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The Strategic Value of Design

A model derived from the existing literature and six case studies of design-driven organizations

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Abstract

The goal of this research was to identify the value of design and the way it may be captured successfully by companies. By relying on the latest research regarding *design-driven innovations* and *design management*, as well as on the study of six leading companies successfully using design, I have proposed a model describing how design should be managed, and the relationships between an investment in design and the company's innovative and competitive performance. This thesis originates from previous work by Verganti (2009), according to which design is defined, together with technology, as one of the dimensions of product innovation: it controls what the product's message is, and, in conjunction with the functional characteristics of the good, it determines what the product will *mean* to the end user. The model introduces a new way of studying a company's investment in design, which is based on the notion of design as a strategy, rather than as an asset. It evaluates a company's investment in design by considering what role is given to design within the organization's structure and culture, which is the result of investments that are for the most part not financial in nature. The model proposes three different approaches to design, each of which is associated with a particular configuration of organizational and cultural variables and corresponds to a growing level of maturity in the use of design. Those approaches are called (in order of increasing design maturity): *design as style*, *design as process*, and *design as strategy*. As a company moves from one approach to the other, it unlocks the potential to generate higher design innovation performance – products with innovative new meanings – and therefore improve the firm's competitive results. The six case studies were also used to validate the proposed constructs and to offer initial support to the model's hypotheses. The cases were found to be adopting the *design as strategy* approach, and the major design management practices they employed appeared to be correctly represented by the model. Most of the sample demonstrated very high competitive performances, vastly outperforming their markets in either growth rate or profit margins, and often in both.

Estratto

Questo lavoro di tesi è stato condotto con l'obiettivo di identificare il valore del design e il modo in cui un azienda può appropriarsene con successo. Basandomi sulle ultimi teorie nell'ambito delle innovazioni *design-driven* e del *design management*, oltre che sullo studio di sei società leader nell'uso del design, propongo un modello che descrive come il design dovrebbe essere gestito nonché le relazioni che sussistono tra un investimento in design e i risultati di una società in termini di innovazione e di competitività. Questa tesi pone le sue fondamenta teoriche nel lavoro di Verganti (2009), il quale ritiene che il design vada considerato, insieme alla tecnologia, come una delle dimensioni dell'innovazione: il design controlla il messaggio intrinseco di un prodotto e, insieme alle sue caratteristiche funzionali, ne definisce il *significato* che verrà poi percepito dall'utente finale.

Il modello introduce un nuovo modo di misurare un investimento in design, al centro del quale vi è l'idea secondo la quale il design debba essere considerato come una strategia, piuttosto che come una risorsa. Tale investimento viene valutato considerando il ruolo che il design assume all'interno delle strutture organizzative e della cultura dell'azienda ed è il risultato di investimenti che per la maggior parte non sono di natura finanziaria. Tre diversi approcci al design sono presentati nel modello, ognuno associato ad una determinata configurazione delle variabili organizzative e culturali di una società, e ognuno corrispondente a un crescente livello di maturità nell'uso del design. Questi approcci vengono definiti (secondo un ordine crescente di maturità): *design come stile*, *design come processo*, e *design come strategia*. Quando una società passa da un livello di utilizzo del design all'altro, vedrà aumentare le sue capacità di generare innovazioni di significato, e di conseguenza potrà migliorare le proprie prestazioni competitive. I sei casi studio sono stati utilizzati per verificare la validità dei costrutti proposti e la solidità delle ipotesi sottostanti al modello. Le società del campione hanno dimostrato di utilizzare l'approccio *design come strategia* e il modello sembra descrivere accuratamente tutte le principali pratiche di gestione del design da loro utilizzate. Nella quasi totalità dei casi, il campione ha dimostrato risultati significativamente superiori alla media del mercato sia in termini di crescita che di profitto, dimostrando un uso vantaggioso del design.

Executive Summary

PROBLEM SETTING

The first obstacle one must overcome when studying design is the lack of convergence in the definition of the term itself (Love 2000; Verganti 2008); so much so that some have argued that a Theory of Design hasn't been properly codified yet, but that design research should be regarded as being in a *pre-theory* state (Dixon 1987; Buchanan 2001). Despite the elusiveness of an univocal definition of design, three broad groups of interpretations of the term can be identified (Verganti 2009):

- *Design as Form* - This interpretation attributes to design control over the mere aesthetic and stylistic appearance of things: while the domain of function and technology belongs to engineers, designers are given the task of making things beautiful and attractive.

- *Design as Product Development and Innovation at large* - When referring to the design of products, the academic literature supporting this view usually considers the terms "design," and "product development process" as synonyms, by describing this activity as the one "that transforms the brief or initial market specification into design concepts and prototypes, and then into the detailed drawings, technical specifications and other instructions needed to actually manufacture a new product" (Walsh and others 1992).

- *Design as Meaning* - recently a new interpretation of design has emerged. Retracing the etymology of design back to the Latin de + signare, meaning "making something, distinguishing it by a sign, giving it significance, designating its relation to other things, owners, users, or gods", Krippendorff (1989) was first to propose that: design is making sense (of things). While "functionality aims at satisfying the utilitarian needs of the customer, the product meanings tickle her/his affective and socio-cultural needs" (Verganti 2008). Designers give meaning to products by using a specific design language, that is the set of signs, symbols and icons (of which style is just an instance) that deliver the

product's message (Verganti 2003; Dell'Era and Verganti 2007). This message interacts with the technological characteristics of an object or service to generate the complete offer which the final user perceives, and interprets as having a certain meaning.

This last interpretation was used by the recent research into design-driven innovation (Verganti 2008, 2009), which is based on the idea that not all innovations require technological advancements, or improvements to the functional qualities of a product, but that instead the *meaning* of a product should be considered as an additional dimension of innovation.
The "traditional" dimension of innovation remains unchanged, raging from incremental improvements in technical functionality to radical ones, but innovations may also be obtained by moving along the axis of meanings, and modifying the semantic characteristics of the product.

The definition of design as meanings was the one adopted for this thesis. As those theories are relatively recent and most of their implications still remain to be explored and analyzed in detail.

RESEARCH OBJECTIVES

The goal of this thesis is to expand the current knowledge regarding the value of design and the way this value may be successfully captured by companies. By building upon the vast body of existing research, I have aimed to propose a model to describe how design should be managed, and the relationship between an investment in design and the company's innovative and competitive performance.

The key research questions this work aims to answer are the following:

- *How does design create value?* Which mechanisms allow design to generate value for a company, and in what way do they allow a company to succeed in the market.

- *How should design be managed and implemented to allow a company to capture its full value?* Are there different ways for a company to adopt design and what are the differences in the results that those various approaches produce?

- *How does the context in which a company operates in affect its use of design?* Do contextual variables impact the way a company adopts design and the results it should expect from this strategy?

RESEARCH METHODOLOGY

In addition to a thorough review of past research, to assist in the development of the emerging model a best-in class exploratory case study was conducted, focusing on six companies displaying an advanced use of design. Their current approach to design was analyzed by examining a wide range of secondary sources, and the insights gained were combined with the theory and findings emerging from the existing literature. The union between those two elements allowed me to identify the key variables involved in the use of design by a company and the relationships which connected them to a firm's performance. Once the model had been defined, the research on the six initial case studies was expanded, to verify the validity of the proposed constructs and to offer initial support to the model's hypotheses.

Four of the companies in the sample were selected according to replication logic, with the goal of achieving similar results and validate the constructs and results. Those companies all belong to sectors producing goods for end-users and display at least one instance of all the possible characteristics of size and technological intensity. Those companies are Technogym S.p.A., Dyson Ltd., Kartell S.p.A., and Tesla Motors Inc.

Two of the companies were instead chosen with the goal of extending the validity of the model across different variables. KUKA AG was selected to represent companies operating in industrial sectors, with other business as their main customers, while Facebook Inc. was chosen to represent firms offering services rather than material products.

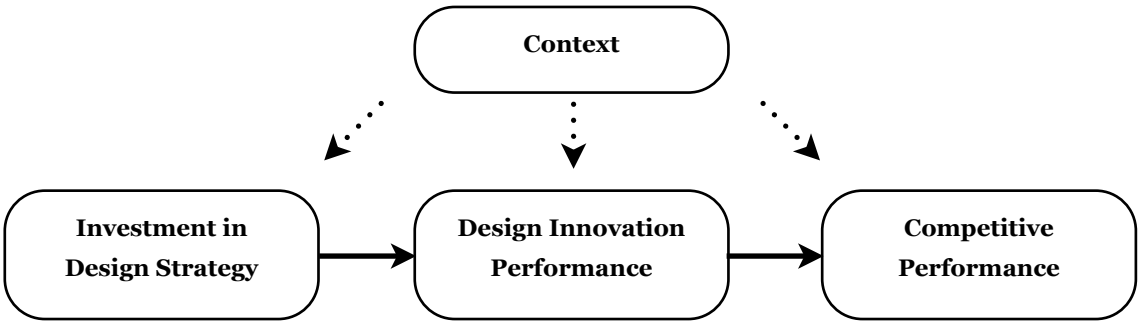

Figure 2: the proposed model of design value and its constructs.

The model introduces a new way of studying a company's investment in design, which is based on the notion of design as a strategy, rather than as an asset. Previous studies in the use of design have usually measured a company's investment in design by measuring financial expenses and other economic indicators. The model I have proposed evaluates a company's investment in design by considering what role is given to design within the organization's structure and culture, which is the result of investments that are for the most part not financial in nature. The way a company chooses to approach and manage design requires a much more significant expenditure in terms of processes, methods, time and commitment, rather than in terms of monetary resources.

Three different approaches to investing in design are presented, with a set of variables describing and identifying the way the company adopts design. Each approach is associated with a growing level of maturity in the use of design and has the potential of generating a gradually higher design innovation performance as the company moves from one to the other. Those three configurations are called (in order of increasing design maturity): *Design as Style*, *Design as Process*, and *Design as Strategy*.

Each approach to design is defined by a particular configuration of organizational and cultural variables. Six categories of variables were selected, relating to:

- *what design is*: measured by observing what definition of design a company adopts;

- *how design is used*: recognized by studying the role that design has within the new product development process, and what kind of NPD process the company employs;

- *who designs*: identifying who is involved in the company's design activities;

- *where design happens*: evaluated by examining how far away from top management design is performed, and how connected the company is to the "innovation network";

- *when design is used*: measuring when the design activity takes place relative to the main product development process;

- *why is design used*: determined by the kinds of activities in which the company employs design, and the design outputs generated.

According to the model, the increase in design innovation performance which a higher investment in design strategy generates, will result in an improved competitive performance. The design-driven company benefits from more innovative products in terms of profits, growth and corporate assets.

Finally, the model is based on the idea that the most mature approaches to design will not be significantly affected by changes in the company's context, and that the strategy may be applicable to a wide spectrum of contexts.

EMPIRICAL RESULTS

The studied sample of companies, which were selected for their high performance in terms of innovation of meanings, scored high values in all of those variables, and were therefore categorized as belonging to the *Design as Strategy* configuration, while their respective markets were found to be generally employing the *Design as Style* approach.

The major design management practices employed by the studied companies appear to be correctly represented by the model, as there didn't seem to be any characteristic in the sample's implementations of design which wasn't intercepted

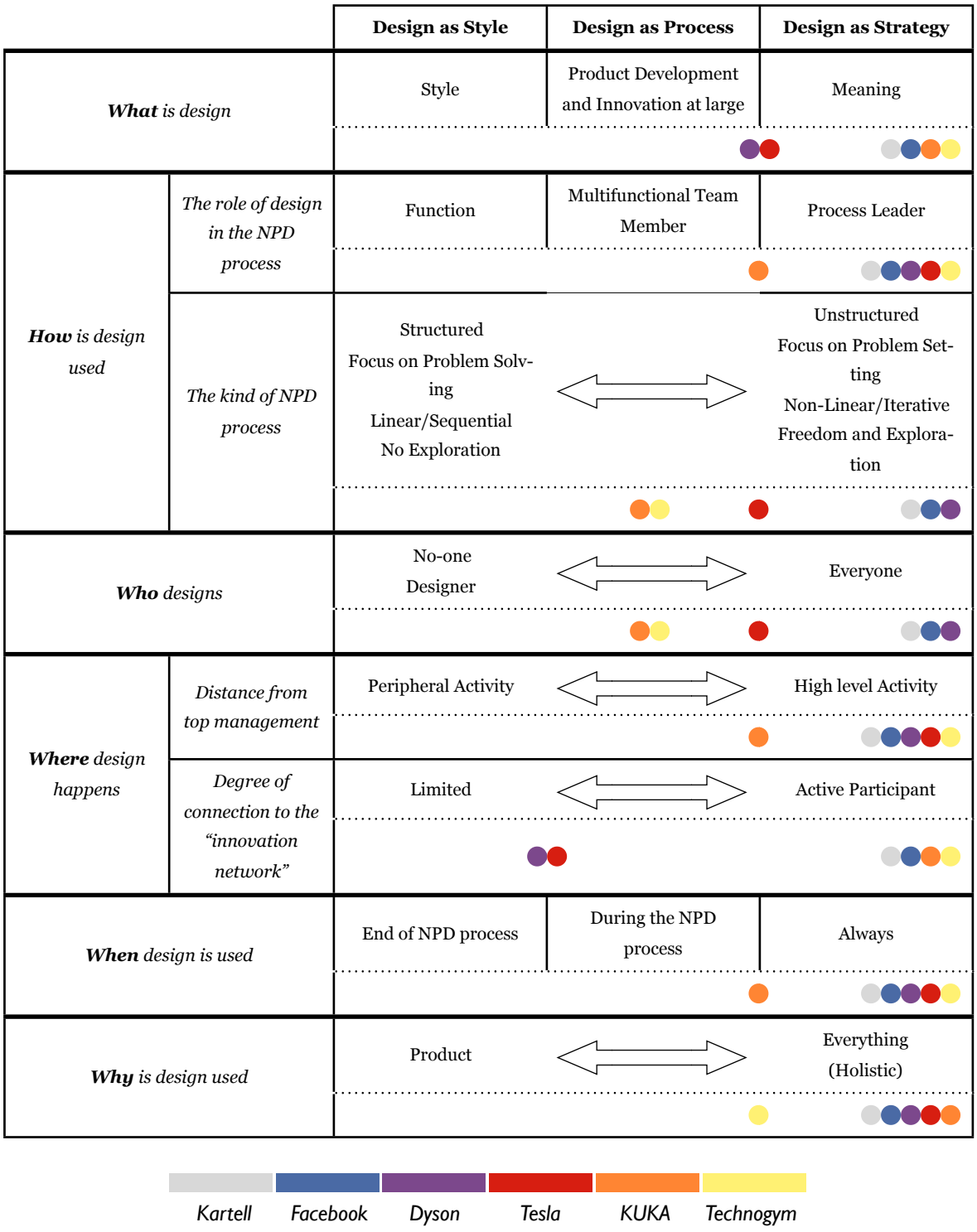

Table 1: the distribution of the scores of all companies on the variables measuring their approach to design.

by at least one indicator. In some cases, a number of variables were leaning towards some of the less advanced approaches to design, but the deviation was usually limited to less than one full level, leaving no doubts over a company's classification.

Overall, the variables selected appeared to describe appropriately the processes and behaviors implemented by the selected sample of firms.
The companies operating in more technologically intensive markets displayed a larger variance in results, and particularly a tendency to score lower on the variable measuring the *kind of NPD process*, and on the one measuring *who is responsible for design*, which can be explained by the peculiarities of highly technical sectors.
The only variable showing inconsistent results is the one measuring the *degree of connection to the "innovation network"*, as some companies have chosen to adopt an "isolated" attitude, almost exclusively relying on in-house resources. The coexistence, within firms adopting the *design as strategy* approach, of both the "isolated" and "open" orientations might indicate that the variable, while preferred by the majority of the sample, isn't particularly effective at identifying a company's approach to design, and might not be significant.

The large difference in the way the sample's companies approached design compared to the rest of the market, lead to significant divergence in the resulting competitive and innovative performances.

