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***Understanding Technological Simplicity:  
theory and empirical evidence***

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## Understanding Technological Simplicity: theory and empirical evidence

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### ABSTRACT

This research study originated from an exhibition of 43 simple objects, called the Hidden Heroes, that took place in London and in other European museums between 2010 and 2012. The aim is to explore the relationship between technological simplicity, at the background and foreground level, and the product life cycle in order to understand if simplifying may be the winning strategy to create ever-lasting products. However, simplifying does not mean creating second class products and customers should not perceive the lack of higher performance; products should instead be enriched by emotional and cognitive qualities that make customers fall in love and be loyal through time.

Our guide question is: *why do technologically simple products tend to last longer than their complex counterparts?*

In order to shed new light on this under-researched (or taken for granted) phenomenon, we identified 14 technological simplicity characterising dimensions that we tested through multiple case studies. In particular, we selected and interviewed 8 French design companies (operating in both B2B and B2C) that helped us evaluate the accuracy of the starting dimensions and discover new important insights. Thanks to the responding firms, new 6 dimensions have enriched the starting portfolio and interesting simplicity paradoxes came to light.

### SOMMARIO

Questa ricerca nasce da una esibizione di 43 oggetti, soprannominati gli “Eroi nascosti”, che venne organizzata a Londra ed in altri musei europei tra il 2010 e il 2012. L’obiettivo è di esplorare la relazione tra la semplicità tecnologica dei prodotti e il loro ciclo di vita in modo da comprendere se semplificare è la strategia vincente per creare dei prodotti longevi. Tuttavia, semplificare non significa creare dei prodotti di seconda classe; infatti, i clienti finali non dovrebbero percepire la mancanza di performance più sofisticate e i prodotti dovrebbero essere arricchiti con qualità intangibili che li facciano innamorare e li rendano fedeli nel tempo.

La domanda che guida la nostra ricerca è: perché prodotti semplici sembrano durare più a lungo rispetto a prodotto più complessi?

Per rispondere a questa domanda, abbiamo identificato 14 dimensioni che abbiamo cercato di validare attraverso dei casi studio. In particolare, abbiamo selezionato e intervistato 8 design companies francesi (B2B o B2C) che ci hanno aiutato a valutare la fondatezza e l’accuratezza delle dimensioni inizialmente individuate e a scoprire nuove interessanti aspetti. Grazie alle interviste svolte infatti abbiamo arricchito il portfolio iniziale con 6 nuove dimensioni ed interessanti paradossi della semplicità sono venuti alla luce.

## 1. SCOPE OF THE WORK AND OBJECTIVE

The holy grail all firms aim at is creating long-term life cycle products, hence, influencing customers' behaviour and choices, in order to keep them hooked. Making them loyal means understanding whether – and to what extent – they are influenced by tangible and intangible products features. Every product has a meaning and capturing the real reason why people use it implies the success of the innovation process. If a firm succeeds in capturing product meanings, customers will fall in love and they will be loyal through time. New cognitive qualities indeed fill the lack of higher performances and simplified products may be created by removing the unnecessary components. The problem is that meanings are related to the cultural and social context: emotions, values and beliefs cannot be created but they should be interpreted and understood. And without the understanding of the external context, innovations have no meaning.

The goal of this research study is to investigate the link between product technological simplicity and long-term life cycle because empirical evidence is still missing. We aim at shedding new light on the under-researched phenomenon of technological simplicity by identifying its characterising dimensions and by understanding its impact on the product life cycle. Our hypothesis is that behind long-running products there is a radical innovation of meaning that has “hooked” the customer for many years. The idea is that by focusing on the why people choose a product and hence on the emotions, values and beliefs that drive people’s actions, firms are capable to guarantee the loyalty of their customers and, consequently, the longevity of their products. The second idea is that meaningful products make technology less important and simplicity is favoured over technological performance: when a deep and intimate relationship between product and customer has been created, he may even forgive the lack of some features.

