2008).

Dans les sciences de conception, c'est avec l'arrivée du concept de l'expérience utilisateur, que *nous passons à des propriétés esthétiques* qui définissent 'un objet' – La Joconde, vers l'expérience esthétique vécue par 'les personnes qui regardent l'objet' – voir **Figure 9**. Dans la photo à droite on est Louvre et on regarde les personnes qui regardent La Joconde). La forme est moins importante, mais c'est la façon dans laquelle un produit nous parle : lampe Philips qui est conçu pour une expérience de réveil (Hassenzahl, 2013), l'histoire que nous créons et l'expérience intellectuelle qu'elle nous fait vivre : comme le drift table qui est une table qui nous fait voyager en fonction du poids des objets sur la table (W. W. Gaver, Bowers, et al., 2004). Dans la recherche sur l'expérience utilisateur (UX), les découvertes les plus récentes portent sur la temporalité de l'expérience comme l'étude de (Karapanos, Zimmerman, Forlizzi, & Martens, 2009). La temporalité d'une expérience utilisateur évolue dans trois états: *anticipation, orientation et incorporation* – dans chaque étape la relation entre une personne et un produit évolue et s'enrichit. Enfin, la nouvelle figure du Designer de l'expérience apparait dans le design. Un des premiers Designer d'expérience, Nelly Ben Hayoun nous propose avec son fauteuil Soyouz, l'expérience du décollage dans l'espace. Pour le moment ce type de design est présenté dans des galeries d'art et n'est pas étudié avec les protocoles développées par la recherche en design.

Pour synthétiser ces recherches, nous retenons une définition de l'expérience esthétique qui combine les éléments issus de l'esthétique et de l'expérience esthétique dans la recherche en design (McCarthy & Wright, 2007; Petersen, Iversen, & Krogh, 2004). Ainsi,

Une expérience esthétique est une situation extraordinaire, mémorable, transformatrice, qui se développe dans le temps et qui mélange les sens mais aussi l'intellect.

Les chercheurs en design prennent en compte des différents éléments pour la création des expériences esthétiques : des propriétés esthétiques qui sont perçues pour développer une **histoire dans le temps**, portée par **une interaction physique incarnée** (Petersen et al., 2004). Peu d'études expliquent le développement temporel d'une expérience de ce type, mais la littérature sur l'expérience utilisateur identifie des moments clefs dans la relation avec un produit comme l'anticipation, orientation, incorporation and identification (Karapanos et al., 2009). Nous observons une manque dans la littérature dans **la description et l'analyse des état mentaux d'une personne qui vit des expérience esthétiques**. C'est pour cela que nous ouvrons le corpus de l'état de l'art à d'autres disciplines comme la psychologie et philosophie.

2.1.2 Le concept de l'expérience esthétique dans les sciences humaines et la philosophie

Pour mieux comprendre le concept de l'expérience esthétique, nous avons identifié trois ouvrages qui décrivent et analysent la structure d'une expérience esthétique (Dewey, 1934) ainsi que les conditions vécues par une personnes qui est en train de vivre ce type d'expérience (Beardsley, 1982; Csikszentmihalyi & Robinson, 1991).

A partir de ces trois ouvrages et un particulièrement basé sur l'étude de Csikszentmihalyi & Robinson, qui modélise l'expérience esthétique des professionnels des musées, nous créons un cadre théorique descriptif (voir **Table 2**) des état mentaux d'une personne qui vit une expérience esthétique avec une œuvre d'art. Ce modèle a quatre dimensions : perceptive, émotionnelle, intellectuelle, communicative.

La **dimension Perceptive** est composée des conditions comme *le caractère physique et l'originalité* de l'œuvre – ce qui est en face du spectateur n'est pas une reproduction, la perception d'une *harmonie et de l'équilibre*, d'un sentiment *d'unité et imbrication* parfaite comme un puzzle et aussi la perception d'un *sentiment de liberté* qui se dégage au moment de l'interaction.

Table 2 Les conditions d'une expérience esthétique – cadre théorique

I. CONDITIONS PERCEPTIVES [a]	II. CONDITIONS EMOTIONNELLES [a]	III. CONDITIONS INTELLECTUELLES [a]	IV. CONDITIONS COMMUNICATIVES [a]
Caractère physique & Originalité [a]	Familiarité & Surprise [a]	Persévérance & Volonté de savoir [a, b, c]	Dialogue dans le temps [a]
Harmonie & Equilibre [a]	Connectivité & Résonance [a]	Solutionner un problème & Dépasser un challenge [a, b, c]	Connectivité œuvre, contexte & artiste [a]
Unité & Imbrication [a, b, c]	Transformation émotionnelle [a, c]	Imagination & Ouverture [a]	
Liberté [a, b, c]			

a (Csikszentmihalyi & Robinson 1991, p. 27 – 71),
b (Beardsley 1982, p. 288 – 289)
c (Dewey 1934, p. 36 – 60)

La **dimension émotionnelle** est représentée par la *connectivité émotionnelle* entre le spectateur et l'œuvre. Certaines personnes *résonnent* avec des œuvres qui les surprennent, d'autres préfèrent des œuvres qu'ils connaissent et qui amènent des sentiments de confort et de nostalgie. Ce qui est important dans ces réponses, ce ne sont pas la valence des émotions, mais leur *intensité et évolution dans le temps.*

La **dimension intellectuelle** est composée de deux types de réponses: l'expérience de compréhension et celle de l'imagination. Pour l'expérience de compréhension des conditions comme la *persévérance*, la *volonté de savoir* et de *solutionner un problème* sont primordiales. L'expérience de l'imagination est un exercice de *stimulation intellectuelle* ouverte dont le plaisir vient justement de la c*apacité de voyager dans le monde des idées d'une façon ouverte.*

La **réponse communicative** mobilise des conditions comme le dialogue œuvre -spectateur dans le temps. Ces deux entités parlent. Le spectateur désire trouver un point de *connexion avec l'œuvre, l'artiste et son temps*, et l'œuvre donne des éléments pour une relation forte et intime.