The design-driven companies selected were characterized by a much higher design innovation activity than the rest of the market, with frequent introductions of products displaying innovative meanings. In most cases, the sample's companies contributed in a major way to the overall innovative output of their respective sectors, being responsible for an ample portion of their market's recent radical changes in meanings.

Most of the sample demonstrated very high competitive performances, vastly outperforming their markets in either growth rate, or profit margins, and often in both. The results for all of the companies are summarized in figure 3. The very high differential results observed across most of the measures recorded, offer support with high levels of confidence to the hypothesis of a causal relationship connecting the implementation of a *design as strategy* approach to high competitive performances.

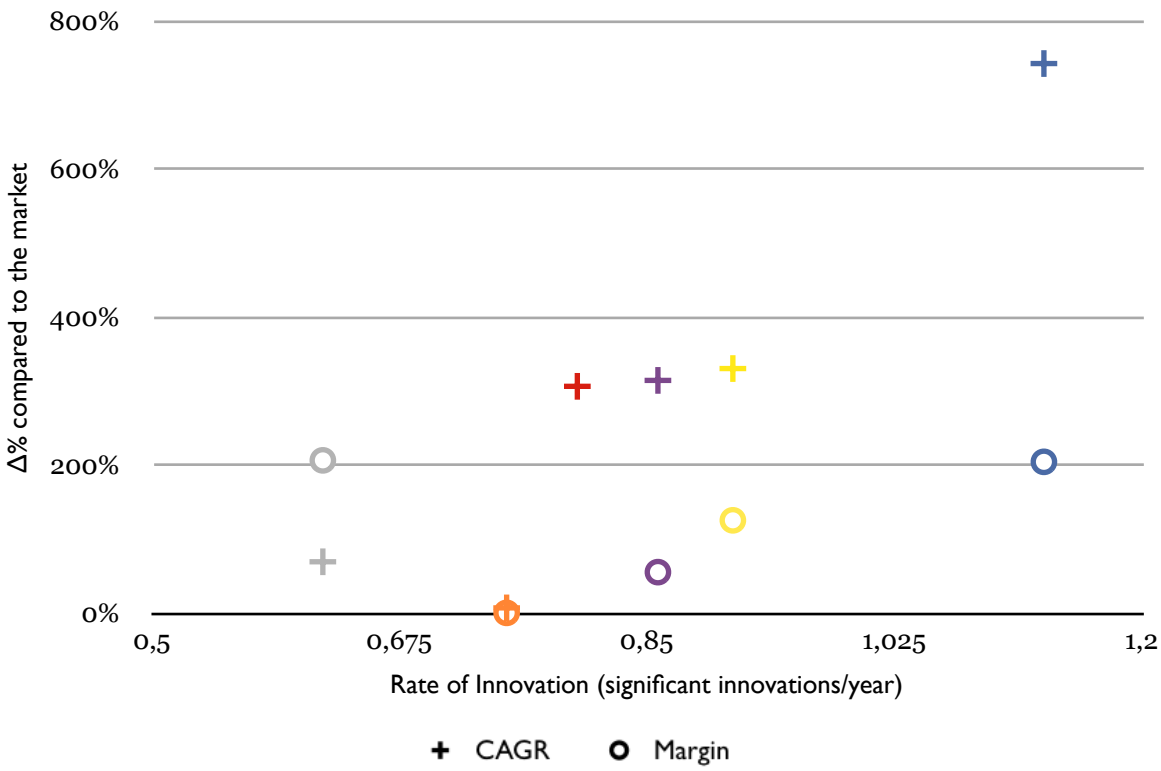

Figure 3: the relationship between rate of innovation and the variation in performance compared to the market in terms of growth and profits.

Contextual variables were found to have only mild effects on the sample's use of design, and consequently had no particular impacts on the results obtained by the companies compared to their sectors. The model seems to be applicable across a wide range of markets and sectors, and both for companies producing physical goods, as well as services. Evidence was found that the model may be used also in industrial and B2B sectors, but, given the partial inconclusiveness of the results in the case used to extend the model's applicability in this direction, this hypothesis is only partially supported and will require further investigation.

MANAGERIAL IMPLICATIONS

The findings of this research confirm the crucial role of management in the successful adoption of design by large companies. Top management was found to impact on many of the model's variables describing an organization's approach to design: in five out of six examined companies, the CEO or founder was directly involved in the product development process, and was among the main proponents and supporters of the organization's culture of design. Since design should be

treated as a strategy, the company's management is in the best position to affect the firm's future vision and direct it towards an advanced use of design.

In most sectors and industries (possibly even all), after implementing a sophisticated design strategy, companies can expect to significantly improve their product performances, leading to substantially superior competitive results on the market. Advanced approaches to design are associated with higher growth rates, higher product margins and accumulation of corporate assets. However, managers should keep in mind that, for a design strategy to be successfully embraced by an organization, substantial changes in the company's processes, structures, and overall mindset will be necessary. The company's culture will need to be modified deeply, usually requiring a rather long and gradual process of change. The firm's leadership should be the first to overcome the obsolete conception that investing in design consists of a spot investment in a product's appearance, and embrace the new long-term and continuous conception of design as a strategy.

Depending on the industry's characteristics, design strategies require several years to produce their first returns, as the effects of design are accumulated over time. The resulting product performance will also be distributed over a long period, as mature design approaches generate innovative streaks across many years rather than sporadic individual radical innovations.
Managers looking to incorporate design into their companies should therefore do so by assuming a long-term perspective, and focusing the company's efforts first of all on their product portfolio, the most effective source of competitive advantage.

LIMITS AND FUTURE RESEARCH

This study's sample, while presenting strong evidence in support of the initial hypothesis, is limited, in terms of the definitiveness of the conclusions it might lead to, by its small size. The results presented in this thesis provide an initial confirmation of the emerging theory, but they should not be considered conclusive.

Future research involving larger samples will need to be conducted. In particular, it might be useful to select samples including companies employing different approaches to design, but operating within the same sectors, in order to provide a precise measurement of the relationship between a company's maturity in

the use of design, and it's performances. The sample used in this thesis was limited to companies adopting the *design as strategy* approach, but future studies would do well to also include companies making use of intermediate stages of design maturity.

Overall, the variables selected to describe a company's approach to design appeared to appropriately intercept the various processes and behaviors implemented by the studied sample of firms. However, by employing larger samples of data, more rigorous testing methods such as factor analysis may be applied on the proposed set of variables, to better determine the efficacy of those indicators, and their eventual interdependencies and overlapping measurements.

Further research will also be needed to determine the model's applicability in industrial and B2B sectors. Additional case studies may be useful to verify the use of design in this sector, before resorting to more statistically significant testing.

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1. Introduction

During the course of this master's degree, I've had the opportunity to collaborate with Roberto Verganti and with Claudio Dell'Era, my former professor of Management of Innovation, on a consultancy for one of the leading electronics companies in the world. When we met with the head of design for the company, he told us that what he needed was for someone to help him explain to his CEO *how many* designers to hire in the future.

This statement surprised me, it conjured in my mind the image of an enormous room filled with designers scribbling away: was this really what was needed to create excellent product design?

This research started with the goal of answering this question. I wanted to identify in what way design could benefit a company, and how those benefits could be maximized. Is it really a question of *how much* a company invests in design? Does hiring a larger number of designers really benefit a company's design performance?

I set out to answer those questions by first reviewing the previous literature on the topic of design, which I will present in the next chapter. Guided by Verganti's (2009) work on the relationship between innovation and design, I chose to start at the source of the problem: what is design?
I discovered that even within the academic world, no single answer to this question existed. A large number of research streams had accumulated over the years, each exploring a different direction and following its own set of rules. How was it possi-

ble, in a world in which the most valuable company by capitalization, Apple Inc., has emerged from the brink of bankruptcy thanks to its successful use of design, that we still had such a fragmented and partial understanding of this important concept?

After reorganizing the existing theories and findings, I studied the way design is currently used in six of the most effective design-driven companies on the market, and combined those results to create a model that could reconcile the different views in the academic world with the practices of those best-in-class firms. This model will be explained in detail in chapter three, followed by a chapter describing the methodology adopted during the development of this thesis.

Once the model and its variables had been defined, the six initial case studies were expanded, in order to validate the proposed constructs and to offer initial support to the model's various hypotheses. Each of the six cases is presented in its entirety in chapter five, reporting all of the observations relevant to the model's constructs. At the end of each case a summary and analysis is conducted, anticipating the main cross-case analysis which is described in chapter six.

Finally, once the findings from the cases have been examined and reviewed, I will conclude by recapitulating the entire research and presenting the final implications of this work.

2. Innovation and Design

In this chapter I will introduce and examine the latest theory regarding the concepts of innovation and design. The first paragraph (2.1) will be dedicated to innovation, describing its crucial role in economic development, and illustrating its main characteristics and properties. Paragraph 2.2 will then focus on design, discussing the various definitions of this, often abused, term, and presenting the theories which identify it as an additional dimension of innovation. The paragraph will be concluded with a review of the existing research on the effects generated by a company's use of design, and present the implicit model those studies are based upon.

2.1. Innovation

"The fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumers, goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates."

Joseph Schumpeter (1942)

Innovation, and its impact on the capital system have been analyzed since the early days of economics, with Adam Smith, in the second half of the 18th century, suggesting technological change as a major concern for the development of industrial production. The birth of what could be called the modern "Theory of Innovation", however, is quite recent and coincides with the works of the austrian economist Joseph Schumpeter, in the first half of the 20th century.

Schumpeter (1934, 1942) identified innovation as the critical dimension of economic change, describing it as the fuel "keeping the capitalist engine in motion." Challenging Smith's model of economic growth as an harmonious, gradual, and self-perpetuating process governed by the "invisible hand" (Smith 1776), he argued that the "creative destruction" brought about by a new technological innovation superseding existing technologies often creates temporary monopolies, allowing abnormal profits for the innovator, and pushing rivals and imitators to scramble to compete through new innovations. A steady-state is never achieved, instead the economy cycles through periods of temporary monopoly, when a new innovation is introduced, followed by a gradual increase in competition and a progressive evolution of the market towards perfect competition as competitors "imitate" the new technology and improve upon it. As innovations stimulate new

innovations, creating "clusters of innovations", new opportunities for profit emerge, generating growth in the economy and finally resulting in an enhancement of the standard of life of the public. A period of equilibrium might follow, as competition completely erodes the innovator's share of excess profits, until a new innovation disrupts the market once again, restarting the entire process.

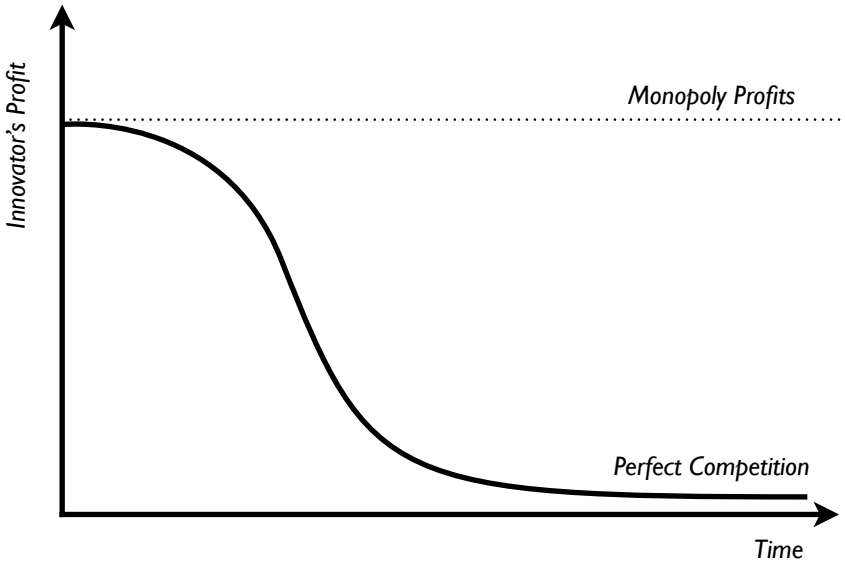

Figure 2.1: the evolution of an innovator's profit according to Schumpeter's model (1934).

Schumpeter's theory has later been developed by neo-Schumpeterian economists such as Freeman and Dosi, and has been expanded by the contributions of diverse disciplines including Design, Management, and Marketing.

Today more than ever, innovation is considered one of the fundamental elements contributing to the survival and health of an organization, and an indispensable competitive weapon. The competitive advantages to be obtained through innovation have been discovered to extend well beyond the creation of temporary monopolies (Verganti and others 2004): innovations are used to differentiate the company's offer, to obtain more stable profits (by distancing an organization from fluctuations of the market caused by competitors), as well as to achieve the strategic advantage of being the first movers in the market and forcing the competition to compete according to one's own rules. While most of those benefits are tied to the temporary nature of innovations, some permanent advantages can also be attained (Verganti and others 2004), such as increases in reputation, the accumula-

tion of know-how and loyal customers, and the control of standards and distribution channels.

A BROAD DEFINITION OF INNOVATION

In the broadest context, innovation is defined as "introducing something new" and "making changes to something [...] by introducing new methods, ideas, or products (Oxford English Dictionary, 2012). This basic definition has its roots in Latin, where the word 'novus', which means 'new', is derived into the verb 'in+novare', meaning 'to make new'.

A more sophisticated description by the Product Development and Management Association (PDMA), expands and specifies the basic definition:

> *"Innovation: A new idea, method, or device. The act of creating a new product or service. The act includes invention as well as the work required to bring an idea or concept into final form." (Rosenau 1996)*

INNOVATION VS. INVENTION

The PDMA's definition introduces the concept of Invention. This notion, commonly considered a synonym of innovation, is interpreted as the first step in the process of bringing a good idea to widespread use. According to Roberts (2007 - first published in 1988), innovation is the combination of invention and exploitation. The invention process includes the creation of the new idea, and the efforts required to make it work. While the exploitation process covers "all stages of commercial development, application and transfer, including the focusing of ideas or inventions towards specific objectives [...] and the eventual broad-based utilization, dissemination and diffusion of the technology based outcomes"(Chiesa 2001). To innovate, one must be able to successfully capture the potential market value of an invention; something inventors have often not been able to do, allowing others to innovate, and profit, from their inventions (Teece 1986; Chiesa 2001; Tidd and Bessant 2011).

DIFFERENT KINDS OF INNOVATIONS

Something that is not addressed by the PDMA's definition is the fact that innovations must not necessarily relate to products.

Traditionally, innovations have been sorted into two main categories: *product innovations* and *process innovations* (Schumpeter 1934). According to Schumpeter (1934), product innovations refer to the creation of completely new goods or to the introduction of products or services which more adequately satisfy existing or previously satisfied needs. A process innovation on the other hand, replaces a good with a product or service which serves the same or approximately the same purpose but is cheaper, as a result of new materials, new supplies or new production techniques (Schumpeter 1934). The effects of an innovation could therefore be imperceptible to the final customer, who could, in some cases, even be asked the same exact price for the new product, with the producing company reaping all the benefits of the improved process.

More recently, a third category of innovations has been often described: *organizational innovations* (Daft 1978; Kimberly and Evanisko 1981; Damanpour 1987). Those innovations relate to organizations that implement ideas, models, technologies or values, which are completely new to the context in which the organization operates (Bartezzaghi 2010, 530).

One last important aspect that should be kept in consideration is the fact that innovations do not always relate to tangible and physical changes in products, processes or organizations. The definition of organizational innovation we have just presented, for example, includes new "values" and new "ideas" as possible outputs of innovation.
This characteristic has been used as the basis of a framework that distinguishes innovations by examining both the internal resources affected by the changes, as well as the results produced by the innovation (Verganti and others 2004).
With regards to the kinds of internal leverages an organization employs to generate an innovation, this classification refers to:

- *Technological changes,* which leverage internal competences relative to the characteristics of products or processes, to generate new *product* or *process innovations*.

- *Organizational changes,* which introduce new organizational configurations and *organizational innovations*.

Regarding the output generated by the innovation, we again have two options:

- *New capabilities:* the innovation introduced has superior performances or lower prices than what was previously available on the market. Those are therefore *material innovations*.