## 2. METHODOLOGY

This research study is organised as follow:

Phase	Objective	Methodological steps
<b>Literature Review</b> <i>Thesis chapter 2</i>	Exploring and analysing the existing literature in order to identify the gaps to fill and define the scope of the project and its research questions.	<ul style="list-style-type: none"> <li>▪ Exploring the existing literature (books)</li> <li>▪ Identifying keywords</li> <li>▪ Analysis of abstracts and selection of papers</li> <li>▪ Identifying literature gaps and defining the research questions</li> </ul>
<b>Conceptual framework</b> <i>Thesis chapter 3</i>	Defining the conceptual framework to use as guide in the analysis of technological simplicity and its impact on product longevity.	<ul style="list-style-type: none"> <li>▪ Defining the concept of technological simplicity</li> <li>▪ Developing the framework: dimensions and 2x2 matrix</li> </ul>
<b>Data collection</b> <i>Thesis chapter 4</i>	Applying the framework to different case studies in order to validate the framework and discover new important insights.	<ul style="list-style-type: none"> <li>▪ Applying the conceptual framework to the Hidden Heroes</li> <li>▪ Selecting and contacting French design firms</li> <li>▪ Applying the conceptual framework to the design firms</li> </ul>
<b>Results</b> <i>Thesis chapter 5</i>	Collecting and presenting data from different case studies.	<ul style="list-style-type: none"> <li>▪ Collecting data from the analysis of the Hidden Heroes</li> <li>▪ Collecting data from the design firms' interviews</li> </ul>
<b>Discussion and conclusions</b> <i>Thesis chapter 6</i>	Comparing and analysing the findings to validate the framework and answer to the research questions.	<ul style="list-style-type: none"> <li>▪ Comparing and analysing the findings according to the conceptual framework</li> <li>▪ Answering to the research questions</li> </ul>

Table 1. Phases of the research study

### 3. LITERATURE REVIEW

Technology, which was supposed to make our lives easier, has taken a wrong turn: in the last decades, the intense technological innovation has caused a loss of meaning and firms have increasingly favoured technologically complex products. Market requirements for increased functionalities have indeed led to smarter and more complex products and many firms have lost the link between technology and society by improving product performances within the existing meanings of the market. However, to create breakthrough and ever-lasting innovations, it is necessary to completely change products meanings: innovations of meaning consist of new solutions with a new why. And even if radical innovations are risky, they are one of the major sources for long-term competitive advantage.

The problem is that meanings are often tacit and culturally embedded. Meanings mean emotions, feelings, values and beliefs that drive user's action and play a decisive role in his product evaluation: emotions and values orient choices and insure congruence between technology and society. When firms invest in the innovation of meaning, they should investigate the evolution of society, economy, science and technology. However, understanding the dynamics of socio-cultural models requires time and this starts well before the standard formal product development process. Innovation of meaning cannot be thought as a short-run strategy. But time invested in exploring the socio-cultural world turns into product success and loyal customers. Indeed, when people love something that is meaningful and valuable, they do not even think in terms of performance and they might even forgive the lack of perfection.

If a firm succeeds in capturing the real meaning that drives the user, technological complexity is no longer necessary and superfluous components may be removed. Meaning mediations supplies the simplified technical object with new secondary qualities that are embedded in its social context. The simplification process refers to the process in which products are simplified, stripped of technically useless qualities, and reduced to those aspects that have a real value for the customer. Simplification should be pursued by guaranteeing organisation and time savings because organised and fast things appear easier. Knowledge plays also an important role: knowing how to use, handle and preserve a product leads to see it simpler. Knowledge means knowing how the product works and, as people like having a mental model of how things work, the chance to control the flow of events makes the product seem easier.

The concept of simplicity may also meet the aspects of environmental sustainability. Here, the aim is to reduce the total environmental load over the products life cycle. Nature and analogies with biological systems might be a source of inspiration for creating simpler and "green" products: exploring the surrounding natural world, we can discover different solutions to our challenges that are employed by natural organisms in a rapid, ecological and resources-saving way.

According to the literature review, our goal is to explore the link between product technological simplicity and long-term life cycle because empirical evidence is still missing. Formally, we address

three research questions: 1. May simplicity increase the product longevity? 2. May emotions involvement increase the product longevity? 3. May simplicity be gained by looking at nature?