Enfin, ce cadre théorique en quatre dimensions va nous permettre de constituer un filtre pour dépister si une situation est vécue comme une expérience esthétique. Pour conclure l'état de l'art sur l'esthétique et l'expérience esthétique, nous retenons une **définition**, l'importance de **l'aspect temporel** et la construction d'un **cadre théorique** qui décrit les états mentaux propres aux expériences esthétiques.

Pour mieux comprendre le concept de l'expérience esthétique dans d'autres contextes, la section suivante présente un état de l'art sur le concept d'esthétique dans l'expérience de travail d'une équipe de conception.

2.2 Collaboration, innovation et esthétique dans les organisations

Pour compléter l'analyse sur le concept de l'expérience esthétique nous effectuons aussi un état de l'art sur **l'expérience subjective dans le travail**, **le rôle du design dans l'expérience de collaboration** et aussi son **impact sur l'innovation** – Figure 10.

Figure 10 Représentation des trois directions pour étudier l'expérience subjective d'une équipe pluridisciplinaire

L'esthétique organisationnelle est un champ de recherche dans les sciences de gestion. Les chercheurs comme (Strati, 1992, 2005), proposent l'introduction dans l'espace de travail - qui est conçu pour son efficacité et sa productivité, des *artefacts esthétiques* pour la création d'une *réalité* commune entre les employeurs et des *interaction symboliques.*

L'artefact esthétique est une œuvre d'art comme le montre "La cage en fer" (Iron Cage Figure 10) à cote d'une institution universitaire en Autriche. Son but est d'amener dans l'espace de travail du pathos et des sentiments subjectives - une attitude esthétique, pour une *résonance* plus forte avec le travail et un *développement personnel* des employées.

A coté de ce corpus de littérature sur l'objet esthétique, nous retrouvons dans la recherche en design un grand champ sur les artefacts crées dans la conception pour la *collaboration et coordination*: les **objets et représentations intermédiaires** (Bouchard, Camous, & Aoussat, 2005; Mer, Jeantet, & Tichkiewitch, 1995; Vinck, 2009), les « **sonde**s » – *probes en anglais* (B. Gaver, Dunne, & Pacenti, 1999; W. W. Gaver, Boucher, Pennington, & Walker, 2004), les **objets-frontières** (Lee, 2005, 2007). Ces objets amènent dans le processus

de conception, soit des *solutions pour résoudre des problèmes de communications* – surtout les objets intermédiaires fermés, mais aussi de la *subjectivité, de l'émotion et de la réflexion* – c'est le cas des sondes et des objets-frontières négociateurs. Ils sont **des indices, des descripteurs de l'activité de design, transforment les acteurs de la conception.** On peut ainsi se poser la question sur leur *nature expérientielle et esthétiques* pour la création d'une expérience dans la conception.

Enfin, le troisième champ identifié dans cette partie, porte sur la **culture organisationnelle et l'innovation**. Le design rentre aujourd'hui dans la culture organisationnelle et sa *force de représentation*, de rendre *tangible les idées* (Mat Hunter, 2010) et de créer des *hypothèses physiques* (Stappers, 2007) a un impact sur la *culture de l'innovation* (Brown, 2010).

En plus nous vivons aujourd'hui un changement de la pratique design qui est un vecteur pour solutionner des problèmes dans la conception, vers une nouvelle capacité à savoir *gérer l'inconnu* et à s'adapter a des champs inattendus dans une nouvelle approche du design, Design Theory (Hatchuel, 2001). Ainsi les pratiques design et aussi le design thinking sont aujourd'hui des façons incontournables d'innover.

2.3 Conclusion

Nous résumons l'état de l'art de cette thèse. Premièrement nous avons *défini* ce qui était une expérience esthétique et nous avons crée *un cadre théorique* des dimensions et des conditions des états mentaux des personnes qui vivent ce type d'expérience. Deuxièmement nous avons vu des pistes de l'ouverture de ce modèle dans d'autres environnements, comme *l'expérience subjective dans travail* - une nouvelle direction vers l'étude de la subjectivité dans ces contextes gouvernés pas l'efficacité et l'optimisation de la production. Enfin nous avons souligné l'importance des *objets design* dans l'expérience de travail des équipes pluridisciplinaires, pour amener des *solutions à la collaboration*, mais aussi pour *savoir gérer l'inconnu et créer de l'innovation*.

Ces constats mettent en place une relation entre le concept de l'expérience esthétique d'une équipe de conception et plus précisément dans un département de R&D comme celui de Bell Labs, et la relation avec l'innovation et la culture de l'innovation. Nous exprimons cette relation dans la problématique de cette thèse.

3 Problématique

Ce chapitre présente la question de recherche de cette thèse et les deux hypothèses proposées pour y répondre. Nous montrons aussi l'approche de recherche choisie pour tester la validité des hypothèses.

3 PROBLEMATIQUE

Ce chapitre présente la problématique de cette thèse CIFRE. En utilisant une **approche Recherche Action** et en combinant la connaissance acquise en tant que praticien dans les projets de Alcatel-Lucent Bell Labs France et l'état de l'art présenté dans le chapitre précèdent, voici la problématique de recherche qui émerge :

Comment l'expérience esthétique des concepteurs-chercheurs d'un département R&D influence la culture de l'innovation?