- *New meanings*: the physical and economic characteristics of the product are unchanged but the innovation can better satisfy a list of intangible needs by conforming more accurately, or replacing, the values of a particular socio-cultural context. Those are defined as *semantic innovations*.

The intersection of those 4 options creates a matrix of combinations that can be grouped into three main kinds of innovations: *technological innovations, organizational innovations,* and *semantic innovations*.
It should be noted however, that the it is possible for an innovation process, especially for the most radical ones, to encompass more than one, or even all, of those typologies of innovations (for example a very innovative product may possess both new meanings and new capabilities and at the same time require a radically new organizational structure).

	Organizational Changes	*Technological Changes*
New Meanings	Semantic Innovations	
New Capabilities	Organizational Innovations	Technological Innovations

Table 2.1: Forms of innovation. Source:Verganti and others (2004).

RADICAL AND INCREMENTAL

Having talked about the different "directions" an innovative force may point towards it is time to examine the "magnitude" this force may have.

Innovations usually possess different degrees of novelty, a concept pioneered once again by Schumpeter (1934), who differentiated between the initial major innovation that dominates the market, and the "swarming secondary innovations" that follow.

The impact of an innovation can vary from minor, incremental improvements to radical changes that completely revolutionize the way a product is perceived by the market (Tidd and Bessant 2011).
Incremental innovations are usually the result of a process of continuous improvement, in which a product or service is refined and enhanced but progress is made along the trajectory defined by an existing technological paradigm (Dosi 1982; Chiesa 2001). *Radical innovations,* on the other hand, represent a substantial break from the existing offer and are therefore associated with the emergence of a completely new paradigm (Dosi 1982; Chiesa 2001). This kind of discontinuity is usually achieved through the use of projects, and can require significant investments and research, entailing high levels of uncertainty and risk. Once a radical innovation is introduced to the market, it enables various incremental innovations, and major or minor variations developed on the radical innovation by "combining the existing with the new" (Rothwell and Gardiner 1988). Eventually however the benefits of incremental changes decline, and a new radical innovation is required to continue the growth process.

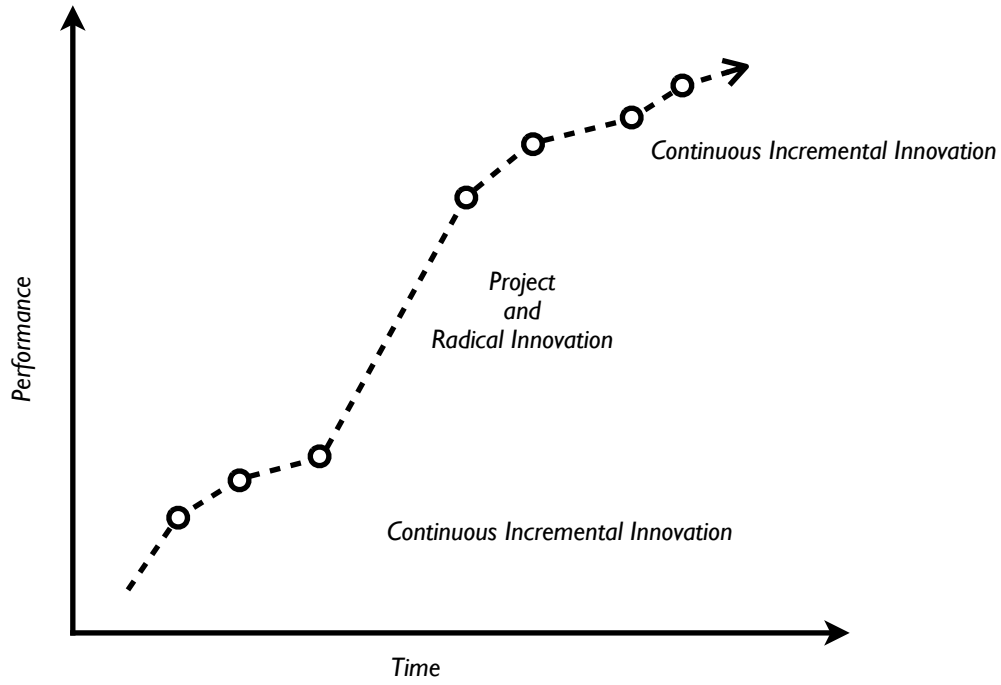

Figure 2.2:The relationship between radical and incremental innovations (Bartezzaghi and others 1999).

This behavior has lead Dahlin and Behrens (2005) to defined a radical innovation as one possessing three characteristics: a new product must be *novel*, and it should be *unique*, but to really represent a radical break from the pust it must have an *impact on future technology*. While the first two criteria enable allow the identification of potentially radical inventions ex ante market introduction, the third condition can only be determined ex post, somewhat complicating the identification of radical pushes.

THE PATHS TO INNOVATION

We have so far analyzed which characteristics an innovation may have; let's now examine how an innovation can come to be and which paths an organization may choose to walk in order to create an innovative product or service.

From a chronological point of view, the first driver of innovation to be analyzed was the most tangible: technological change. The view that innovation is triggered by the discovery and commercialization of a new technological advancement dates all the way back to Schumpeter's original theories and has been the foundation of what is now known as the *technology push strategy*. Originating from the assumption that scientific research should be regarded as exogenous

from the economic system, this strategy dictates that organizations should run Research and Development laboratories which conduct pure scientific studies independently from the rest of the organization, finally presenting their findings to the top management for commercialization and sale (Chiesa 2001). The diffusion of this approach to innovation culminated between the 1950s and mid-1960s, with the success of famous research centers like Bell Laboratories and Philips Electronic's Natuurkundig Laboratorium (Aguilar and Yoshino 1988) leading the way to what has been called the "Ivory Tower generation" of R&D (Chiesa 2001; Nobelius 2004).

With the increase of competition at the end of the 1960s and the emergence of marketing, the emphasis was shifted from long-term research to short-term studies driven by the demands of the market (Nobelius 2004), giving birth to a new approach to innovation known as the *market pull strategy*. First theorized by Schmookler in 1966, it represents the polar opposite of the technology push approach by considering the innovative process endogenous to the economic system: companies are pushed to research in a particular direction as a reaction to the demand by the market of that particular good. This way of innovating starts from the analysis of the market's needs, and subsequently searches for the technologies and languages that can be actually used to satisfy them. Research centers weren't factories of future products and discoveries anymore, they stopped being considered overhead costs that could convert money into innovations, and became tools under the control of marketing divisions, who could interpret what the market needed and use the researchers to create what was necessary: this shift would mark the beginning of the second generation of R&D (Chiesa 2001; Nobelius 2004).

The successes of both approaches, generated substantial debate over which of the two better explained the phenomenon of innovation (Dosi 1982), just as companies worldwide were settling with more balanced approaches, that combined in some way the two extremes in order to overcome their limitations (Chiesa 2001; Nobelius 2004). Dosi (1982), was among the first to properly formalize the two approaches and to highlight how "one-directional explanations of the innovative process, and in particular those assuming 'the market' as the prime mover, are inadequate to explain the emergence of new technological paradigms". Today, the

two strategies are usually seen as complementary rather than contrasting, and the interaction between them is considered the most effective solution (Chiesa 2001).

For years this *push/pull model* has been regarded as sufficient to describe most innovative processes. Recently however, a new line of inquiry has challenged this belief, by analyzing "the drivers and competitive implications of innovation in formal, rather than technological, product features" (Ravasi and Stigliani 2012). Those studies point to the limited predictive capacity of theories of technological innovation applied to this different context, and identify a third kind of innovation strategy which they define as *stylistic or design-driven* (Cappetta and others 2006; Verganti 2006, 2008, 2009). The basis of this strategy is the realization that not all innovations require technological advancements; certain radically innovative products or services propose changes in their formal and symbolic qualities rather than in their functional performance, an aspect often neglected but of significant importance to the market's perception of a product's overall innovativeness (Talke and others 2009). According to Verganti (2008): "this strategy aims at radically changing the emotional and symbolic content of products, i.e. their meanings and languages, through a deep understanding of broader changes in society, culture and technology".

The implications of this third strategy will serve as the foundation of this work. But to better understand this new approach to innovation and what it entails, we must first discuss in more detail the concept of *design*.

2.2. Design

"People think it's this veneer — that the designers are handed this box and told, 'Make it look good!' That's not what we think design is. It's not just what it looks like and feels like. Design is how it works."

Steve Jobs

WHAT IS DESIGN?

The first obstacle one must overcome when studying design is the lack of convergence in the definition of the term itself (Love 2000; Verganti 2008); so much so that some have argued that a Theory of Design hasn't been properly codified yet, but that design research should be regarded as being in a *pre-theory* state (Dixon 1987; Buchanan 2001). Despite the elusiveness of an univocal definition of design, three broad groups of interpretations of the term can be identified (Verganti 2009), which I will introduce in order of increasing sophistication.

- *Design as Form* - This is one of the most common descriptions of design, and the way most of the public actually thinks of design. This interpretation attributes to design control over the mere aesthetic and stylistic appearance of things: while the domain of function and technology belongs to engineers, designers are given the task of making things beautiful and attractive. This definition of design has been absorbed into the managerial culture through the maxim "ugliness does not sell", coined in the 1930s by the French-American industrial designer Raymond Loewy, one of the founding fathers of "styling" with his "streamlined" aesthetic. Products were encased into elaborated enclosures meant to enhance their visual appeal, completely disregarding the functional

aspect of the object.

This approach would later be questioned by the functionalist design movement, characterized by the belief in the principle "form follows function,"[1] which reflected the idea that formal features should enhance (through usability and ergonomics for example) the functionality of an object. While this movement strongly opposed "styling", by designing with strictly rational and essential lines that left no space for superfluous or decorative elements, the underlying interpretation of design remained, in essence, the same: the functionalists simply represent a different extreme of design as form.

The first definition of "design" to be adopted by the International Council of Societies of Industrial Design (ICSID) in 1959 reflected this school of thought by stating that: "an industrial designer is one who [...] determine[s] the materials, mechanisms, shape, colour, surface finishes and decoration of objects which are reproduced in quantity by industrial processes."[2]

Authors sharing this perspective on design have most often used the label of Product Design or Industrial Design to define their interpretation of design as simply aesthetics (some examples are Sewall 1978; Bloch 1995; Veryzer 1995), however many other labels have been used interchangeably, such as product form, product shape, exterior appearance or product appearance. By their definition, design usually pertains to the exterior features of a product that are observable by consumers, and specifically to the external surfaces that house or protect the inner workings (e.g., mechanical or electrical components) of a product (Veryzer 1995; Talke and others 2009). Those authors have been driven by their observation of the fact that product aesthetics can exert a significant influence on consumer behavior (e.g. Veryzer 1993, as well as most of the authors cited above), but have paid little attention to the fact that product function in this context, an integral component to product design, is a fundamental determinant of long-term product success (Ulrich and Eppinger 1995; Page and Herr 2002). This narrow definition of design doesn't acknowledge various important aspects of design, and has little in common with innovation, a concept with which pure aesthetic beauty sometimes even competes (Rindova and Petkova

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[1] This famous maxim was first coined by the american architect Louis Sullivan in 1896, but for a long time it was largely forgotten, until it was rediscovered in the late 1930s.

[2] According to the ICSID website http://www.icsid.org/about/about/articles33.htm (accessed 10/01/2013).

2007; Verganti 2009; Gemser and others 2011). Furthermore, the concept of "design as form" seems stuck in the long-gone era of economies dominated by industrial production, and seems scarcely applicable to the immaterial age of services and bits in which we are living today.

- *Design as Product Development and Innovation at large* - Starting with Freeman (1997, first published in 1974), some studies have identified "design" as the central activity of the innovative process (Walsh and others 1992). The Organization for Economic Co-operation and Development has described design as "the very core of innovation, the moment when a new object is imagined, devised, and shaped in prototype form"(OECD 1992).

When referring to the design of products, the academic literature supporting this view usually considers the terms "design," and "product development process" as synonyms, by describing this activity as the one "that transforms the brief or initial market specification into design concepts and prototypes, and then into the detailed drawings, technical specifications and other instructions needed to actually manufacture a new product" (Walsh and others 1992). This broader definition maintains that design may impact all attributes of a product, and not just its exterior form, as evidenced by the 1969 revision (written by Tomas Maldonado, the leading contributor to the influential "Ulm Model" of design education) to the previously cited definition of design by the ICSID, which stresses the fact that the qualities impacted by design "are not only the external features, but are principally those structural and functional relationships which convert a system to a coherent unity both from the point of view of the producer and the user," and concludes by stating that "industrial design extends to embrace all the aspects of human environment, which are conditioned by industrial production."

Indeed, certain authors have proposed definitions which extend the breadth of design even more, and associate it with almost any creative or innovative human activity; one significative example of such a view can be found in Herbert Simon's observation that "everyone designs who devises courses of action aimed at changing existing situations into preferred ones" (Simon 1969, 111), or in Buchanan's (2001) descriptions of design as "the art of invention and disposition", and "the human power of conceiving, planning, and making products that serve

human beings in the accomplishment of their individual and collective purposes."

While those broad definitions perhaps offer a more complete appreciation of the role and responsibilities of design, some have argued that in practice, they do not offer a useful tool for managers and organizations looking to better manage this resource (Verganti 2009): the breath of those interpretations of design reaches a point in which the concept becomes so generic and vague, that one can hardly distinguish its peculiarity with regard to other fields of investigation, making it hard to extrapolate new management theories and slowing down scientific progress (Verganti 2008).

- *Design as Meaning* - recently a new interpretation of design has emerged.

Retracing the etymology of design back to the Latin de + signare, meaning "making something, distinguishing it by a sign, giving it significance, designating its relation to other things, owners, users, or gods", Krippendorff (1989) was first to propose that: design is making sense (of things).

The intentional ambiguity of the phrase is meant to convey both the idea that "design is a sense creating activity", and that "the products of design are to be understandable or meaningful to someone": perception, experience, and esthetics are defined as fundamental concerns of design, whose main objective, however, is that of dealing with the emotional and symbolic value of things (Krippendorff 1989). This interpretation is based on studies on product semantics [3], and on the observation that people do not perceive products as pure forms or unrelated objects, but always see them in a context of other things, situations, and users (Neisser 1976): in other words, as meanings. The importance of this semantic dimension of products, affecting the affective/emotional and symbolic/socio-cultural perception of products by consumers, has been demonstrated to be as important as the utilitarian characteristics of products (even for industrial goods), by research in marketing, consumer behavior and anthropology of consumption, as well as various design theorists and scholars (see Verganti 2008 for a comprehensive list of such studies).

While this definition is somewhat narrower than the ones prevailing in man-

[3] the "study of the symbolic qualities of man-made forms in the cognitive and social contexts of their use and the application of the knowledge gained to objects of industrial design." See Krippendorff and Butter, 1984.

agement literature (which we have just discussed above), a recent line of inquiry has chosen to adopt it, noting how an emphasis on product semantics actually manages to highlight the peculiarities of design compared to other innovation fields (Verganti 2008, 2009). While "functionality aims at satisfying the utilitarian needs of the customer, the product meanings tickle her/his affective and socio-cultural needs" (Verganti 2008).

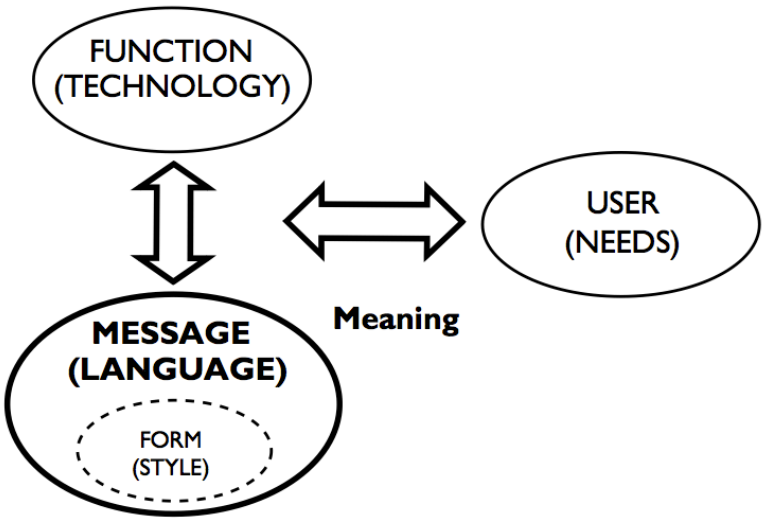

Figure 2.3: products and meanings (Verganti 2003).