#### 4. CONCEPTUAL FRAMEWORK

In order to explore the link between technological simplicity and long-term life cycle, we identified fourteen dimensions, illustrated below, sorted into two main levels: technology in foreground (dimensions 1-11) and technology in background (dimensions 12-14). Technology in foreground (TF) refers to the technology that interacts with the user and that can be directly seen or touched; technology in background (TB) instead allows the product functioning and it is placed behind the interface. Our hypothesis is that simplicity should be gained in both spheres.

The starting dimensions:

1. **Readiness:** spontaneity and immediacy of use
2. **Learning time:** time spent to understand the usage
3. **Effort required to users:** type of skills required to use it
4. **Reliability:** probability of not working correctly
5. **Transparency:** intelligibility in the use
6. **User-friendly interface:** effort put in the interaction between user and interface
7. **Knowledge:** knowledge about the system
8. **Cultural pattern integration:** integration of peculiarities of the cultural context
9. **Emotional dimension involvement:** emotional involvement dimension
10. **Non-routine according:** disruption/replacement of existing meanings
11. **Risk of misuses:** minimization of misuses
12. **Technical features:** number of features and extent to which their functioning is simple
13. **Production time:** amount of time to produce it
14. **Production cost:** amount of investment to produce it

The technology in foreground and the technology in background are arranged into a 2x2 matrix (figure 1) organised into three levels – low, medium and high: low values mean low complexity (high simplicity) and, vice versa, high values imply high complexity (low simplicity).

Figure 1. The TBxTF Matrix

		TECHNOLOGY IN FOREGROUND		
		LOW	MEDIUM	HIGH
TECHNOLOGY IN BACKGROUND	HIGH			
	MEDIUM			
	LOW			

#### 5. DATA COLLECTION

In our research, we compared different case studies: the so-called Hidden Heroes, a specific group of products to whom the Vitra Design Museum dedicates an online exhibition (<http://www.hidden-heroes.net/>), and 8 Parisian design firms. Here, the aim was to analyse the way design companies conceive their product design process and understanding vision and ideas pursued during the product development. We decided to meet designers because we thought that they were better positioned to enlighten us about the design of a product, as they not only work on both tangible and intangible product characteristics, but they also are at the forefront of the conceptualization phase, which is decisive for the success of the entire innovation process.

## 5.1 The Hidden Heroes

The hidden heroes are 43 objects that were exhibited in different museums between 2010 and 2012 thanks to a collaboration among the Vitra Design Museum and Hi-Cone. They are so simple and at the same time so ingenious that they have been remained unaltered for decades. Due to their longevity, efficient use of materials, and great utility, they are the utmost examples of sustainability and functional aesthetics. Examples are the Post-it, the Bic pen, the tea bag, the umbrella. Thanks to their utility and simplicity, they suggest that making simple objects may be the best choice to gain customers' loyalty and have long-running products.

The Hidden Heroes were analysed through the available patents data (not all hidden heroes have a patent), the available information on the online exhibition or on the Internet (in case the available information was not sufficient) and by observing their daily use. The data collected was so used to qualitatively evaluate the Hidden Heroes' degree (low, medium or high) of technological simplicity and to position them inside the technology in background – technology in foreground matrix.

## 5.2 The design firms

The 8 responding companies were discovered by taking into account the sites "*Le Hub du Design*" ([www.lehubdudesign.com/directory](http://www.lehubdudesign.com/directory)) and "*Grand Prix Innovation de la ville de Paris*" (<http://www.grandsprixinnovation.paris/>).

The parameters considered for the companies' selection were essentially:

- *the product design process* as core activity (in both the B2C and B2B sector),
- *the geography position* (Paris and suburbs) to make the interviews more easily achievable as we were based in Paris,
- *the focus on intangible features like human values, believes and morals* because the relationship between tangible and intangible features is at the base of this research study. Indeed, we believe that the technological simplicity and long-running products may be obtained combining tangible and intangible features. And design is the best knowledge domain to connect tangible and intangible aspects surrounding a product.

After a pre-selection by analysing information found on the companies' websites, the companies were individually contacted by private emails. Then, the responding companies were interviewed through semi-structured interviews, conducted in person with the responsible of the design process. The interviews were scheduled from the 13<sup>th</sup> January 2018; the interview language was English (with some exceptions where French was used) and they lasted for a maximum of 1 hour. All of them were tape-recorded, transcribed, and transferred into a case study protocol for each firm. The collected data was used to assess the accuracy of the 14 dimensions, to discover new potentially dimensions and to understand the companies' vision in terms of technological simplicity in order to position them inside the 2x2 matrix.