Pour répondre à cette problématique nous développons deux hypothèses :

H1 : *Il existe une expérience esthétique des concepteurs-chercheurs d'un département R&D.*

H2 : *Il y a une forte corrélation entre l'expérience esthétique des concepteurs-chercheurs, la culture d'innovation et la culture design.*

Dans la première hypothèse (H1), on suppose qu'il existe une expérience esthétique dans le contexte d'un département de recherche et développement, et que cette **expérience est modélisable**. Dans la deuxième hypothèse, nous voulons comprendre la relation entre l'expérience esthétique des chercheurs et deux aspects culturels : **la culture design** et la **culture de l'innovation**.

Pour tester la validité de H1, notre avons mis en place une première expérimentation - **Expérimentation 1**. L'objectif est de dépister les états mentaux des chercheurs dans leur travail. Pour cela nous avons choisi de faire une enquête de terrain sur les projets les plus mémorables. Les résultats de cette enquête vont être comparé avec le cadre théorique issu de la littérature et synthétisé dans **Table 2**. Pour cette enquête nous avons utilisé le même protocole que (Csikszentmihalyi & Robinson, 1991) adapté a notre terrain comme le présente la **Figure 11**. Le musée est replacé par le département R&D, les œuvres par les projets et les conservateurs de musée par les concepteurs chercheurs.

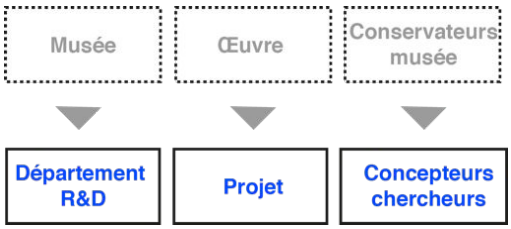


Figure 11 Adaptation protocole de (Csikszentmihalyi & Robinson, 1991) au terrain de cette étude.

Pour tester la validité de H2, notre avons mis en place une deuxième expérimentation - **Expérimentation 2**. Pour cette expérimentation nous avons un double objectif : comprendre l'influence des conditions de l'expérience esthétique sur les indicateurs de la performance et de l'innovation (KPIs) de Bell Labs et dépister l'influence des outils et des méthodes de la culture design sur l'expérience esthétique des chercheurs – voir **Figure 12**.

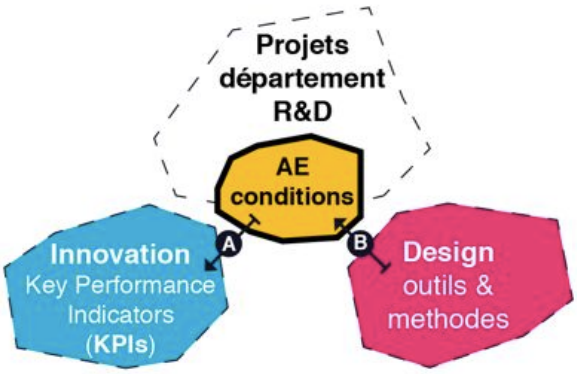


Figure 12 Objectif Expérimentation 2.

4 Expérimentations

Ce chapitre présente les deux expérimentations pour tester la validité des hypothèses, ainsi que les premiers projets de cette thèse regroupés dans le cycle de Recherche-Action nommé Pré-Expérimentation.

4 EXPERIMENTATION

La **Figure 13** présente l'approche d'expérimentation de la thèse. Dans le premier cycle de la Recherche-Action, un travail de praticien - designer a été mené sur les projets d'Alcatel-Lucent Bell Labs France. Ce sont des projets auxquels j'ai participé à la fois pour leur conception et leur réalisation. Ils ont servi aussi de terrain d'observation. Le deuxième cycle porte sur le processus de validation des deux hypothèses avec les deux expérimentations mises en places.

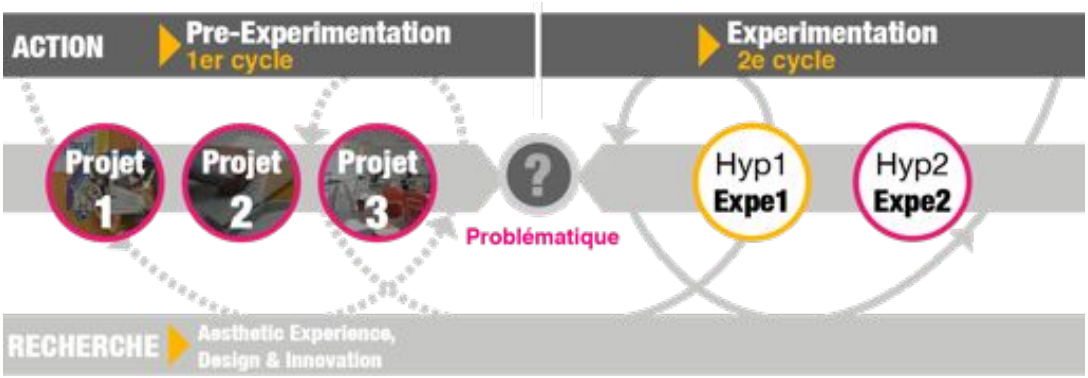


Figure 13 L'approche expérimentale de la thèse.

4.1 Pré-Expérimentation

TechCards : Le premier projet de cette thèse est la conception d'un démonstrateur technologique prenant en compte les briques technologiques acquises dans le département. Un problème de communication est survenu du à l'impossibilité des designers de comprendre les plus de *30 briques technologiques* crées par les ingénieurs de recherche. La solution apporté fut la création d'objets intermédiaires, les TechCards, des cartes qui présentent d'une façon synthétique et métaphorique les technologies – voir **Figure 14**.