The boundaries of design's impact on products therefore appear clearer: designers give meaning to products by using a specific design language, that is the set of signs, symbols and icons (of which style is just an instance) that deliver the product's message (Verganti 2003; Dell'Era and Verganti 2007). This message interacts with the technological characteristics of an object or service to generate the complete offer which the final user perceives, and interprets as having a certain meaning.

However, this interaction between message and function isn't beyond the control of design. In fact, the aspects that fall under the scope of work that may be conducted by "designers" has been grouped into two clusters: the first has been called "functional design", and refers to the side of design affecting technology, functionality, and ease of use, while the second has been labeled "experiential design", and includes the sensorial, symbolic and emotional portions of design (Gemser and others 2011). Design is therefore responsible both for the language of a product as well as various characteristics which impact the technological performance of a product, and may completely modulate its influence on prod-

uct meaning.

This has lead to the application of established theories of innovation to the study of changes in the semantic qualities of products, and the development of an alternative terminology to conceptualize innovation in product form (Cappetta and others 2006; Verganti 2008, 2009).

The recent emergence of this definition of design can be linked to the evolution of society towards what Daniel Pink (2006) calls the fourth "age" of human development : after the *agricultural*, the *industrial* and the *information* age (which belonged respectively to farmers, factory workers, and knowledge workers), we are now reaching the *conceptual age,* which will belong to creators and empathizers, and has been made possible by the fact that "abundance has satisfied, and even over-satisfied, the material needs of millions—boosting the significance of beauty and emotion and accelerating individuals' search for meaning" (Pink 2006). In this age we will increasingly expect sophisticated experiences that must be both emotionally satisfying and meaningful, and therefore require complex combinations of products, services, spaces, and information that go beyond their functional capabilities (Brown 2008).

THE FUNCTIONALITY/MEANINGS FRAMEWORK

Having analyzed in more detail the notion of *design as meaning* we can return to the description of the theory of design-driven innovations, which is based on this definition of design, focusing in particular on Verganti's substantial contribution to the subject.

We've seen that the design-driven approach to innovation is based on the idea that not all innovations require technological advancements, or improvements to the functional qualities of a product. According to Verganti (2008, 2009), this "anomaly" of design-driven innovations can be explained by considering the *meanings* of a product as an additional dimension of innovation (see figure 2.4).

The "traditional" dimension of functionality remains unchanged, raging from incremental improvements to radical ones, but innovations may also be obtained by moving along the axis of meanings, and modifying the semantic characteristics of the product.

Changes in meanings even share some of the same properties of functional innovations, such as the possibility of being either radical or incremental. An incremental innovation of meaning is achieved by slightly modifying the product language in order to deliver a message that is in line with the current evolution of socio-cultural models. This is domain of "style", in which a product conforms to the latest accepted languages, and is therefore perceived as "fashionable" and stylish. However, the underlying meanings of the product have not been significantly impacted, as in the case of a radical innovation of meanings, in which the product language delivers a profound reinterpretation of what a product means. The same parameters which apply to radical technological innovations (that it should be novel; unique; and have an impact on future technology) are relevant to radical changes of meaning, with the third parameter translating to the requirement of having an effect on future *socio-cultural regimes*.

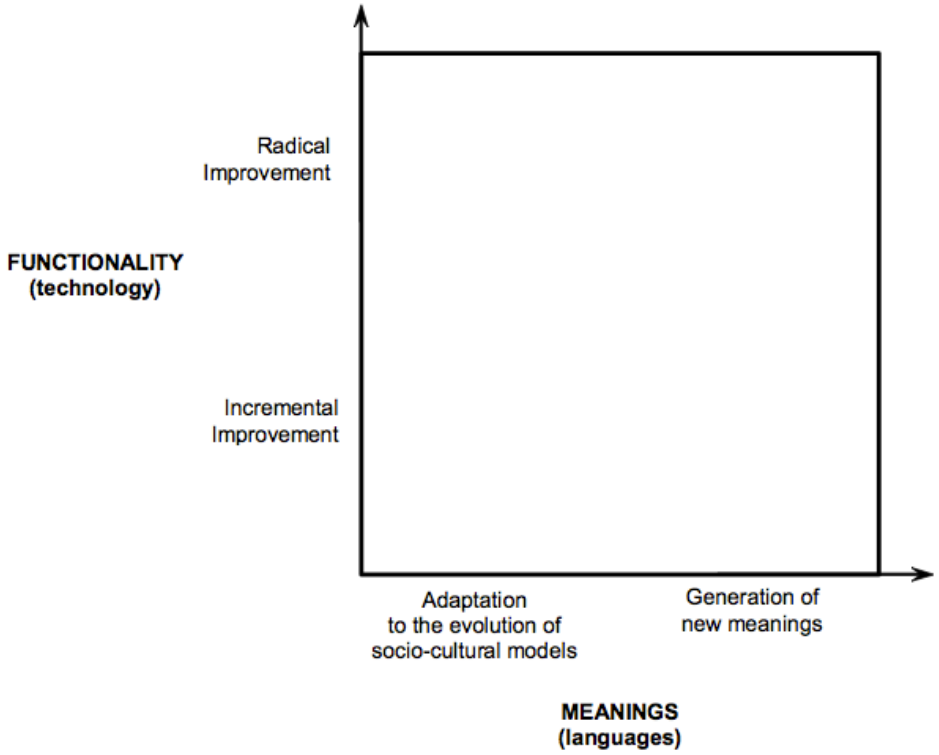

Figure 2.4: the dimensions of innovation (Verganti 2008).

The typical example is the Swatch watch: first launched in 1983, it was a radical innovation of meaning, by breaking free from the traditional view of watches as jewels (popular in the '50s and in the '60s), as well as the then rising trend of watches as instruments with the advent of the Japanese digital quartz

watch industry (which was using electronics to incorporate a large number of functionalities into the products). Swatch proposed a new meaning of watches as "fashion accessories" (Glasmeier 1991), transforming quartz watches through the use of a radical new product language, consisting of colorful plastic, a trendy style and an accessible price. Nowadays Swatch launches into the market a couple of new collections every year, adapting the original meaning of the product to the evolutions in socio-cultural models. After the initial collection of watches, every subsequent Swatch collection may therefore be interpreted as an incremental innovation of meanings.

The Swatch represents an example of a "pure" design-driven innovation. While it introduced a radical innovation of meaning, it only slightly modified the underlying technology of the product and only minimally impacted the functional utility of the product (a Swatch keeps track of time just as well as any other quartz watch). Design-driven innovations are therefore located mainly in the bottom right corner of the Functionality/Meanings diagram (fig. 2.4), and extending upwards to the top right corner.

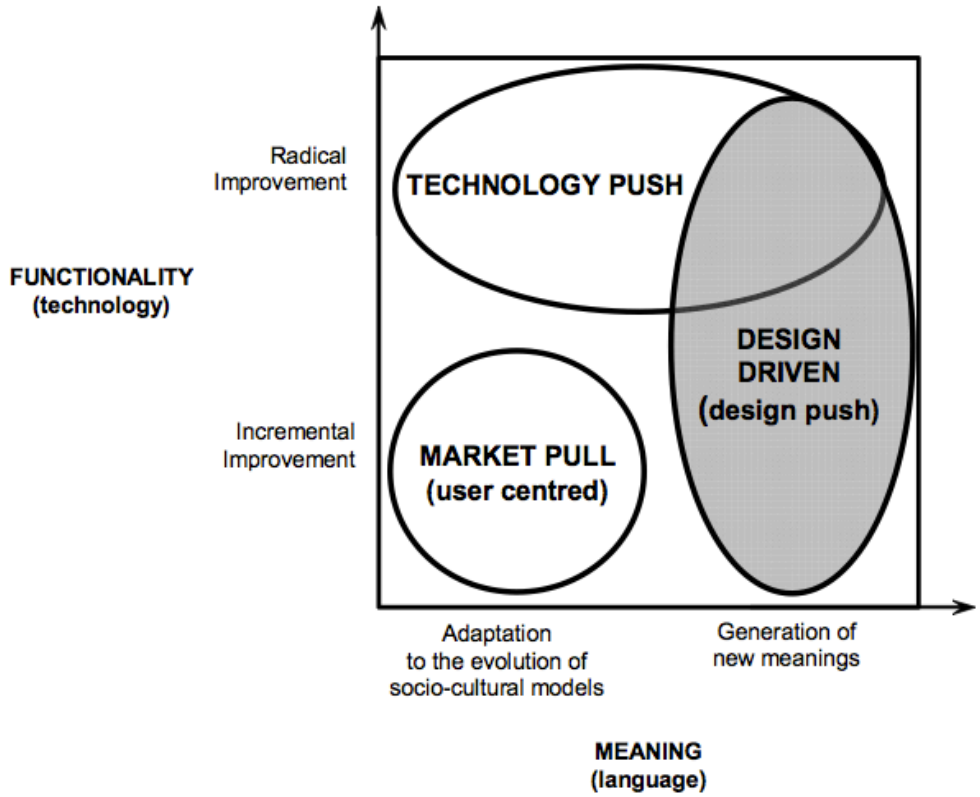

Figure 2.5: the main innovation strategies and their positions on the Functionality/Meanings Diagram. (Verganti 2008).

One of the interesting aspects of this diagram is the fact that it builds upon previous theories of innovation, instead of substituting them: both *technology push* and *market pull* approaches are maintained, and can be positioned on the chart. Verganti places the technology push strategy at the top of the diagram, representing radical improvements in functionality, and the market pull approach at the bottom left, where only incremental advances are achieved. This reflects the conclusions of the intense debate that was born in the 1970s over the relationship between push/pull strategies and innovation performances. The result of the debate was the aforementioned contribution by Giovanni Dosi (1982), suggesting that, while any innovation implies understanding of both technologies and markets, radical changes in technological paradigms are mainly achieved through technology push, whereas incremental innovations within existing technological paradigms are mainly the result of market pull. This approach was later shared by research on the relationship between disruptive innovations and user needs, which has observed the difficulties of disrupting established trajectories of technological progress when exclusively addressing the current demands of the market (Christensen and Rosenbloom 1995; Christensen and Bower 1996; Christensen 1997; Dahlin and Behrens 2005).
Following this same logic, the design-driven approach has also been described as a "push" approach, as it requires the proposal of a radical new meaning for products that was previously latent or completely absent from the market, and thus a "proactive market orientation" (Candi and others 2010). Customers hardly help (Gemser and others 2011), as they are immersed in today's socio-cultural context, which shapes their interpretations towards the current meanings.

A superficial analysis of the diagram may lead to the conclusion that the three approaches are separate, but this could not be farther from the truth: the borders of each area are purposefully blurred, as there is a bit of each strategy in any type of successful project. While the initial starting point changes, all of those approaches should have a firm understanding of the drivers at the core of each other mode, as the underlying technology, the market's needs and the product's meaning, are present and affect each and every product or service.

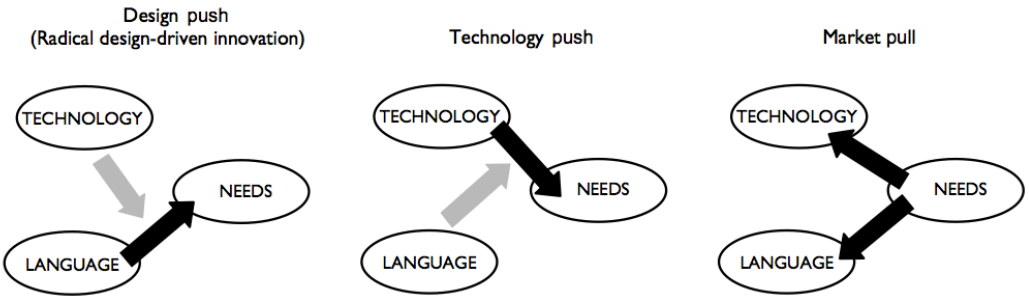

Figure 2.6: the different drivers of innovation strategies (Verganti 2003).

Of particular interest is the area of overlap between technology and design push in the upper right corner of the diagram in figure 2.5, which generates what have been called "technological epiphanies": when a new technology enables the introduction of powerful new meanings (Verganti 2011).

Breakthrough technological changes are often associated with radical changes in product meanings (Geels 2004), even though often the discovery of the new product meanings which fully leverage the new technology comes after a delay that can, in some cases, last years. When a technological epiphany is achieved however, the market changes permanently, giving the innovating company a chance to fully capture the value of a particular technology and dominate, despite the existence of established products already using that same technology, but combining it with old meanings. Think of the Apple iPod, and the way it was able to obliterate the MP3 player market which had been born several years earlier: the main challenge for executives is shifting from being first in launching a new technology, to being first in finding the right application of technological opportunities (Verganti 2011).

IS GOOD DESIGN GOOD BUSINESS?

Recent economic history presents many examples of successful technological epiphanies and design-driven innovations, as well as companies who have built leading market positions thanks to their persistent strategies of innovation and design. Scholars of management and innovation have attempted to quantify the contribution of design to the bottom lines of those companies, and while they have considerably improved our understanding of the impacts of design, they have often struggled with the lack of a common language and unifying theory.

Three separate streams of research seek to identify the effects of design on economic performance: the first two groups of studies have investigated the impact that the design of a product has on its financial success and on its perception by the customers, while the last stream has attempted to trace broad connections between a firm's investments in design and a company's profitability.

Studies focusing on the response of consumers to a product's design have traditionally focused just on the aesthetic aspects of product design (i.e. design as style), considering product form as the first opportunity for the formation of a customer's opinion of a product (Ravasi and Stigliani 2012). Customers determine their attraction and value expectations regarding a product through a fast process that initially only considers aesthetic information, and later even base their quality judgments mostly by integrating just design and brand information (Bloch 1995; Page and Herr 2002; Rindova and Petkova 2007). Still, also in this branch of research, some authors have based their works on more complete definitions of design, and have observed that consumers seem to evaluate products by also considering their meanings and semantic properties (Creusen and Schoormans 2004), as well as the way functionality and aesthetics come together to generate "experiential benefits" (Forlizzi 2004; Candi and others 2010). The consensus of those researchers is that design has significant influence on the perceived value of a product and on customer choice (especially when it goes beyond the aesthetic appearance of products), and should therefore be regarded as an important strategic tool.

While consumer response is an important determinant of financial performance, some scholars have taken the more direct route of examining the results of "good" product design on economic indicators.
To circumvent problems regarding the definition of what design is and when a company exhibits high design performances, this stream of research has usually evaluated companies by considering the number of design awards they had received, or by asking design professionals to rate their skills and achievements.
Companies characterized by a successful use of design have consistently outperformed their competitors on a wide variety of financial indicators (Roy 1994; Trueman and Jobber 1998; Swan and others 2005; Bedford and others 2006; Gemser and others 2011) and even in overall stock performance (Hertenstein and others 2001; Hertenstein and others 2004; Rich 2004; Zec and Jacob 2010). Once

again, evidence pointed to the fact that the most successful product development is characterized by a multi-dimensional approach to design, while loss-making projects involve narrower, styling-oriented approaches (Roy and Riedel 1997).
Even more importantly, the effects of good design even appear to have long term effects, that are persistent and stable over several years (Roy 1994; Hertenstein and others 2004; Verganti 2009; Zec and Jacob 2010). Whereas the effects on sales of technical newness, the other dimension of product innovativeness, have been shown to decrease as the product reaches its maturity, an innovative design is a significant driver of sales over the entire product life-cycle (Talke and others 2009).