## 6. RESULTS

### 6.1 The Hidden Heroes

As we expected, (see figure 2) most of the Hidden Heroes sit in the low-low quadrant (highest degree of simplicity). Exceptions are the container (14) and the lipstick (37) which present a higher background complexity, due to the longer and more demanding production process.

In terms of technology in foreground, all the Hidden Heroes reside in the low-low quadrant validating the 11 dimensions elaborated to assess the phenomenon of technological simplicity and its impact on the product life cycle. The most critical dimensions resulted the “Emotional dimension involvement” and the “Routine according” for which many Hidden Heroes obtained high values. First, this might be caused by the fact that some of them were invented to accomplish activities that do not necessarily interfere with the emotional sphere. Second, the Hidden Heroes replaced products that were already present in the market without significant improvements. According to our third research question, some hidden heroes show how nature may be a source of inspiration. Examples are the Hook-and-loop fastener (40), the Reflector (33) and the Air bubble film (2) whose invention started from natural events.

Figure 2: The Hidden Heroes and the 2x2 matrix

		TECHNOLOGY IN FOREGROUND		
		LOW	MEDIUM	HIGH
TECHNOLOGY IN BACKGROUND	HIGH			
	MEDIUM	14, 37		
	LOW	All the hidden heroes except for 4,37		

### 6.2 The design firms

The 8 responding companies are described in table 2 where the main parameters are introduced. The acronyms Y.L. and Y.E. represent respectively the year of launch of the company and the interviewer’s years of experience in the design sector. We have decided to distinguish the two dates because we noted that in many cases they did not agree and designers with many years of experiences gave us noteworthy insights.

Firm	Y.L.	Y.E.	N.E.	Sector(s)	Market
<b>Nimos Design (1)</b>	2008	37	2 + freelancers	Mobility, energy, medical, connected objects, packaging, construction, electronics, aeronautics, leisure activities, sport, industrial equipment	B2B France
<b>Furn (2)</b>	2016	5	3	Furniture	B2C (Currently) France
<b>Kapsdata (3)</b>	2015	35	2	Big Data and IoT: Industrial connected objects for the security of buildings, resource, equipment or zone, the control and supervision of systems (presence, access, duration of functioning, ...), cybersecurity	B2B (Currently) France
<b>Belty Paris (4)</b>	2014	5	2	Technological-fashion accessories (power-bank belts)	B2C Europe and USA

<b>Pineau &amp; Le Porcher (5)</b>	1989	29	4 + freelancers	Children, sport, television, fashion, automobiles	B2B	World-wide
<b>NoDesign (6)</b>	2001	27	8	Connected objects, leisure activities, electronics	B2B	World-wide
<b>Emanuel Cairo (7)</b>	2000	20	1	Mobility, urban design, electronics, industrial equipment, connected objects	B2B	World-wide
<b>Xavier Houy (8)</b>	1998	25	1 + freelancers	Connected objects, leisure activities, IoT	B2B	World-wide

Table 2. The responding design firms

### 6.2.1 The starting dimensions

Most designers agreed with our hypothesis that simplicity affects user's action as people are surrounded by more and more complex inexpressive products, and they end up falling in love with what is simple to use. Simple, but also meaningful: to persuade people to be loyal, products should be linked to people's emotional sphere.

Simplicity also means creating something that is easily understandable by human beings. There should be a coherent relationship between what we want to do and what we see done: product honesty may be seen as a further kind of simplicity carried out through the product interface. When a product is simple and intuitive, customers do not reflect how to behave. Here, the perfect example is represented by the Hidden Heroes where a strong relationship between form and function is created. With them, the form moves in background in favour of the essence of their function.

However, simplicity may be difficult to realize, as many responding designers highlighted. Simplicity in background is hard to reach, especially when electronic components are incorporated inside the product. Then, in many cases, creating simple objects requires more time than the complex counterparts. For instance, the firm 5 created a small riding for kids, a simple plastic box with four wheels and a handle, where children could sit on. Despite of its technological simplicity, it was a project of ten years.