Figure 14 Présentation du projet TechCards.

L'aspect esthétiques des cartes a été un facteur clé pour la diffusion dans l'équipe, la création d'un scénario à partir de ces matériaux et aussi pour influencer la **motivation intrinsèque** des acteurs impliqués dans le projets (Ocnarescu, Bouchard, Aoussat, Pain, & Sciamma, 2011; Ocnarescu, Rodio, et al., 2011).

Dans un 2eme temps, nous avons observé l'appropriation de ce support de cartes à plus large échelle dans le département, prouvant la création d'une **culture commune** et l'**influence du design dans le département.**

Knock-Knock : Le deuxième projet est un projet de communication synchrone entre deux acteurs distants. Ce projet est le résultat d'une collaboration avec un laboratoire en design d'interaction de l'université Aarhus School of Architecture et il explore la *communication suggestive*. Une interface *change de forme* en fonction de la façon dont on touche l'artefact. Le changement de forme est transmit au partenaire de communication.

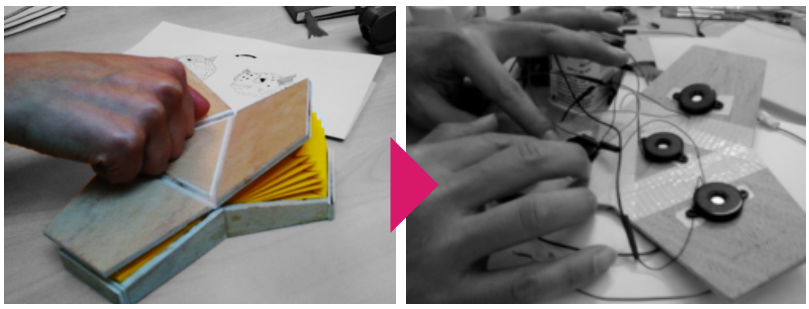


Figure 15 Présentation du Knock-Knock.

Ce projet répond à des questions de la communauté recherche en design d'interaction sur les artefacts suggestifs (Rasmussen, Lehoux, & Ocnarescu, 2012) et en même temps est porteur d'une *culture de prototypage rapide* qui se développe dans le département. L'usage de cette interface aujourd'hui est purement démonstratif. Cependant cet objet montre un exemple de prototypage rapide comme une *compétence acquise* par les chercheurs de ce département, l'ouverture des chercheurs vers des nouvelles pratiques de design qui permet d'enrichir le corpus des connaissances de l'entreprise.

Creativ'lab : Le troisième projet est crée en 2009 pendant mon stage de fin d'étude design au sein de Bell Labs. Ce projet est emblématique pour le département APPRD car il montre comment le design et l'esthétique de la culture design habille aussi les espaces de travail. Creativ'lab est une *image symbolique* forte de la culture design, *un showroom*, *un espace de prototypage* et *une salle de créativité* et a été *un diffuseur* de cette culture dans le département. Ce projet est né à l'initiative de Frédérique Pain, et de son équipe User eXperience Design (UXD), pour montrer comment une culture design peut être incarnée dans un espace de travail.

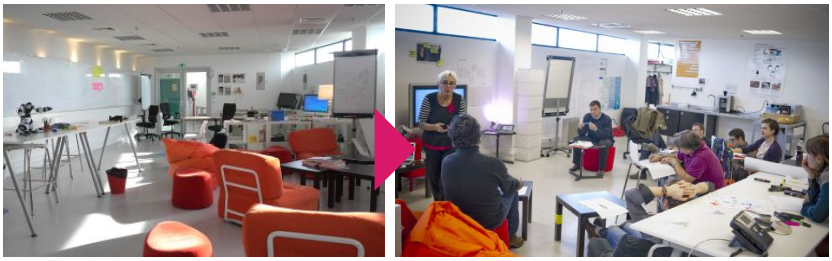


Figure 16 Présentation de l'espace Creativ'lab.

Pour synthétiser cette première étape d'immersion dans le terrain de Bell Labs, nous exposons deux constats. **L'esthétique des objets design** amène dans le département des **nouvelles manières de faire le travail collaboratif** et **des appropriations d'outils design et d'apprentissage** de cette culture qui impactent les résultats et la culture d'innovation du département. Aussi cette esthétique d'artefacts design, amène aussi une **expérience collective** des chercheurs qui ne se manifestent pas seulement dans l'apprentissage de nouvelles façons de faire, mais qui influencent aussi leur motivation intrinsèque dans le travail.

Ces constats consolident la volonté de résoudre la problématique cette thèse: comment l'expérience esthétique des concepteurs-chercheurs d'un département R&D influence la culture d'innovation?

4.2 Expérimentation 1

Pour la 1ere expérimentation nous avons mobilisé **31 ingénieurs de recherche** d'APPRD d'Alcatel-Lucent Bell Labs France pour des entretiens semi-directifs de 1h-1h30. L'enquête a été menée sur les aspects valorisant du travail d'un chercheur, ainsi que sur une analyse détaillé d'un projet mémorable parmi les 70 projets du département pendant quatre ans de 2009 à 2011.

Les interviews ont était transcrites et analysées avec la **Théorie encrée** – *Grounded Theory* (Strauss & Corbin, 1998). Nous avons mené une analyse sémantique en 4 niveaux: **code - concept, catégorie, cluster, thème**.

Figure 17 Les niveaux pour l'analyse sémantique avec la Théorie encrée de Strauss & Corbin.

Un code est un but de texte qui est synthétisé dans un concept (voir Figure 17 la motivation contagieuse). *Les concepts* sont groupés en catégories (contagiosité) qui eux aussi sont rangés en *clusters* (action collective). Les 17 clusters sont partagés en 6 *thèmes* (expérience collective).