Finally, the last stream of research has taken a similar approach to the previous, but has analyzed the performances of companies based on their investments in design, rather than their design results, with a goal of identifying some sort of ROI for design (Wallace 2010; Zec and Jacob 2010).
Once again, companies with higher design budgets were generally found in better competitive positions than other companies (Gemser and Leenders 2001; Danish Design Centre 2003; Swedish Industrial Design Foundation 2004; Tether 2005; Chiva and Alegre 2009; Tether 2009; Candi 2010).
Conditions outside of the company affect the outcomes of an investment in design, with greater results obtained in sectors where the use of design is an emerging (Gemser and Leenders 2001). Nevertheless, an innovative use of design results in a higher payoff when compared to companies with different strategies regardless of the maturity of the industry's use of design.
Most importantly however, the results of an investment in design depend heavily on the company's design management capabilities, as those play a crucial role in assuring a firm's effective use of design. Financial performance has been found to correlate to a company's skill level in managing design, with Chiva and Alegre (2009) finding a strong and significant relationship between five main categories of design management skills (following a conceptualization proposed by Dickson and others 1995) and an organization's growth and profitability.
While Chiva and Alegre focused on individual design management skills (for example measuring the ability of using the latest computer aided design tools effectively), other studies concentrated on the way design was adopted by the sample of

companies on a broader level. They relied on a model developed by the Danish Design Centre (DDC 2003) called the "Design Ladder", which identifies four steps of design maturity within an organization:

- *Step 1: No Design*. "Design is an inconspicuous part of, for instance, product development and performed by members of staff, who are not design professionals. Design solutions are based on the perception of functionality and aesthetics shared by the people involved. The points of view of end-users play very little or no part at all."

- *Step 2: Design as Styling*. "Design is perceived as a final aesthetic finish of a product. In some cases, professional designers may perform the task, but generally other professions are involved."

- *Step 3: Design as Process*. "Design is not a finite part of a process but a work method adopted very early in product development. The design solution is adapted to the task and focused on the end-user and requires a multidisciplinary approach, e.g. involving process technicians, material technologists, marketing and organizational people."

- *Step 4: Design as Innovation*. "The designer collaborates with the owner/management in adopting an innovative approach to all – or substantial parts – of the business foundation. The design process combined with the company vision and future role in the value chain are important elements."

The original survey by the DDC, as well as others using similar methods (Swedish Industrial Design Foundation 2004; Danish Design Centre 2007) indicate a general tendency towards correlation between high performance and high placing on the design ladder. Companies have also been found to be moving upwards along the ladder as time passes, indicating a growing realization of the importance of design.

Within those studies, some authors note that financial indicators alone cannot capture the full value of design: the impact of design on a company's performance is multifaceted and mediated by various other factors, making it difficult to measure by just analyzing financial data (Tether 2005; de Mozota 2006; Gabrielsen and

others 2007).
Indeed, the effects of design can be tangible, when they generate direct financial returns for the business, but may also be intangible, when they contribute to the future performance of the company by affecting difficultly quantifiable factors such as the cultural and strategic assets of a company (Inns 2002).

THE IMPLICIT MODEL OF DESIGN VALUE

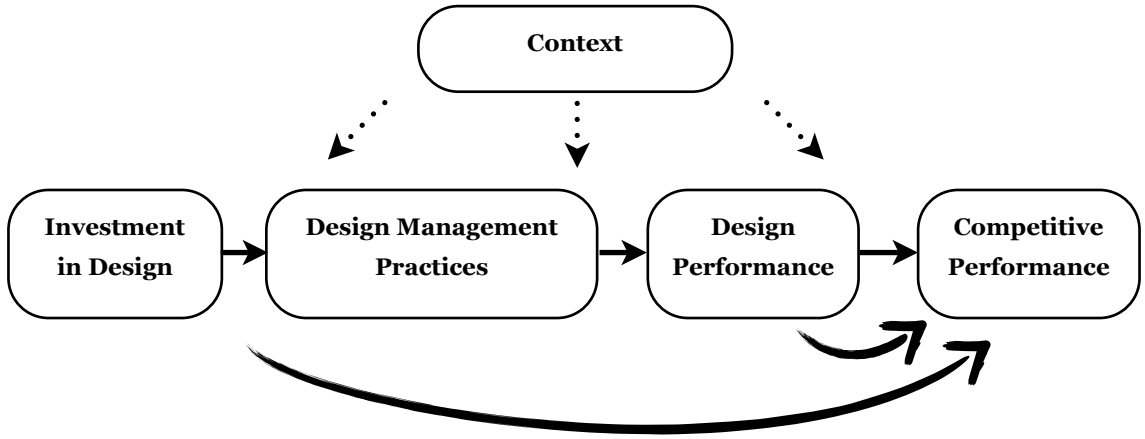

Fig. 2.7: the implicit model for design value and its constructs. The two arrows on the bottom represent the path that the research streams have taken to study the relationship between design and competitive performance.

By aggregating the results of the three research streams on the value of design, it is possible to extrapolate a model that unites and reconciles most of their findings (figure 2.7).

This implicit model is composed of five constructs. The first is *Investment in Design* and relates to the amount of financial resources employed by the company's design activities. This construct is followed by *Design Management Practices*, which incorporates the way the company organizes and manages the design processes within the firm. The *Design Management Practices* employed by the company mediate the results of its *Investment in Design*, which are represented by the *Design Performance* construct. The last step in design's value chain is when "good" (or "bad") design finally impacts the firm's *Competitive Performance*.
One final construct stands above the others and affects them all. It is the *Context* in which the company operates.

Through the contributions of those researchers, the connection between design and financial performance has been, for the most part, established. The

constructs of the implicit model have been separately identified and some of their relationships have been studied thoroughly. But the model has not been analyzed in its entirety, or in consideration of the latest interpretation of design as *meaning*. Is there a more accurate way to describe how design should be managed, and the way it generates value for a company? I will expand upon this implicit model in the next chapter, in order to better understand how a company should manage design to maximize its performance.

3. A Model for Design Value

"Innovation has nothing to do with how many R&D dollars you have. When Apple came up with the Mac, IBM was spending at least 100 times more on R&D. It's not about money. It's about the people you have, how you're led, and how much you get it."

Steve Jobs

Having introduced in the previous chapter the implicit model that emerges from the existing literature on the value of design, I will now attempt to advance it, by incorporating the latest developments in Innovation and Design Theory.

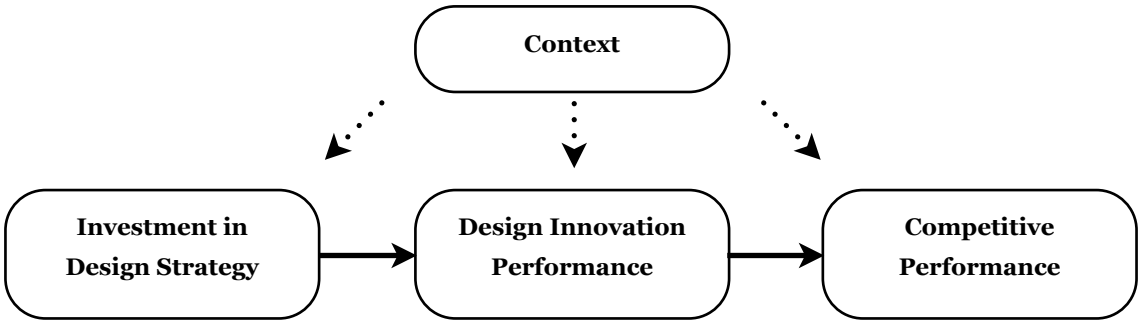

Figure 3.1: a model for design value and its constructs.

The model I propose is structured similarly to the implicit model, bus is composed of just four main constructs. Three of them are positioned sequentially and are called: *Investment in Design Strategy*, *Design Innovation Performance* and *Competitive Performance*. The last construct impacts all of the others and is the external *context* the company operates in.

Let's examine each construct individually and its differences from the current implicit model.

3.1. Investment in Design Strategy

FROM DESIGN AS AN ASSET, TO DESIGN AS A STRATEGY

This first construct incorporates the *Investment in Design* and the *Design Management* construct of the implicit model.

The fact that a company's design management capabilities might have a mediating effect on the results produced by design has been researched only recently, and just by a handful of authors. This says a lot about the maturity of Design Theory, but is understandable when one considers the traditional role given to design.

In 2001, Gemser and Leenders wrote a paper titled "*How Integrating Industrial Design in the Product Development Process Impacts on Company Performance*", and, while they basically ignored the way the companies managed design for most of the study, they concluded by noting that it seemed very likely that the impact of industrial design would vary depending on the skills and talents of the individual designers involved; finally they proposed that the use of designers with a good reputation and years of design experience would probably lead to better results than the use of designers who had just graduated from design school.

Their conclusions represent the view of design as style that we have described in the previous chapter: design is seen as an asset that can be employed by a company to differentiate and improve its products from an aesthetic point of view. It behaves similarly to a machine that applies spray paint to a product in its last stages of production: one may choose to buy a more expensive and better performing machine to apply a higher quality coating to the product, but the machine operates autonomously and separately from the rest of the production process.

The question was whether this asset should be acquired by companies and at what

price. Did customers really care if a product had a better paint coating? And if so, how much did they value it?

Today we know that design means much more than just style and we have started to appreciate the importance of correctly managing it, leading to the development of an entire stream of research based on the notion of design management (Ravasi and Stigliani 2012). Researchers have observed how good design emerges from a carefully managed process (Walsh and others 1992; Roy 1994; Bruce and Bessant 2002), and how design management skills and the maturity in the use of design correlate to a positive financial performance (as we have seen in the previous chapter).
Interestingly however, the design management capabilities of a company were found to be only moderately effected by the level of investment in design (Chiva and Alegre 2009), revealing that only a partial dependency exists between design skills and the amount of economic resources employed.
Furthermore, when companies are categorized by the maturity of their use of design (according to the "ladder model" we have previously discussed) no statistically significant differences in total investment in design are found among the different groups of companies (Danish Design Centre 2003): the observed investment in design does not increase as the use of design becomes more pervasive in the company, and, surprisingly, even companies which describe themselves as belonging to the first step of the design ladder, which is labeled "No Design", recorded high investments in design.

These anomalies can be explained when one considers the fact that design should not be viewed as an *asset,* but as a *strategy*.
Various authors have already embraced, although in different ways, this transition, and have realized that, in order to fully express its value, design should be integrated into the company culture and overall firm strategy (Hertenstein and Platt 1997; Trueman and Jobber 1998; Bruce and Bessant 2002; de Mozota 2002; Lockwood 2004; Ravasi and Lojacono 2005; Verganti 2009; Zec and Jacob 2010). Some have described design as a way of thinking that can be applied to everything inside an organization in order to solve complex problems and drive a company's innovation and growth (Brown 2008, 2009; Martin 2009). This strategic dimension of design allows it to become simultaneously a differentiator, a coordinator,

and a transformational process (de Mozota 2002), driving the company in new directions and markets (Ravasi and Lojacono 2005), and improving its vision and innovativeness (Hertenstein and Platt 1997; Danish Design Centre 2003; Verganti 2009).
This shift in perspective entails a very different approach to investing in design than what was traditionally considered. Simply hiring a designer, or paying for an external consultant, is no longer sufficient; the entire organization must embrace the new strategy and contribute with new structures, processes and capabilities: the company culture must change radically, so a mere financial investment will not be sufficient to enable the full potential of design.
Furthermore, since it requires a modification of the company's entire strategy, the process of fully integrating design requires a long and gradual process. Research has identified a relationship between a prolonged use of design and its strategic use as a core competency, demonstrating how just a few years of design experience limits the effectiveness of a strategic positioning of design and its impact on the activities of the firm (de Mozota 2002).

THREE APPROACHES TO DESIGN

We have analyzed how design can be interpreted in three main ways: as *style,* as *product development at large,* and as *meaning*.
Those three different concepts can be tied to three separate approaches to design, and associated with specific organizational and cultural configurations. Each of those configurations are characterized by particular values of certain variables that describe the way design is considered and used within the entire company.
I will call those three approaches *design as style, design as process,* and *design as strategy*.

This view is consistent with previous literature. We have already seen how the Danish Design Council has categorized the stages of design maturity into a ladder with four steps. The last two steps are maintained, but the first two steps of the ladder, *no design* and *design as styling*, are united, reflecting the belief that even though companies declare not to be using design in any way (the design ladder was developed for use in surveys) they are actually just adopting the design as style approach, albeit in a very mild way. This same approach has been followed by de Mo-

zota (2006), who talks about the three approaches to design (as styling, as process, as strategy) as one of the defining factors of design management, determining the way a company will make use of design. Through her research on design-oriented European SMEs she identified three levels for design's use in a company: as a *differentiator*, when design impacts on the market and the company's primary activities, as an *integrator*, when design affects the support activities of the firm's value chain, and as a *transformer*, when design is a core competence that may change the company's vision and culture (de Mozota 2002).
At the base of this model is the belief that organizational culture has an influence on the degree to which creativity and innovation is stimulated in a company (Martins and Terblanche 2003), and that design may contribute on three levels to the performance of a company: influencing the products offered by the firm by giving "sense" to them; impacting the human resources management and the interaction between company functions; and encouraging the strategic nucleus in the company to generate a vision (Hetzel 1993; de Mozota 2006).

Let's now breakdown the variables that influence those approaches and the values they assume in each configuration (table 3.1).

- ***What** design is* - this first variable relates to the way the company interprets design, which I have already discussed. The view of *design as style* relates to the eponymous approach; design as *product development and innovation at large* is associated with *design as process*; and finally the interpretation of *design as meaning* belongs to the *design as strategy* approach.

- ***How** is design used* - this variable actually refers to two different parameters: the *role of design* in the product development process, and the *kind of product development process* that the company employs.

  - *The role of design in the NPD process* - the move towards a strategic design culture is associated with substantial changes in the duties of the design function within the product design process (Hertenstein and Platt 1997). A high degree of integration of design into the product development process has been linked with significative impacts on design quality and time related measures of performance, and has been identified as a necessary (al-

though clearly not sufficient) determinant of financial product performance, highlighting the importance of this parameter (Swink 2003).

Each approach to design can be associated with a different role of design in the NPD process, corresponding to increasing degrees of design integration.

Design as style is linked with *Design as Functional Specialism* (Perks and others 2005). Designers in this category concentrate purely on design and are perceived by the business as a resource. Decisions and actions relating to marketing and manufacture in this category are dictated by other functions as design sticks to its functional silo, and designers are ring-fenced and highly controlled. This functional characterization is found mainly in those companies that undertake incremental product developments (Perks and others 2005).

Design as process is associated with *Design as Part of a Multifunctional Team* (Perks and others 2005). In this characterization, a team approach is used throughout the development process, as design is identified as a crucial aspect of the product development activity. Designers are encouraged and emerge as key players of the team, and an effort is made to generate ongoing interaction between designers and relevant stakeholders throughout most stages of the NPD process. Designers are encouraged to show greater flexibility in their role, as they are required to provide support to other functions, such as participating in product testing with engineers or aiding in product launches and exhibitions with sales managers. Designers also often stay with the project throughout the manufacturing phase, supporting and helping to solve manufacturing process problems, and receiving feedback that may be incorporated in subsequent designs. Cross-functional teams are considered fundamental to overcoming communication barriers established by functional silos, as teams enable greater decisional speed and provide more creative solutions (Hertenstein and Platt 1997; Swink 2003). This configuration also provides numerous advantages from a motivational point of view, including isolation from distractions, team cohesiveness, project ownership, and high levels of commitment (Swink 2003). The most important benefit however, is the fact that, when compared to the previous approach, firms which include design into multifunctional teams produce a greater number of radical innovations. To adopt this configuration though, companies must also

overcome some new challenges, such as the fact that for some designers, acquiring the skills to implement team-based NPD can be a long and problematic learning process, or that divergent design and engineering perspectives may require frequent management intervention for resolution of conflicts (Swink 2003; Perks and others 2005).