High developing times are mainly due to the fact that simplicity does not only mean looking for the right material and the right technology, but new intangible factors play an important role, whose analysis may take time.

### 6.2.2 New dimensions

The 8 interviews helped us understand the phenomenon of technological simplicity and its impact on products life cycle. Particularly, the open and exploring questions used allowed us to come up with new 6 interesting dimensions (five for the TF – from 1 to 5 – one for the TB – 6):

1. **Versatility:** adaptability to different contexts and usefulness for people with different age or gender
2. **Cultural democratization:** no discrimination of people and cultures
3. **Geographical democratization:** no geographical boundaries by aiming at international markets
4. **Nature of need:** characteristics of a need, its background, its origin and bases
5. **Biomimetics:** nature as source of inspiration for simple and green products
6. **Conceptualizing time:** time spent before production in analysing the social and cultural context

### 6.2.3 Other effects of simplicity

Simplifying a product has positive effects over its entire life and not only on its production and use. Firstly, in terms of resources supply, unnecessary components are eliminated in order to guarantee a simple use of the product and the total number of components decreases in favour of a simplification of the whole supply process: less components to stock turns into less suppliers to interact with, less quality controls to carry out, smaller stocking spaces and shorter assembling times. And all this means lower costs.

Secondly, making simpler products also simplifies the retail process: when a product is “deprived” of the complex technology, its functioning becomes more intuitive and more understandable for both the seller and the client, improving the quality of the service offered, before, during and after the purchase. In particular, with simple products the maintenance is simplified: in some cases, the user can fix the product on his own; in other cases, he may rely on the seller’s intervention who may already have in stock the necessary components or appeal to the producer that, thanks to the product simplicity, may resupply the retailer in short times. Then, simple maintenance implies less products substitution that turns into less waste and environmental pollution.

### 6.2.4 Paradoxes of simplicity

- **TIME:** simple products are often harder to create than their complex counterparts. Especially, they may require longer conceptualizing processes. Indeed, to simplify it is necessary to focus on intangible features that fill the lack of higher performances, but catching intangible features implies investigating in people’s cultural background and this requires time.
- **CONTROL:** people love controlling the flow of events because there are no risks and uncertainties. However, simplicity may imply undermining the user’s power and making the decision for him.
- **HABITS:** many times, we tend to perceive simplicity only because we have habits that influence our actions and judgments.
- **EMOTIONS:** nowadays, there are products on the market that meet all the requirements in terms of interaction simplicity (use, learning time, maintenance, transparency, interface, etc) but they do not stimulate emotions. The market has received fashionable and successful products that have lost the meaningful dimension.
- **LEARNING TIME:** as the technological innovation has decreased the learning effort required to users, they can easily switch from a product to another with negative impact on the product life cycle. As a consequence, companies may adopt the inverse strategy: making complex products to keep customers hooked.
- **VERSATILITY:** to create versatile products is necessary to add multiple functions to make the product adaptable to different contexts. However, the more functions it has, the more complex the product becomes.

## 7. DISCUSSION AND CONCLUSIONS

Starting from 14, we ended up with 20 dimensions characterising the phenomenon of technological simplicity and its impact on the product life cycle.

In the light of the final 20 dimensions, the Hidden Heroes and the 8 responding design firms were qualitatively positioned inside the technology in foreground and technology in background matrix.

Even though the number of dimensions is higher, most of the Hidden Heroes sit at the low-low level.

The responding firms instead form a cluster in the medium-low quadrant (7 firms). For them,

simplicity at the foreground level is a must that is reachable by simplifying the customer-product interaction and by strengthening the emotional dimension that is essential to allow a deep customer-product relationship and hence to guarantee customer's loyalty. On the contrary, the simplicity at the background levels is not so obvious. Indeed, making simple objects is often harder than making their complex counterparts, especially in terms of conceptualizing time; exploring the customer's cultural background, intercepting the cultural meanings and translating them in a right product may take a lot of time. In addition, as the innovation technology has allowed to satisfy basic needs, complex needs may require more complex answers, at least in technical terms.