La **Figure 17** présente la synthèse des résultats de cette étude qualitative. Nous retrouvons les quatre dimensions du cadre théorique issu la littérature (revoir **Table 2**) : la *dimension perceptive, émotionnelle, intellectuelle et communicative* qui sont représentées en gris ainsi que deux dimensions supplémentaires - la **dimension collective et organisationnelle**, représentées en noir. La **Figure 17** montre aussi le les clusters de chaque dimension. Dans chaque cluster on retrouve le nombre des concepts correspondants.

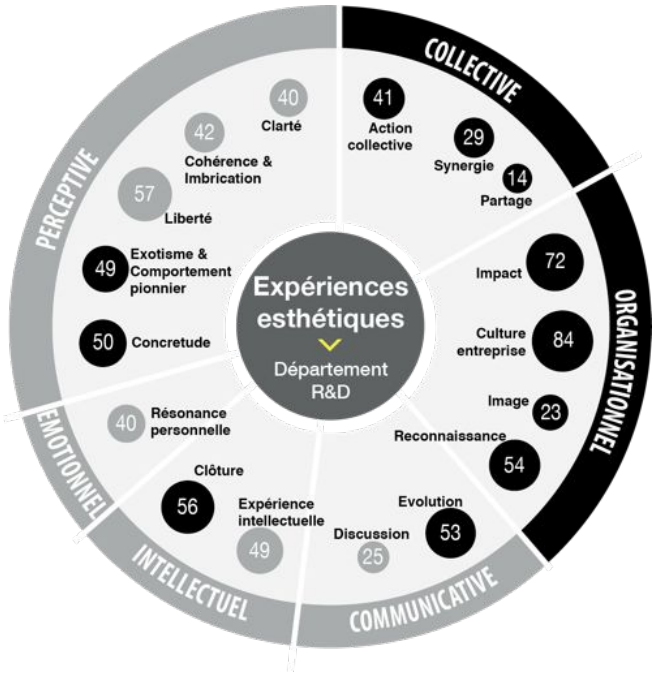


Figure 18 Les résultats de l'étude qualitative de l'Expérimentation 1. Les thèmes et les dimensions de l'expérience esthétique des chercheurs dans le département R&D.

La thématique Perceptive est constituée des aspects liés à la perception d'un projet mémorable dans le département : la *clarté* dans les rôles, dans l'objectif, les deadlines, le processus, la satisfaction ; la *cohérence & l'imbrication* des idées font vivre aux chercheurs des moments remarquables. La *liberté* dans la façon de mener la recherche, la perception d'un certain *exotisme* et *comportement pionnier* dans les projets. Etre le premier à concevoir une application, breveter une idée, ou avoir la chance de rencontrer des entreprises très connues comme Google ou Yahoo met en valeur les projets des les ingénieurs de recherche. La *concrétude* est un élément spécifique à l'expérience esthétique dans notre terrain – environnement R&D. Ce cluster regroupe des notions de plaisir issues de la construction des prototypes et démos. Il s'agit de la concrétude des choses, de leur tangibilité qui engagent les personnes et les font vivre une réalité ensemble.

La thématique Emotionnelle est constituée d'un seul cluster, la *Résonance personnelle,* et exprime la relation entre l'engagement personnel et la mémorabilité dans les projets.

La thématique Intellectuelle est très similaire à celle de professionnels des musées. Cette notion est vue soit comme un *challenge intellectuel* pour résoudre un problème, soit comme une *expérience de pensée ouverte*, un voyage intellectuel ayant le plaisir de se poser des questions. *La clôture* est une notion temporelle très importante car il s'agit de faire une conclusion d'un projet, et les chercheurs manifestent un besoin de finalisation. Un projet mémorable est surtout un projet fini.

La thématique Communicative rassemble des aspects liés à la satisfaction qui viennent des *discussions*, à la confrontation des idées, et au sentiment d'*évolution*.

Dans **la dimension Collective** nous trouvons des clusters liés à *l'action collective* et au *partage*, le fait de vivre les mêmes contraintes organisationnelles amène de la motivation et une unité dans les équipes; la perception d'une *synergie*, d'un moment de fédération et de coopération dans lequel toutes les personnes d'une équipe vont dans une seule direction.

Enfin **la dimension Organisationnelle** regroupe des notions liées à l'*impact* - social, interne, externe - plus il y a d'impacts personnels et d'influences dans le projet, plus les projets deviennent mémorables; la *culture de l'entreprise* est un cluster significatif de cette étude car il s'agit de l'impact du nom des Bell Labs qui influence le travail dans ce département - certains chercheurs se considèrent comme faisant partie de la famille des chercheurs prestigieux, d'autres, trouvent cette liaison assez problématique, car elle impose de grandes attentes. Globalement Bell Labs amène une excellence scientifique difficile à atteindre. Image que les chercheurs portent sur eux mêmes et sur le travail est également essentielle, comme que la *reconnaissance,* un facteur très important pour qu'un projet est bien vécu.

Ces notions démontrent **l'existence d'une expérience esthétique des chercheurs dans un département de R&D** et qu'il y a des **similitudes entre cette expérience et l'expérience des conservateurs des musées** décrite par (Csikszentmihalyi & Robinson, 1991). En ce qui concerne ces deux types d'expérience et les limitations de l'étude, il y a une première différence liée à la population: les ingénieurs de recherches sont des créateurs de leurs propres œuvres. Ce constat, ainsi que le cluster *Concrétude* nous amènent à définir une thématique en tant que telle: l'expérience du prototypage, l'expérience des créateurs. Cette notion est aussi étudiée par d'autres chercheurs qui expliquent que le prototype rapide aide l'apprentissage comme (Gerber & Carroll, 2012). En ce qui concerne l'**Expérience collective** celle-ci est similaire avec des notions d'*imbrication* et d'*intégration* à une échelle collective.