Finally, *design as strategy* is related to *Design as NPD Process Leader* (Perks and others 2005). Design in this categorization is seen as a major force for innovation as it drives and supports actions across a broad scope of functional activities and throughout the entire development process. Design is the source of new ideas and concepts, and influences the company's marketing strategy by proposing new markets and segments, as well as the R&D strategy by envisioning advanced products with new requirements and characteristics. The combination of both market pull and technology push drives this design-led approach to product development, in which the need to understand market requirements, but also to deploy advanced technologies, propels design to a central role in the NPD effort. This configuration requires once again an increase in the number of skills possessed by those who design, as a higher number of non-design functional activities fall under their control, demanding additional leadership and process management capabilities. However, the rewards of this increase in requirements are the highest association with radical product development of all other approaches and a reduction in the duration of development cycles, which makes this the ideal configuration for the most innovative companies (Perks and others 2005).

The increase in the variety of necessary skills and capabilities as a company progresses through the three configurations closely ties this variable to others which we will analyze later, such as *who designs,* and *where design happens*.

- *The **kind** of NPD process* - research indicates that, while more than 80 percent of "high-performance" companies report having a formally documented new product development process, those processes are often not consistently followed, leading to rampant changes in the way product design process are managed (Hertenstein and Platt 1997). This statistic shows how innovative companies are struggling with traditional project management: design-driven organizations require a more agile approach to product devel-

Table 3.1: the three approaches to design and their variables.

		Design as Style	Design as Process	Design as Strategy
***What** design is*		Style	Product Development and Innovation at large	Meaning
***How** is design used*	*The role of design in the NPD process*	Function	Multifunctional Team Member	Process Leader
	The kind of NPD process	Structured Focus on Problem Solving Linear/Sequential No Exploration	⟷	Unstructured Focus on Problem Setting Non-Linear/Iterative Freedom and Exploration
***Who** designs*		No-one Designer	⟷	Everyone
***Where** design happens*	*Distance from top management*	Peripheral Activity	⟷	High level Activity
	Degree of connection to the "innovation network"	Limited	⟷	Active Participant
***When** design is used*		End of NPD process	During the NPD process	Always
***Why** is design used*		Product	⟷	Everything (Holistic)

opment, which often involves informal processes that change often and are continuously adapted to fit the current task in the best possible way (Lockwood 2004; Martin 2009).

This tendency is measured by examining a variable that behaves differently from the previous two, as it doesn't posses three distinct configurations, but assumes a value along a continuous axis.

On the extreme associated with *design as style* we have the traditional approaches to product development. Those approaches have been grouped into a category that Brooks (2010) calls the "Rational Model", which is rooted in rationalist philosophy and originates in the works of Simon (1969). Those methods were developed mainly within the field of problem solving, where innovation is considered as the search for a new, optimal solution to a given problem (Verganti and Öberg 2012), and emphasizes "analytical thinking," logic and certainty (Martin 2009). The development process is understood in terms of a discrete sequence of stages, which lends itself easily to high degrees of formalization and to a mostly linear structure. This approach underlies several project management techniques, such as the "phase-gate model", the "waterfall model", the "toll-gate approach", or the "systems development life-cycle".

Over the years the Rational Model has been criticized by various authors who have observed how the linearity of those models potentially interferes with creativity and innovation, as overly structured processes may hinder the process of innovation, often leading to mostly incremental innovation. Researchers realized that professionals do not act sequentially as the rational model suggests, because a designer "does not separate thinking from doing" and "does not keep means and ends separate, but defines them interactively as he frames a problematic situation" (Schön 1983, 69). The Rational Model has also been criticized for being based on unrealistic assumptions, as goals are often unknown when a design project begins, and the requirements and constraints continue to change (Brooks 2010).

Innovation studies have therefore concentrated on less analytical and more intuitive processes, by analyzing how a creative person thinks. This approach has been pioneered by the software development industry, which has developed a new group of development methods known as "agile" programming

(Brooks 2010; Ralph 2010, 2011), and later embraced by scholars working on "design-thinking" (Brown 2008; Martin 2009), which, not by coincidence, originated in Northern California, right in the middle of the Silicon Valley.

Those methods represent the extreme of this variable associated with *design as meaning*: they emphasize "intuitive thinking" and raw creativity and are best described metaphorically as a system of spaces rather than a predefined series of orderly steps (Brown 2008). Projects follow non-linear paths through those spaces and frequently loop as more knowledge is generated, ideas are refined and new directions taken. The shortcomings of the Rational Model are fought through the use of creativity, heuristics and, in most recent proposals, hermeneutics. The majority of those methods underscore the importance of exploration and iteration, and propose a shift of focus from problem solving to problem setting.

Several scholars suggest that companies should emphasize exploration and high degrees of freedom during product development (Perks and others 2005; Martin 2009), and often indicate methods such as brainstorming as an integral part of successful creative processes (Kelley 2001; Brown 2008). Freedom to explore concepts and ideas that go beyond the scope of the project has been linked with higher product performance and even directly to long-term financial success, since the new ideas often lead to new opportunities for future development projects (Gemser and others 2011).

Iteration is another recurring theme among agile development methods; it is considered essential to allow ideas to mature and evolve and to improve the speed an effectiveness of the development process. Rapid prototyping techniques are often cited as the fundamental methods to enable fast iteration, allowing project members to visualize the current advancements and to analyze their work in a direct and tangible way, through a high number of cheap and simple mockups (Kelley 2001; Brown 2008).

Finally those methods push towards a greater focus on problem setting rather than problem solving (Ralph 2010; Verganti and Öberg 2012). In real-world practice, problems do not present themselves as givens, but, through the process of problem setting, must be constructed in order to define the decision to be made, the ends to be achieved and the means which may be chosen (Schön 1983). Meanings cannot be innovated by focusing on the details of a

product or technical problem: radical innovations of meaning only occur when one expands the scope of investigation by stepping back from the problem at hand to consider the overall user experience beyond the specific interaction with a product (Verganti and Öberg 2012). Given the peculiar nature of product meanings, that differs greatly from technology, innovation is described as a process of interpreting (developing meaningful scenarios rather than finding an optimal solution to a problem) and envisioning (imagining experiences that are still not asked for, rather than answering to existing needs).

To summarize, a NPD process that is highly structured, focuses on problem solving, is linear and sequential, and doesn't allow exploration beyond the project's scope, is consistent with the *design as style* approach; at the other side of the spectrum, *design as meanings* requires NPD processes that are unstructured, focus on problem setting, are non-linear and iterative, and encourage free exploration.

- ***Who** designs* - as we have seen, as a company increases its reliance on design the number and variety of skills and responsibilities that must be covered by those who design increase significantly. This shift clashes with the idea of industrial designers as the only "design agents" within a company. As the definition of design changes, more and more company functions are called upon to contribute to the design process. Innovation is seen as a process that combines creative and analytical approaches, and requires collaboration across many disciplines as knowledge is combined and integrated.

Once again the variable of *who designs* is continuous rather than discrete.

In the *design as style* configuration design is usually performed by dedicated professional designers who work independently from the rest of the company, or even by no-one in particular, as the employees of the company make styling choices while the product is developed. Interestingly, despite the fact that this approach lends itself very easily to outsourcing, as the styling of the product is usually realized downstream and separately from the rest of the product development, companies in this configuration usually carry out internal design (Perks and others 2005).

As a company's use of design matures, the duties of design are distributed

among a greater percentage of the company's employees, gradually enabling design's full potential. At first general managers, marketers, salespeople, and engineers are trained to better understand design, and conversely designers are taught to understand the functions of these people (Kotler and Rath 1984). As design is integrated more tightly into the fabric of the firm, the formal linkages between the product design process and other functions and processes within the firm grow (Hertenstein and Platt 1997). Multidisciplinary teams are created to drive forward the product development process and bring together a large number of different competences, capabilities and opinions.

The *design as meanings* stage is reached when the company culture fully embraces design, and a shared vision of design is embedded into the corporate strategy (Lockwood 2004). Robert Bradford (2002) calls this "designer collectivism", and Paul Odomirok (2001) supports this proposition, by arguing that the core of organizational success is collaborative purpose. The task of designing extends beyond the designers to the entire organization, and especially into the hands of the top executives who possess the crucial capabilities of setting the direction and choosing the vision which will guide the entire organization (Martin 2009; Verganti 2009). Top management sets an example that propagates through the entire organization so that every employee ends up contributing to the design process by recognizing the role of design, and by sharing the same approach to product development. By viewing design as a strategy rather than an asset, the key role in the innovation process is no more played by scientists and creative employees, but by the top management, as the process of vision creation, rather than product development and idea generation, becomes the decisive moment for innovation (Verganti and Öberg 2012). Therefore, leaders have to be a part of the design process, and as the entire organization aligns to their vision and strategy of design, the innovative process becomes a collective effort by everyone within the company.

- ***Where** design happens* - this variable also refers to two different parameters: the first measures the *distance from top management* of the design process, while the second refers to the level of *connection of the company to external networks*.

• *Distance from top management* - as we have seen, business leaders must play an active and crucial role in the innovative process. To achieve this, when a company recognizes the strategic value of design to the business and therefore reaches the *design as meanings* stage, it must position the design functions appropriately within the organizational structure to enable effective design (Lockwood 2004). Companies which excel in product design consider it important to have a person competent in design represented at the top management level, and have design usually reporting, in priority, directly to the CEO or top management (Hertenstein and Platt 1997; de Mozota 2002). Design thus becomes a key participant in the strategic planning process and has the opportunity to participate in strategy formation (Hertenstein and Platt 1997). Top management support in the product development process is a predictor of design quality, and is linked with product and financial success, as well as improved NPD times (Swink 2003): by providing vision, a clearer direction, and better access to resources, as well as creating a feeling of priority and enthusiasm, the top management encourages and enables team members to better achieve their goals .

On the contrary, without a committed leadership, no business can realize the structural, processual and cultural adjustments needed to become a design-thinking organization (Martin 2009), and may even incur in top management interference (Swink 2003). Ultimately, most radical innovations of meanings require a personal commitment by the leadership of companies, as no financial or marketing tools will help (and may in fact sometimes impede) the process of evaluating and deciding to bring to market a new product meaning (Verganti 2009): the top management alone has the authority to make the decision of taking the risk of launching a radical innovation.

In the *design as style* approach the failure of management to recognize the potential of design often stifles creativity and innovation within the company, as the development of radical new products is restricted by the leadership's inability of judging design and by its unwillingness to risk in something which it doesn't value. In those companies, the cosmetic and superficial view of design relegates the design function to the periphery of the company and limits its interaction with the leadership.

- *Degree of connection to the "innovation network"* - when analyzing a company's use of external, rather than internal, designers, one might expect to find that companies at the lower stages of design would tend to mostly outsource this activity, as they don't consider it critical to their success. Interestingly this tendency is actually inverted, as companies are found resorting more to external designers as their maturity in the use of design increases (Perks and others 2005; Dell'Era and Verganti 2010). Those external consultants however do not substitute the internal resources completely, but are rather integrated into the existing team to complement and reinforce the company's capabilities.

  This behavior is consistent with the concept of the "design discourse" (Verganti 2003, 2008), a collective and continuous research process on meanings and design languages that companies advance through several explicit and tacit interactions among several actors in their global and local networks. Those actors, or "interpreters", include external designers, but also lead users, firms in other industries, artists, media, architects, cultural centres, schools and universities, exhibitions, etc...

  The interpreters, and especially those "outside of usual networks" in the industry, play a major role, as they bring a critical stance to what is currently assumed to be meaningful by a company and add new perspectives in the search for new, profitable, meanings (Verganti and Öberg 2012).

  This approach is built over time and demands a sophisticated internal process through which all these contributions can be integrated (Verganti 2003). But it has the power of enhancing inspiration and creativity, and the internal design teams will be able to absorb new skills, knowledge and opportunities (Perks and others 2005). For those reasons, companies belonging to the *design as strategy* configuration will display a higher degree of connection to the network than the other configurations, with the *design as style* configuration mostly adopting an "isolated" and predominantly internal approach to design.

- ***When** is design used* - as the role of design in the NPD process changes, so does the temporal position of the design phase (Perks and others 2005).

In the *design as style* configuration, design is treated as a downstream process

that starts at the *end of the product development process* (Ravasi and Lojacono 2005; Brown 2008). Clearly, such an approach severely restricts the possible contribution to the project by design, which is assigned to make only superficial choices.

When a company matures to the *design as process* stage the product development process integrates design more fully, and designers are called upon *during the NPD process*. This configuration includes various degrees of participation: while some companies will restrict the involvement of design to the central portions of the development process, it is not uncommon to see designers following the project even during more technical or market oriented phases of the process such as manufacturing or customer research (Perks and others 2005). While design is now in a better position to affect the product in its entirety it still won't be able to affect the company's strategy completely.

The most important shift happens when designers are brought in even earlier in the process (Kotler and Rath 1984), and especially when they are given access to activities upstream of product development such as the creation of vision and strategy (Verganti and Öberg 2012). This is when the *design as strategy* characterization is reached, in which design is a continuous process that is *always* driving the company, and, most importantly, is in a position to contribute to the overall strategy of the the company.

- ***Why** is design used* - product design is the main form of design to be adopted by companies, and is the first aspect companies consider when approaching design for the first time (de Mozota 2002). Product design has in fact been identified as the main driver of company performance, with other forms of design giving positive contributions to competitive performance but not with sufficient strength to compensate for a poor product (Gabrielsen and others 2007).

The output of design in companies at the *design as style* stage therefore usually concentrates just on *products*, but as the culture of design propagates throughout an organization it ultimately reaches all activities of the company and other forms of design are embraced.

Finally, companies involve design in most of their processes and design has an effect on the entire output of the company, from products to advertisement,

from internal communications to corporate architecture. This kind of *holistic* design is associated with the *design as strategy* approach: the company projects a cohesive image of itself both to internal and external stakeholders, and creates an integrated experience around its products and services that remains consistent and uniform across all of the company's activities and resources.
Scholars suggest that this approach is beneficial, as the greater the involvement of designers in corporate visual identity development, the better the outcome in terms of perceived firm image, and consequently overall firm performance (Gemser and others 2011). Empirical results also illustrate an inverse relationship between innovativeness and heterogeneity of product signs and languages (Dell'Era and Verganti 2007). Innovators have lower heterogeneity of product languages than imitators and usually adopt a consistent and distinctive visual identity in all of its activities, that gives them an opportunity to characterize its products, distinguish them from competitors', and make them immediately recognizable (Ravasi and Lojacono 2005).

THE RELATIONSHIP BETWEEN INVESTMENTS IN DESIGN AND DESIGN PERFORMANCE

As companies move towards the use of design as strategy, their scores on each of the variables we have examined will change accordingly. It is not required for the values of all indicators to be consistent with the same particular approach, as the position of the majority of the variables will be sufficient to determine the current stage of design in the organization.

The relationship of an investment in design strategy with the rest of the model is quite simple: each of the the three approaches we have examined gradually enables a higher level of design innovation performance.

Let's see how this model explains the anomalies regarding investments in design and their returns that have been observed by previous studies.
As we have seen the kind of investment that a strategy of design requires goes far beyond economic resources. A company's investment in design can only truly be measured if one considers what role is given to design within the organization's structure and culture, which is the result of investments that are for the most part not financial in nature. The way a company chooses to approach and manage

design requires a much more significant expenditure in terms of processes, methods, time and commitment, rather than in monetary resources.
Most studies, however, have concentrated on the financial element of investments in design, and have thus ignored the actual underlying source of good design performance.