Differently from the other responding firms, the firm 4 expressed strong concerns about simplicity at the background level, as its idea was that simplicity was reachable only for the user level.

### 7.2 Research questions

#### 1. *May simplicity increase the product longevity?*

According to our findings, the answer is not completely positive.

On one hand, the Hidden Heroes and the designers' responses demonstrate that simplicity may affect the product longevity as people tend to choose products that are easy to use and understand. Then, the product versatility (adaptability to new contexts) and universality (in cultural and geographical terms) allow it to last over time.

On the other hand, simplifying may sometimes be harmful. In terms of learning time, simple products mean low time to learn how to use them and consequently people may easily switch to other products. In addition, simplicity may entail weakening the user's power by making the decision for him: the user's participation is passive and emotionless, and his product

Figure 3. The final positioning

		TECHNOLOGY IN FOREGROUND		
		LOW	MEDIUM	HIGH
TECHNOLOGY IN BACKGROUND	HIGH	4		
	MEDIUM	1, 2, 3, 5, 6, 7, 8 14, 37		
	LOW	All the hidden heroes except for 4, 37		

desire may disappear with time. Finally, versatile product means incorporating multiple functions to make it adaptable to different contexts. However, the more functions it has, the more complex the product becomes.

2. *May emotions involvement increase the product longevity?*

All the responding designers agreed with the important role played by emotions. Products should tell a story, they should be meaningful for customers, they should be right. This implies investigating in the familiar and cultural sphere to discover new products meanings. Then, focusing on what customers really care allows to remove more complex features.

3. *May simplicity be gained by looking at nature?*

According to our findings, the answer is partially positive. Indeed, nature may seem simple and efficient, but its functioning may be very complex. Then, the “natural approach” may be completely different from the “traditional design approach”. We suggest taking inspiration from nature only in terms of product shapes and functions.

CONFERENCE PAPER FROM THIS MSc thesis project:

MATTEUCCI G., APPIO F.P., MARTINI A. (2018), “*Accomplishing Technological Simplicity: Myth or Reality?*”, R&D Management Conference, Milan, 30 June-4 July. Accepted

## APPENDIX

### *My experience in Paris*

Fin dalle scuole superiori, ho sempre desiderato fare un'esperienza all'estero ma per vari motivi e imprevisi mi sono sempre trovata a rimandare. L'occasione giusta è arrivata con la tesi all'estero. All'inizio ero scettica nel candidarmi per Parigi, principalmente perché la mia conoscenza del francese era nulla. E come tutti sanno, la lingua inglese non è proprio il punto forte dei francesi. Tuttavia, mi sono dovuta



ricredere; questa esperienza non solo mi ha permesso di imparare una seconda lingua (il francese) ma anche di approfondire e migliorare la lingua inglese. Ho avuto infatti la fortuna di vivere in una famiglia "franco-internazionale" nella quale ho potuto conoscere e approfondire culture e lingue diverse. Un pensiero positivo va sicuramente a lei, la mia famiglia ospitante e soprattutto alle mie coinquiline che hanno reso la mia permanenza nella capitale francese ancora più bella. Se dovessi descrivere la mia esperienza a Parigi con una sola parola utilizzerei **MAGNIFICA**. Quando sono partita, ero alla ricerca di nuove esperienze e nuovi stimoli, e credo che Parigi mi abbia dato tutto quello che stavo cercando. Non solo sono potuta crescere professionalmente, lavorando e vivendo in un contesto internazionale, ma anche umanamente. Infatti, vivere in un contesto internazionale e conoscere e interagire con persone provenienti da tutto il mondo mi ha permesso di avere una visione

diversa (e migliore) del mondo.



La mia esperienza è stata positiva anche dal punto di vista universitario. Lavorare al mio progetto di tesi, per il quale ho intervistato diverse aziende francesi, mi ha sicuramente permesso di acquisire maggiore sicurezza e consapevolezza, fondamentale per vincere la timidezza che prima dimostravo di fronte a situazioni non familiari. Un ringraziamento va sicuramente a Francesco P. Appio che mi ha accolto in modo caloroso e amichevole, fornendomi un aiuto costante durante tutta la mia permanenza a Parigi, e alla professoressa Antonella Martini che mi ha permesso di vivere questa fantastica esperienza.