Les aspects organisationnels amènent des similitudes dans les conditions de l'expérience esthétique avec les théories sur les besoins

dans les organisations (Alderfer, 1969). Enfin les limitations de cette études sont liées à l'image forte des Bell Labs qui a influencé l'expérience des chercheurs, ainsi que notre incapacité à pouvoir transcrire les émotions fortes vécus par les personnes en dehors des entretiens.

En conclusion ces résultats nous amènent à valider notre première hypothèse. Il existe des expériences esthétiques dans des départements de R&D et pour les décrire nous proposons le modèle théorique présenté dans la **Figure 18**. Nous exposons maintenant la deuxième expérimentation de cette thèse pour comprendre les corrélations entre les conditions trouvées dans cette première expérimentation et la culture design et de l'innovation chez Alcatel-Lucent Bell Labs.

4.3 Expérimentation 2

Pour la deuxième expérimentation nous avons mobilisé une population de **30 chercheurs** de Bell Labs pour une étude quantitative basée sur un questionnaire à une échelle de Licket à 6 points. Le but de ce questionnaire à été de calculer la matrice de corrélation entre **les conditions de l'expérience esthétique d'un projet mémorable** avec

A: les indicateurs de performance de chez Bell Labs – nombre des brevets, publications, transferts technologiques et solutions de rupture ;

B: les pratiques design dans ce département : prototype rapide, prototype software, scénarios d'usage, objets intermédiaires, cours d'illustration et dessin, discussion avec des designers, Creativ'lab – voir **Figure 19**).

Figure 19 Les éléments des la culture design dans le département APPRD de Alcatel-Lucent Bell Labs France de 2009 à 2011.

Cette étude quantitative nous a servi aussi pour dépister **les conditions les plus importantes de l'expérience esthétique** pour les chercheurs.

4.3.1 La relation entre l'expérience esthétique et l'innovation

Nous présentons les résultats du premier point abordé dans l'hypothèse 2**: la relation entre l'expérience esthétique et l'innovation** représenté dans la **Figure 20**. La matrice de corrélation montre qu'il y a des nombreuse corrélations fortes entre **le nombre de**

brevets et les conditions de l'expérience esthétique (EE) et de faibles corrélation entre les autres indicateurs comme le nombre des transfert technologiques et le nombre des solutions de rupture.

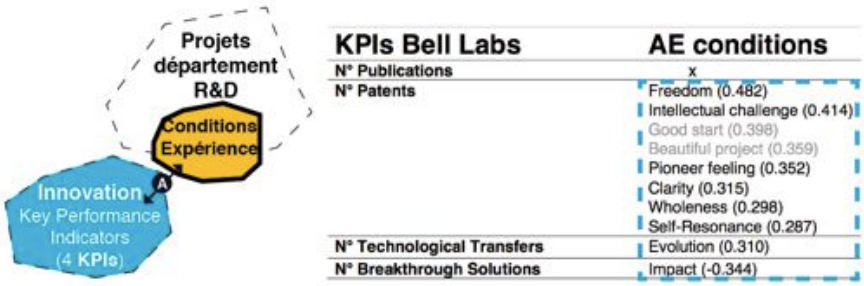


Figure 20 Les coefficients de corrélation entre les indicateurs qui mesurent l'innovation et les conditions de l'expérience esthétique.

Comme les brevets ne sont pas directement liés aux projets, mais à un climat techno-centré du département, nous pouvons conclure que l'EE - surtout sa dimension perceptive, émotionnelle er intellectuelle à une influence plus sur la culture techno-centré d'innovation. Même si la composante recherche est très importante dans les discours et valeurs de ce département, il reste un département techno-centré où les brevets sont un symbole d'une culture d'ingénieur.

Les transferts technologiques sont corrèlés avec la dimension évolution/ transformation du domaine et les solutions de ruptures (très peu dans le département), sont inversement liées à la notion d'impact : moins de volonté d'impact plus de solutions de rupture.

4.3.2 La relation entre l'expérience esthétique et la culture design

Nous présentons les résultats du deuxième point abordé dans l'hypothèse 2 : **la relation entre les conditions de l'expérience esthétique et les éléments de la culture design** représenté dans la **Figure 21**. Il y a des nombreuses corrélations fortes entre les pratiques design et cinq conditions de l'expérience esthétique : liberté, évolution, résonnance personnelle, communication, exploration intellectuelle. Il y a des pratiques comme *le prototypage rapide* qui ont influencé plusieurs conditions et d'autres comme le Creativ'lab qui sont liées seulement à une condition. Ces résultats montrent que l'expérience des chercheurs est influencée par le design surtout dans la dimension Communicative, Intellectuelle et Emotionnelle.