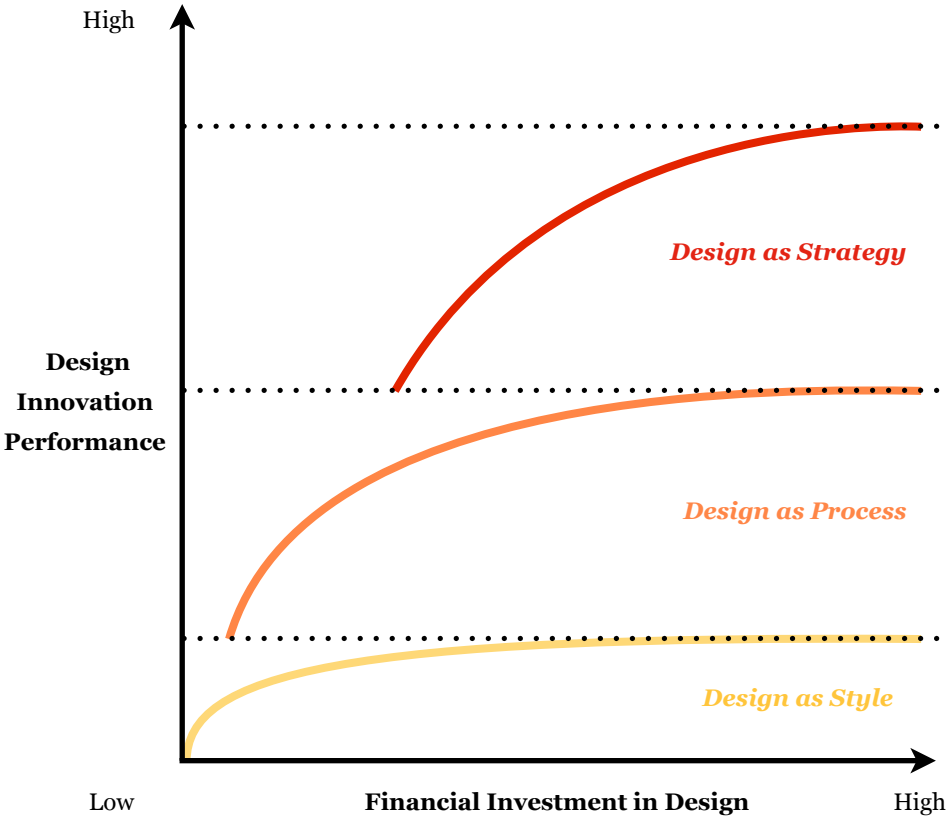

Figure 3.2: the relationship between financial investment in design and design innovation performance. The approach to design used by the company must be taken into consideration.

Each approach to design possesses an upper limit to the quality of design innovation that it may generate (see figure 3.2). A company may choose to commit an ever increasing amount of financial resources to the design structures it currently has in place, but, in addition to obtaining diminishing returns as with most investments, the output it will produce will never surpass the boundaries set for the current approach to design: the only way to break free of this limitation is to adapt the organization's use of design to the next level of design maturity.
A company characterized by the *design as style* approach will eventually surpass a threshold where not only additional resources will become significantly less effective at improving the company's design innovation results, but a significantly better performing alternative will also be available at the same level of expenditure

although through a different use of those resources.
It should also be noted, that with every new level of design the minimum investment increases, as the effective portion of expenditure from the previous stages is maintained. A company which reaches the *design as strategy* approach will preserve and build upon the effective expenditures it has accumulated during the *design as style*, and *as process* stages.

For those reasons, it is impossible to predict a company's design effectiveness by simply observing the amount of financial resources it allocates to design related activities. The *Investment in Design Strategy* construct of this model therefore includes both the *Investment in Design* and *Design Management* constructs of the implicit model and directly relates to the next construct: *Design Innovation Performance*.

3.2. Design Innovation Performance

THE FAR REACHING EFFECTS OF GOOD DESIGN USE

When a company changes and improves its approach to managing design it will impact the organization in three ways (Hetzel 1993; de Mozota 2002):

- by optimizing the primary activities. Design influences the value perceived by consumers by giving "sense" to the products that the firm offers.

- by optimizing the coordination among functions and the support activities of the firm. Design transforms the management process and influences human resources management by mobilizing, motivating, facilitating the circulation of information, and by bringing together the various actors working in different services around one project.

- by generating a new vision of the industry and guiding the strategy of the firm. Design facilitates the formulation of projects and encourages the strategic nucleus in the company to generate a vision.

This multi-dimensional action of design allows it to positively affect a wide variety of company activities and assets and, through those results, the overall competitive performance of the organization. Design doesn't improve a company's competitive performance by just helping in the creation of better products or services. As we have previously discussed the effects of design are far-reaching. Design may also enhance other crucial processes belonging to different and more indirectly related company functions (Hertenstein and Platt 1997; Trueman and Jobber 1998; de Mozota 2006): from improved recruitment to higher staff motiva-

tion and empowerment, from cheaper production to reduced materials use, from higher reputation and better brand image.

The cross-functional and layered nature of design makes measuring its performance complex, as separating design's unique contributions from a company's aggregated results is extremely hard (Roy 1994). This difficulty is evidenced by the indicators companies choose to evaluate the contributions of their design teams. Companies are much more prone to selecting a high number of non-financial measures (such as customer satisfaction or innovation/creativity indicators) to evaluate design performance rather than financial measures (Hertenstein and Platt 1997). Non-financial indicators better reflect design's complex contributions and may also be used to assess the strategic impact of design, which would be almost impossible if one were to rely exclusively on monetary measurements.

DESIGN'S MOST IMPORTANT OUTPUT: INNOVATIVE PRODUCTS

While design's contributions may be varied and far reaching, there are no doubts that the crucial final goal of design, and the primary determinant of a company's prosperity or failure (Cooper and Kleinschmidt 1987; Cooper 1994; Talke and others 2009), is the ability to bring to market innovative, and therefore desirable, products and services.

Product design has been identified as the most important driver of company performance (Gabrielsen and others 2007), and a product's innovativeness, as well as its unique benefits and value to users, are considered critical to achieve a positive financial return and high demand (Cooper and Kleinschmidt 1987; Cooper 1994; Talke and others 2009). Product superiority is the key determinant of success, and while elements of non-product advantage (such as customer service and support, sales force capabilities, brand and reputation or product availability and efficiency of delivery and distribution) yield positive results, their impacts are far less significant and hardly compensate for an inferior product (Cooper 1994).

For those reasons the model focuses, through the *Design Innovation Performance* construct, on the effects of design on products, and specifically on their degree of innovativeness.

To determine a company's design innovation performance we will once again return to Verganti's "Functionality/Meanings" Diagram.

As companies move towards the higher stages of design maturity, their ability to produce radical innovations of meanings improves substantially. Sporadic innovations may happen fortuitously in companies regardless of their approach to design, but only the ones using the more advanced configurations, and especially the *design as strategy* approach, create the proper conditions for radical innovations of meanings to flourish, allowing the firm to produce major product improvements more consistently and frequently.

The elusive and extraordinary nature of radical innovations of meanings means that no company, whatever its use of design, may be guaranteed of achieving one of those breakthroughs as soon as a new way of managing design is adopted. However, the *design as strategy* approach offers the best chances to a firm, by gearing it towards this ambitious goal through the best possible combination of structural and cultural variables. Furthermore, while radical results may not be guaranteed, companies will certainly see, even in the short term, a more efficient and productive incremental innovation performance, which will still result in significant benefits, even though not as considerable as with radical innovations.

3.3. Competitive Performance

THE RELATIONSHIP BETWEEN DESIGN INNOVATIONS AND COMPETITIVE VALUE

The way good design contributes to a company's competitive performance has been frequently researched by scholars, and as we have seen in chapter 1, has been established thoroughly. According to Verganti (2009), the threads that connect an innovation to a company's economics and shareholder value are profits, assets and investments.

Innovations of meanings are a major source of *profit*, as they create unique value for people and therefore receive very strong demand and high sales volume. Also, when a product is meaningful people are willing to pay more than the pure utilitarian value they receive, allowing innovators to achieve much higher profit margins. Since value is generated both through the meanings and functionality dimensions, there is no need to overburden the product with powerful but expensive functionality in order to stand out purely from an utilitarian point of view. This is why, while customers are always available to pay a premium price for meaningful products, this strategy doesn't just apply to high end or luxury segments, but may on the contrary be especially successful when employed for inexpensive product categories where the meanings dimension offers an affordable path to differentiation.

Corporate assets, such as brand equity, are deeply affected by good design, since product languages and meanings intimately determine a user's experience and therefore have a direct impact on a company's image. This has a direct influence on the sale of the specific innovation, but also creates a halo affect across the

entire product line, generating additional and sustained profit. Many different activities in the company benefit from an improvement in firm image, further contributing to the profitability of the firm by reducing various costs and expenditures. At the same time meanings innovations are often associated with first mover advantages, such as allowing the company to impose its own rules and standards on the market, or obtaining feedback and knowledge on new meanings and technologies before the competition.

Finally, as we have seen, design doesn't require significant *investments* in financial terms. This means that a company will achieve higher returns on their investments and will be able to use monetary resources more efficiently. At the same time, this offers companies a sustainable market advantage as competitors will find it harder to replicate those non-monetary investments in order to catch up.

The combination of those three factors allows innovative companies to obtain substantial economic rewards, but more importantly, it elevates those firms to the position of market leaders in their sectors, either in terms of market-share or profit, and offers them strong and stable strategic positions.

THE QUESTION OF TIME IN MATTERS OF DESIGN INNOVATION

One of the complexities with measuring design's impact on a company's performance is the fact that the main contributions brought by design to the new product development process often lead the manufacture and sales of products by months or perhaps years, making it questionable to tie design's current performance to the current sales figures (Hertenstein and Platt 1997). This applies also when companies start the long and gradual process of implementing a new approach to design, as the results of those actions will take some time to emerge and will likely suffer a large time lag (Roy 1994): the company must go through an entire product development cycle under the new regime for its effects to be felt by the market.

At the same time we have seen how good design has long term effects, which remain stable over several years. Meaningful products have longer lives on the market compared to their competition and generate several virtuous cycles within the company that help it maintain its success over time.

For those reasons when examining the design innovation performance of a company it is necessary to assume a long-term perspective, and to examine the results across a wide temporal interval.

EFFECTS OF DESIGN MEDIATED BY OTHER ACTIVITIES

Finally, it is important to remember that the effects of design on a company's performance are significantly mediated by a multitude of other critical activities (such as distribution, procurement, quality management etc.). The success or failure of the entire company depends on the firm's ability to execute those activities correctly, however, while those processes are crucial mechanisms of the corporate engine, the fuel that allows the engine to run are ultimately its products. Those activities may be optimized to enhance the performance of the company's product portfolio, and can produce astonishing results when managed correctly (sometimes even with the help of design); but the benefits that those improvements may offer pale in comparison to the crippling damage that they may inflict upon a product's fortunes when not functioning properly.

Innovative products are not sufficient to guarantee a company's success, so the results of proper design alone, while necessary, are not sufficient to achieve firm prosperity (Roy 1994; Swink 2003). Leading companies must then consider the proper management of those activities a priority, and must explore all opportunities to unleash their full potential; at the same time though, successful firms must never forget that the foundation of their existence resides in their product portfolio, and in their ability of continuously innovating and refreshing it.

3.4. Context

The last construct of the model is *Context*. It refers to the effects that the sector of industry, or even the product segment, in which a company operates may have on its approach to design, and on the results that this approach will produce. Should a company producing industrial equipment use design in the same way as a furniture manufacturer? Is design as effective with intangible services, as it is with physical products?

Even among scholars of design, the idea that design may be applicable to all markets and industries has not been always supported. Peter Zec, the president of the International Council of Societies of Industrial Design, recently wrote in a book he published with Jacob Burkhard that: "of course there are branches of industry in which the significance of design is all but nil" (Zec and Jacob 2010, 104).
Others however argue quite the contrary, saying that "as with technological innovation, innovation in meanings occurs in every industry" (Verganti 2009).

Perhaps unsurprisingly, those two opposing visions coincide with a different underlying interpretation of design. Researchers adopting the "design as style" definition, seem to favor the view that design may be applicable just in certain sectors and product categories. While those who interpret design as *meanings*, support the other perspective.
Because of this difference, both statements are actually true, from a certain point of view.

This is a consequence of the fact that the three approaches to design we have analyzed in the *Investment in Design Strategy* construct actually have different

levels of compatibility across industry types.
The *Design as Style* approach, which limits the impact of design to the aesthetic qualities of a product, has the lowest degree of applicability. While certain categories of consumer products (such as furniture, clothes etc.) possess innate decorative characteristics and therefore benefit the most from the work of stylists and decorators, other kinds of products (such as industrial products, or even most services, like those belonging to the financial or health sector), will be minimally affected by cosmetic improvements and ornamental elements. In fact, decorative styling usually applies to products whose meaning is compatible with the projection of the user's self-image to the external world.
But even among those industries which are traditionally associated with style not all product categories necessarily support styling, and will receive minimal benefits from an aesthetically pleasing exterior: this is because their meaning does not require them to be primarily "beautiful" or "decorated" (think about furniture for technical uses such as electrical cabinets or server racks, or work clothes and jumpsuits).

Those limits fall as a company grows in its use of design. The more advanced approaches become gradually more relevant in all sectors and across all industries, because every product has a meaning. Extensive research has shown that the emotional and symbolic dimensions of consumption are important in all markets, even in industrial sectors, and that especially for services, the semantic dimension is even more critical (see Verganti 2009 for a comprehensive analysis).

Each sector however will reward the various characteristics of products in different ways. If design is divided into two categories, one relating to functional properties and one to experiential features, each product category will demand a specific balance between the two, which successful companies will have to choose accordingly (Gemser and others 2011 make this distinction, while others have used different categorizations of design but have made the same observation, such as Trueman and Jobber 1998). Most industrial sectors, for example, will favor the functional benefits that design might provide, but some value will always be associated with the experiential characteristics of those products.

Some authors have even observed that the payoff of an investment in design is greater when the use of design in the company's reference market is just emerging or is completely new (Gemser and Leenders 2001). Those industries offer the greatest opportunities in terms of differentiation and exploration of new concepts. Sectors which are traditionally design-intensive, where the practice of competing through new meanings is already mature and has been thoroughly exploited, will be harder to impress.

Another interesting result of past research is the fact that design thrives in technologically driven markets (Swink 2003). Technology does not exist by itself but requires to be brought into a complete product or service that the final user may experience. In many sectors, technical innovations remain insignificant and irrelevant until they are embodied by design into a meaningful product. Strategic approaches to design allow companies to manage technologically intensive sectors more efficiently, and to cope with fierce competition and uncertainty efficiently (Perks and others 2005; Swan and others 2005).

The main effects of the *Context* construct on the rest of the model become relevant only when a company is using the *design as style* or, in a lesser way, the *design as process* approaches. Firms at the *design as strategy* stage operate on products at a higher level, which is less affected by changes in context and markets.

4. Research Methodology

Having described the theoretical model and its constructs in the previous chapter, I will now present the methodology adopted during the development of this thesis, in order to prepare the reader for the following empirical data and its analysis.

Paragraph 4.1 is dedicated to the objectives behind this work of research, as well as the process which has been employed to create it. The following paragraph (4.2) will examine the methodology at the base of the case studies, as well as the tools employed. Finally, in paragraph 4.3 we will introduce the companies which compose the empirical sample and outline the characteristics considered during the selection process.

4.1. Research objectives and process

RESEARCH OBJECTIVES

The goal of this thesis is to expand the current knowledge regarding the value of design and the way this value may be successfully captured by companies. By building upon the vast body of existing research, I have proposed a model which describes how design should be managed, and the relationship between an investment in design and the company's innovative and competitive performance.

Empirical research has been employed to support the development of the theoretical model, and to provide initial verification regarding the validity of the emerging theory. With the model serving as the conceptual framework, we will attempt to test the primary hypothesis behind the theory, and verify the validity of its constructs.

The key research questions this work aims to answer are the following:

- *How does design create value?* Which mechanisms allow design to generate value for a company, and in what way do they allow a company to succeed in the market. Is the proposed model an accurate representation of the way design impacts a company's innovative, and competitive performance?

- *How should design be managed and implemented to allow a company to capture its full value?* The model proposes a new way of studying a company's investment in design, which is based on the adoption of design as a strategy, rather than as an asset. Three different approaches to design are presented, with a set of variables describing and identifying which approach a company is

adopting. Do those approaches accurately reflect the actual use of design by companies? Are the identified variables effective at describing and identifying the three approaches to design?

- *How does the context in which a company operates in affect its use of design?* The model is based on the idea that the most mature approaches to design will not be significantly affected by changes in the company's context, and that the strategy may be applicable to a wide spectrum of contexts. Do contextual variables impact the way a company adopts design and the results it should expect from this strategy?