DESIGN	CONDITIONS EXPERIENCE ESTHETIQUE								
	Wholeness	Freedom	Evolution	Self-Reson	Closure	Int. Chall.	Communicat°	Clarity	Intel. Explo
Prototypage Rapide	-0.038	-0.136	**0.518**	0.360	0.320	0.296	**0.536**	0.147	0.414
Prototypage Software	0.038	**-0.622**	0.077	-0.264	0.242	-0.025	-0.019	0.130	-0.076
Creativ'Lab	-0.336	0.118	0.235	0.444	-0.065	0.121	0.217	0.102	0.045
Illustration & Dessin	-0.131	0.231	**0.508**	**0.635**	0.177	0.180	**0.545**	0.092	0.261
Objets intermédiaires	-0.156	-0.033	0.373	0.336	0.257	0.126	0.395	0.081	0.189
Scénarios	0.061	-0.326	**0.564**	-0.081	0.209	0.197	0.427	0.030	0.182
Discussion Designers	-0.131	0.304	0.434	0.323	0.109	0.212	0.460	0.262	0.262

Figure 21 Les coefficients de corrélation entre l'utilisation des éléments de la culture design et les conditions de l'expérience esthétique

Les questionnaires de cette expérimentation nous ont permis de comprendre aussi l'ordre d'importance des ces notions pour les chercheurs. Ainsi la notion d'**évolution** est le critère les plus important pour les chercheurs de ce département. Cette notion est suivie par des aspects comme la **communication des idées**, **l'exploration intellectuelle, la reconnaissance, le challenge intellectuel, la clarté** et **la synergie**.

4.3.3 Conclusion

Dans la deuxième expérimentation nous avons vu comment plusieurs clusters de l'expérience esthétique sont liés au nombre des brevets. Une première observation se porte sur *la relation entre l'expérience subjective* dans ce département de recherche et *une culture techno-centrée d'innovation*. Nous observons aussi que *le design* influence les aspects les plus importants de l'EE dans le département. En ce qui concerne l'influence du design dans l'innovation, nous pouvons seulement constater qu'il y a une relation entre la culture design et le nombre des brevets et de transferts technologiques sur deux critères: l'**Evolution** et la **Résonance Personnelle**. Mais nous ne pouvons malheureusement pas tiré de conclusion sur leur causalité.

Ces constats empiriques nous amènent à **valider seulement partiellement la deuxième hypothèse sur l'expérience esthétique**, car ses conditions sont seulement corrélées avec un climat techno-centré de l'innovation.

5 Apports & Perspectives

Ce chapitre présente les apports de cette thèse et des nouvelles directions possibles pour le développement des concepts issus de cette recherche.

5 APPORTS ET PERSPECTIVES

5.1 Apports de la thèse

Les apports de la thèse sont de trois types : **méthodologiques, académiques** et **industrielles** - **Figure 22**. Du point de vue méthodologie ce projet de recherche propose une méthodologie pour étudier l'expérience esthétique qui sort d'un cadre classique d'étude – le monde de l'art, pour une contextualisation dans le processus de conception.

Figure 22 Apports de la thèse

Nous proposons donc une étude in-situ sur le concept d'expérience esthétique dans un laboratoire de R&D. Une méthode de recueil de données et d'analyse est mise en place en se focalisant sur les projets les plus mémorables du département R&D. Un codage des ces données est fait en utilisant une méthode issue des sciences interprétatives – la *Théorie Encrée* (Strauss & Corbin, 1998). Ainsi nous créons un modèle qui regroupe les états mentaux des personnes qui ont vécu des projets riches en expériences - **Figure 18**. Ce modèle est ensuite opérationnalisé dans des premiers guides pour la créations de riches expériences-projet dans le processus de conception.

Aussi nous proposons aussi des premiers opérationnalisations des notions de ce modèle pour l'industrie. L'apport industriel est constitué sur trois axes: **les espaces de travail**, **les objets intermédiaires** et **le processus design**. Ces applications ont été extraites de la première étude qualitative de cette thèse dans laquelle les chercheurs ont proposé des points que nous avons liés aux dimensions du modèle. Dans **Figure 23** nous regroupons des premières propositions et applications. Par exemple pour *la clarté*, les chercheurs proposent des espaces dédiés à un projet, l'utilisation des propriétés esthétiques pour améliorer la qualité de ces objets dans le travail. Pour la condition bon *rythme*, les chercheurs proposent des sessions de sprint prototyping. Autres dimensions comme *l'exploration intellectuelle* peuvent être mise

en pratique en utilisant des prototypes ouverts similaires au concept d'*objet intermédiaire ouvert* qui suscite l'inspiration.

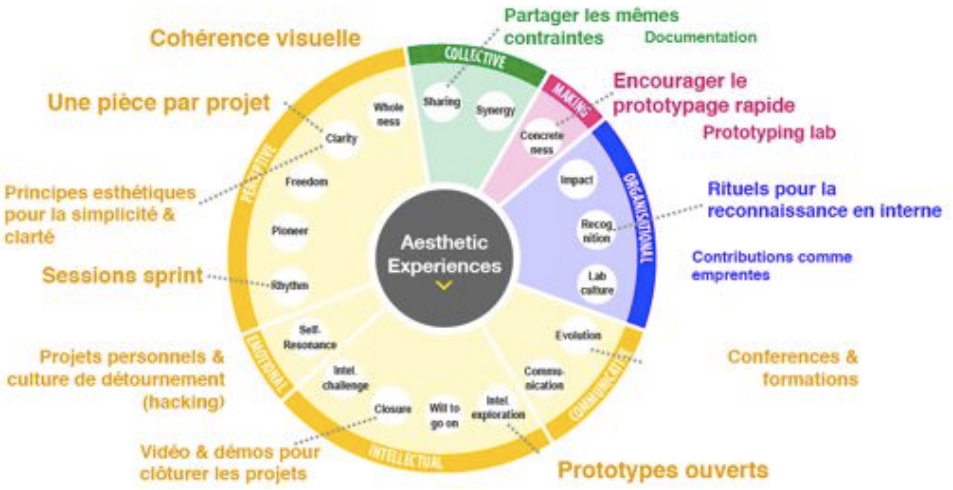


Figure 23 Premiers implications à partir du modèle théorique de l'expérience esthétique des chercheurs de R&D.

Des résultats additionnelles de notre de la deuxième Expérimentation montre l'avis des chercheurs sur **les pratiques design les plus influençables**, **l'héritage et l'apprentissage de la culture design** et leur motivation d'utiliser certains de ces pratiques dans leur travail futur.

5.2 Perspectives

Une thèse répond à certaines questions mais elle met également au jour de nouvelles questions à résoudre. Nous proposons 3 directions pour poursuivre nos recherches.

1. **Validation des conditions de l'expérience esthétique**

L'apport industriel de la thèse propose des premiers opérationnalisations des conditions de l'expérience esthétique. Des futurs travaux peuvent valider ces dimensions incarnées de l'expérience esthétique et leur influence sur la culture de l'innovation. Pour cela nous proposons une méthodologie dans **Figure 24**.

Figure 24 Méthodologie pour la validation des opérationnalisations issues de la thèse en trois étapes: 1er Diagnostique, Recherche-Action et 2eme Diagnostique.

2. **L'expérience esthétique et les besoins humains**

Dans notre étude sur l'expérience esthétique de recherche-ingénieurs de Bell Labs, nous avons identifié plusieurs conditions similaires avec les besoins humains dans les organisations: *l'influence, l'impact et de reconnaissance.* Cette observation montre le lien entre l'expérience, les besoins organisationnels et les théories sur la motivation comme celle développée par (Alderfer, 1969) dans laquelle nous retrouvons des aspects similaires : besoin de partage, de réciprocité, d'acceptation, la compréhension et l'influence. Cette notion est également semblable à la condition d'action collective de l'expérience collective. Nous proposons donc une continuation d'investigation sur la relation entre les expériences esthétiques et théorie des besoins.

3. **La temporalité de l'expérience et ses conditions**

Dans cette thèse nous avons discuté l'importance de la clôture pour le succès d'une expérience. Une future étude peut investiguer la corrélation entre les phases temporelles d'une expérience - anticipation, d'orientation, de constitution et d'identification (Karapanos et al, 2009.) et les conditions de l'expérience esthétique. Y a-t-il un *ordre des conditions* et une c*orrespondance avec les phases temporelles* d'une expérience afin de vivre des expériences riches dans le temps?

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L'EXPÉRIENCE ESTHÉTIQUE ET LA CULTURE D'INNOVATION: l'expérience esthétique des concepteurs et l'influence du design pour une culture d'innovation

RESUME : Cette thèse CIFRE, au cadre du Laboratoire CPI avec les partenaires Alcatel-Lucent Bell Labs France et Strate Ecole de Design, explore le concept de l'expérience esthétique des concepteurs dans le contexte de l'innovation et du travail pluridisciplinaire.

Un des intérêts actuels de la recherche en design se focalise sur l'expérience utilisateur (UX) et propose des modèles et des méthodes pour comprendre ce concept pour la conception. D'autres études récentes portent sur l'expérience esthétique dans les organisations. Avec une approche Recherche-Action, nous prolongeons la connaissance sur l'expérience esthétique avec un changement de perspective de l'expérience de l'utilisateur vers l'expérience des concepteurs. Dans une étude qualitative et quantitative nous modélisons le concept de l'expérience esthétique dans un département de recherche. Notre terrain est constitué des projets pluridisciplinaires d'Applications Research Domain (APPRD), le département pluridisciplinaire de Alcatel-Lucent Bell Labs. Nous étudions les projets les plus riches, mémorables, transformateurs (ceux qui ont donné lieu à des expériences esthétique dans le travail des concepteurs) pour comprendre quel est le lien entre ces projets les pratiques design et la culture d'innovation. Finalement nous proposons un modèle de l'expérience esthétique dans ce contexte et nous montrons des premières implications pour déclencher ce type d'expérience dans un département de R&D pluridisciplinaire.

MOTS CLEFS: Expérience esthétique, R&D Culture design, Culture de l'innovation.

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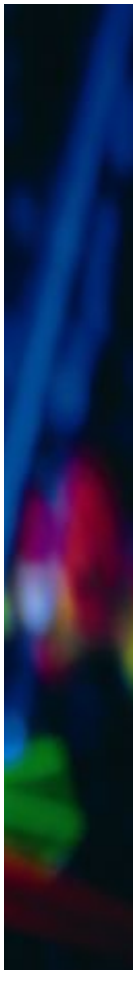
AESTHETIC EXPERIENCE & INNOVATION CULTURE: the Aesthetic Experience in an R&D department through design and for innovation culture

ABSTRACT: This thesis is conducted at Alcatel-Lucent Bell Labs France under the supervision of LCPI Laboratory and Strate School of Design. It explores the concept of aesthetic experience in an R&D department and its relation with the design and innovation culture.

One of the current interests of research design focuses on the User eXperience (UX) and provides frameworks and methods for understanding to observe, describe and generate a good product experience. Other recent studies focus on the aesthetic experience in organizations. With an Action-Research approach, we extend the knowledge on aesthetic experiences through a new perspective. Rather than looking at the users' experience we framework the experience of multidisciplinary R&D teams through a qualitative and quantitative study. Our experimentation field consists of multidisciplinary projects from Applications Research Domain (APPRD) - the multidisciplinary department Alcatel-Lucent Bell Labs. We study the most memorable projects - those that triggered aesthetic experiences in the work of research-engineers. Our goal is to understand what is the link between aesthetic experience feelings, design practices and aspects of the culture of innovation. Finally, we propose a model of aesthetic experience in this context and we show first implications to trigger this type of experience in a multidisciplinary R&D department.

KEYWORDS: Aesthetic experience, Design culture, Innovation culture.



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