RESEARCH PROCESS

The first step in the research process was to review the existing literature discussing investments in design and their effects of company performance. Findings emerging from previous empirical studies have been compared to the models proposed by the latest theories relating to *design-driven innovation* and *design management*.

An initial conceptual framework was developed, and six best-in class case studies were conducted, with the goal of assisting in the development of the emerging model. Case research is considered one of the most powerful research methods when building new theory in management studies (Eisenhardt 1989; Voss and others 2002). The use of cases was warranted by the nature of the research objectives, which mainly concentrated on questions of "how", and needed to be answered with a relatively full understanding of the nature and complexity of the complete phenomenon (Voss and others 2002).

The current use of design by the selected companies was studied, to identify the key variables involved in a company's use of design, and the relationships between those variables. The insights gained by examining those six leading companies were therefore combined with the theory and findings emerging from the existing literature, to generate an updated model describing the possible approaches to design and their effects on a company's performance[1].

[1] *see chapter 3 for a detailed description of the model and its constructs.*

Finally the work on the six initial case studies was expanded, to verify the validity of the proposed constructs and offering initial support to the new theory. Case studies have been found to be particularly well suited for testing theory pertaining to strategy implementation (Voss and others 2002), and were therefore appropriate tools for evaluating the model proposed by this thesis. The effects of investments in design were examined over time, and compared to the performance of the company's relative sector whenever possible, in order to determine the differential results obtained. The findings were then aggregated and examined in their entirety, to extract the relevant conclusions and insights.

4.2. Case study methodology

SAMPLE SELECTION

In accordance with established practice (Eisenhardt 1989; Voss and others 2002; Yin 2002), the sample of cases has been constructed through theoretical sampling, which is based on replication logic rather than sampling logic. The goal of theoretical sampling is to choose cases which are likely to replicate or extend the emergent theory (Eisenhardt 1989), with each case selected so that it may display similar results (literal replication), thus achieving convergence and duplication of evidence. This differs from traditional sampling in which the goal is to identify a population, and then to select a random or stratified sample from that population.

Some cases were selected with the additional objective of enhancing the generalizability of the theory: companies with sharply contrasting characteristics were chosen, in order to highlight the differences being studied, and extend the scope of application of the new model.

A best-in-class selection criteria was employed, so that information could be obtained about the most effective ways for a company to use design. This choice also allowed a level of theoretical replication, (the selection of evidence displaying contrasting results for predictable reasons), as it is possible to examine the differences between the selected companies and their competitors.
The decision to select best-in-class case studies is consistent with the goal of theory building (Voss and others 2002), and offers the greatest insight into the most sophisticated and recent design management practices.

SAMPLE SIZE AND TYPE

The size of the sample was chosen in order to allow the best tradeoff between depth of research and external validity.
All research was conducted through the use of secondary sources, seeking in each case for the largest possible number of resources to achieve triangulation and improve validity and reliability. Existing research, case studies, articles, documents and web sites were accessed and combined to build each case, specifically looking for information coming in the most direct possible way from the company or its employees. Whenever possible, past interviews with key actors in the product development process were used as the main reference during the study.

During the phase of theory building, the companies were examined by considering only their current approach to design, but as the study advanced to the theory testing phase, longitudinal research was conducted on all cases. This was done to observe the sequential relationships between the model's constructs, and test the long-term effects of the use of design, which had emerged as one of the hypothesis. Depending on the amount of available data, the companies were studied over a period ranging between a minimum of five to over ten years.

ANALYSIS

The case studies were analyzed following the established procedure of conducting two levels of examination: the first analyzing within-case data, and the second searching for cross-case patterns (Eisenhardt 1989; Voss and others 2002).

Once detailed case descriptions had been developed, the data of each case was coded in order to be separately studied. For each case, variables corresponding to the model's constructs were overlapped, and an analysis of the evolution of those variables over time was conducted, searching for patterns of data within every individual case, and recording significant observations and peculiarities. The relationships connecting the summarized variables were studied, in order to determine the effects linking the model's constructs. Finally, the goodness of fit between the observed data and the proposed model was determined for each case.

Next, the data from all cases was aggregated, in order to study the overall phenomenon. Arrays representing the entire model, and each company's behavior and performance within each construct, were examined. Cross-case patterns were searched, and the peculiarities of each individual case were compared to the rest of the sample to identify potential problems within the model, and draw additional conclusions. Similarly to what was done with the within-case analysis, a final overall assessment of the goodness of fit between model and data was performed.

VALIDITY AND RELIABILITY

Along the entire process, steps were taken to ensure the reliability and validity of the research.

According to Yin (2002), there are three measures of validity: construct validity, internal validity, and external validity.
Construct validity refers to the extent to which correct operational measures are established for the concepts being studied (Voss and others 2002). It has been addressed by:

- verifying that predictions made about relationships of each construct to other variables are confirmed;
- using multiple sources of evidence in order to achieve triangulation;
- and assuring that the measurement of each construct allowed it to be differentiated from another (discriminant validity).

Internal validity is the extent to which we can establish a causal relationship between constructs, which are clearly distinguished from spurious relationships (Yin 2002). It was confronted by employing pattern matching, and time series interpretation during the within-case portion of analysis. The most significant behaviors and changes of each measured variable were confronted with the results predicted according to the model across the entire interval of study, and explanations were searched in case of discrepancies.

Finally, the reliability of the study, or its ability to be replicated, has been guaranteed by the use of objective indicators whenever possible, and the use of

several information sources in order to reduce the risk of inaccurate observations which is associated with the use of secondary sources.

4.3. Sample selection and characteristics

SELECTION CRITERIA

During the selection process, companies were selected according to two main criteria:

- first of all, they had to to have displayed high levels of design innovation performance within the last five to ten years. The companies had to have been awarded with at least one, but ideally several, international design awards, and possess an established reputation as innovators in their industry. In all cases one radical innovation of meanings was identified prior to their definitive inclusion into the sample, to make sure that their use of design had already reached its maximum expression. For each company, design innovation performance was calculated by considering only *significant* innovations. The two categories of innovation intensity, incremental and radical, were divided into four subcategories: minor and major incremental, and minor and major radical. The choice was then made to select major incremental changes as the minimum level for an innovation to be considered significant, ignoring minor incremental improvements.

- The second criteria for selection was an explicit use of design. The companies were selected on the basis of their declared use of design, which they had to credit in their communications or marketing as one of the sources of their product performance.

Some contextual variables were considered while selecting the sample, in order to obtain a consistent but varied sample, which could guarantee good theory generalizability.

- *The size of the company* – to minimize geographical effects, the choice was made to select only multinational corporations, with operations in several countries and a global reach. While remaining within this limitation, the sample was constructed in order to represent a wide spectrum of company dimensions: from small (less than 100 million euros and few employees), to very large (several billion euros and thousands of employees).

- *Main industry* – given the limited number of case studies, a main area of applicability of the model had to be identified. The choice was made to select companies producing primarily physical products for use by end-users as the core of the research sample. Beyond this general condition of applicability, no other restriction has been placed on the nature of the sector in which the company operates. A portion of the sample was chosen to purposefully violate in some way the limits imposed on this contextual variable, in order to extend the generalizability of the theory to other areas, such as service companies and B2B companies.

- *The technological intensity of the sector* – this contextual variable measures the extent to which the technological characteristics of the products impact its final performance as perceived by the end-user. The consumer electronics industry, and the food and beverage sector, represent examples of technological intensity which is respectively high and low.
This characteristic is meant to distinguish between sectors based on the customer's perception of the product's innovative dimensions. When the technological intensity is high, the customer might attribute greater value to the functional dimension of innovation, rather than to the meanings dimension, therefore possibly reducing the effects of design on product performance. This parameter should not be confused with other measures such as capital intensity, as certain sectors may display high capital intensity but a low perceived technological intensity. This is the case with some service industries, where the cus-

tomer perceives a low technological intensity but high investments in capital and technology might be necessary in order to provide the service.

The sample was chosen in order to provide a uniform distribution among high, medium, and low technologically intensive markets.

SELECTED COMPANIES

Table 4.1 presents the sample of selected companies and their main characteristics in the relevant contextual variables.

Company	Revenue Range €M	Employee Range	Main Industry	Tech. Intensity	Selection Logic
Technogym S.p.A.	<500	>1500	Training Equipment B2B/B2C	M	Replication
KUKA AG	>1000	>7000	Industrial Robotics B2B	H	Extension (Industrial)
Tesla Motors Inc.	<500	>3500	Automotive B2C	H	Replication
Dyson Ltd.	>1000	>4000	Household Appliance B2C	M	Replication
Facebook Inc.	>3000	>4500	Internet Services B2C	L	Extension (Service)
Kartell S.p.A.	~100	<100	Furniture B2C	L	Replication

Table 4.1: the sample of companies and their characteristics.

Four companies were selected according to replication logic, with the goal of achieving similar results and validate the constructs and results. Those companies all belong to sectors producing goods for end-users and display at least one instance of all the possible characteristics of size and technological intensity. Those companies are Technogym S.p.A., Dyson Ltd., Kartell S.p.A., and Tesla Motors Inc.

Two of the companies were instead chosen with the goal of extending the validity of the model across different variables.

KUKA AG was selected to represent companies operating in industrial sectors, with other business as their main customers. The B2B characteristic is also partially represented by the Technogym case, which sells its products to other companies operating in the fitness sector, but whose products are finally used by private individuals.

Facebook Inc. was instead chosen to represent firms offering services rather than material products.

5. Case Studies

I will now present the six cases in their entirety, reporting all of the observations relevant to the model's constructs.

Each case will be structured in a similar manner. I will start by introducing the company's context and design innovation performance: examining its history since its foundation and describing the most interesting products the firm has created. Next, I will characterize the way the company approaches design, by breaking down its design management practices in order to identify how the organization scores in each of the model's variables. Finally I will report measures of the firm's competitive performance over the last several years.

At the end of each case I will summarize its principal characteristics and conduct a first interpretation of the results, anticipating the main cross-case analysis which will be described in chapter six.

A.

A.1. Design innovation performance and context

Technogym was founded in 1983 by Nerio Alessandri, a 22 year old industrial designer, who began building exercise equipment in the garage of his home in Cesena, Italy.
The 80s had seen the explosive diffusion of the then somewhat niche culture of bodybuilding, which had inspired a gym opening craze and the development of the first practical training machines.

Figure A.1: Nerio Alessandri's garage in 1983, and the Technogym Wellness campus in 2012.

Technogym's goal was to create products for everybody, going beyond gym enthusiasts and bodybuilders, and reaching a much wider market: from women to seniors, from casual sportsmen to serious athletes. Training machines, then a rarity in most gyms, had the potential to allow this, making weight training a much more approachable practice.

The first product family was called Isotonic, a line of basic variable resistance strength equipment, which was followed by Executive Line, that integrated specific rehabilitation features into the machines. Those were spartan machines, which allowed training of specific muscle groups and represented the first step from free weights to the sophisticated machines of today.
Despite their crudeness, the machines were less intimidating than dumbbells, and allowed people to lift light weights easily, which was perfect for beginners.

The first breakthrough came a few years later, in 1986, with the introduction of a completely new design: Unica. It was the first multi-function home trainer, allowing a user to exercise in 25 different exercises in less than 1,5 square meters.
This product opened the doors of weight training to a whole new market. It was

now possible to have a complete gym directly at home, and even smaller public spaces such as offices or hotels could rapidly equip themselves with an entire set of weight machines.

Technogym was among the first companies to recognize that bodybuilding was now being surpassed by a bigger movement: fitness, which appealed to the wider audience of those who wanted to train to look good and improve their athletic performance.

In 1988 Technogym created CPR (constant pulse rate) technology, a self adjusting workload system capable of adapting in real time to the user's heart rate in order to maintain it within an optimal range. This new technology was rapidly integrated into new product lines, like Bikerace and Rowrace, as well as into existing ones, opening the doors to the adoption of Technogym products by a wide variety of athletes just starting to train with machines.

The ‘90s saw the continued expansion and consolidation of the entire product portfolio. Five years of research collaboration with the Massachusetts Institute of Technology culminated with the launch in 1992 of REV, a line of sophisticated isokinetic machines for rehabilitation, leading the way to the creation of a new company division dedicated to the medical sector. In 1995, came Spintrainer, the first cycling training system that could be mounted on a real bike and simulate real road conditions.

The company also pioneered the use of software in gym and training products. In 1996 it introduced an innovative gym management software called Technogym System: it used a digital key that gym clients could insert into each machine to personalize their training and to keep track of their progress, allowing gym owners to revolutionize the way they managed their clubs.

This is when Technogym developed the concept of Wellness. Fitness was about the hedonistic pleasure of being physically attractive, it resonated significantly with a portion of the population but it intimidated and shunned the larger percentage of the market. Instead of just focusing on the body, Wellness would be about both physical and mental well being. Improving the quality of life through “regular physical activity, a balanced diet and a positive mental attitude”. Every-

body could relate to Wellness, across all ages and physical conditions.
The company embraced this concept in 1992 by changing its slogan to "the Wellness Company", and redirecting its research and development efforts towards bringing this vision to life.

A few years later Technogym was nominated as the official supplier of athletic training equipment at the 2000 Olympics in Sydney, the coronation of a long history of sponsorships that ranged from Formula 1 racing teams to top football clubs and national soccer teams. Since then the company has been an official supplier for numerous other Olympic Games, including Athens 2004, Turin 2006, Beijing 2008 and, most recently, London 2012.

In 2000 the company also took one of the first steps towards Wellness: the Selection Line was launched, and quickly became one of the most popular strength training lines for gyms in the world, thanks to its uncluttered appearance and ease of use. The machines hide most of the mechanisms and pulleys, have comfortable cushioning on the seats, and simple adjustment levers which are rapidly identified by their bright yellow color. Brief and clear instructions are inscribed on each machine, telling the user how to exercise correctly and showing which muscle groups will be affected. The machines are not just easier to use, they are safer than free weights and only allow the user to make controlled movements, reducing the risk of injury.

Designed with a broad audience in mind, they are much less threatening than a long stack of heavy weights, or than other machines, with their complex machinery and ominous appearance, and this has been the key to their success. Gym owners bought the new machines after noticing how their customers chose them over other equipment, and how they attracted a wider crowd to the gym. New groups of people started training, and participation by women grew especially, becoming the majority of the gym going market. In the U.S., the leading market for exercise equipment, the percentage of the population training regularly, which had been stagnating and decreasing during the 90s started to grow again, reaching 35% in 2002, up from 20,5% in 1999 and 23,3% in 1990[1].

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[1] *according to a study by the Sporting Goods Manufacturers Association in 2004, titled "Sports Participation in America 2003".*

Integral to the birth of the concept of Wellness had been Technogym's correct prediction and interpretation of the home training trend. Families demanding to train at home with the same quality and technological standards of a gym. Wellness, as an all around philosophy of living well, was the perfect response to this market development, so the company continued working on products that could materialize this new way of exercising.

The company worked intensely on its home training product roadmap, and in 2004 it introduced an entirely new workout method called Kinesis, a multipurpose training machine based on cables and a spring resistance that allows more than 200 different exercises without any adjustments.
The new product, designed in collaboration with Antonio Citterio, has been critically acclaimed, and described as a major innovation in training systems both by the sports equipment world, as well as the design world, which presented Kinesis with a Red Dot product design award, and an honorable mention by the Compasso d'Oro jury.

KINESIS: THE UNION OF WELLNESS & FITNESS DESIGN

The company went back to the basics of training, to decide which kind of movements and exercises could be associated with the Wellness concept. Traditional strength training focuses on guided, isolated exercises, but the new products would require more complete and harmonious workouts. After some research, the team finally settled on functional training: an exercise method that originated from rehabilitation and involves training the body for the activities performed in daily life through free movement and full body workouts.
The choice of functional training meant that the product would necessarily have to be a multi-exercise machine. It would have to allow training of a wide variety of muscles, but at the same time occupy as little space as possible to be suitable for home use.

But the design team had another important intuition. Simply transplanting the look and feel of gym equipment to the home would not work: a new product language had to be developed to match the environment

those products would inhabit. The product would need to adapt to any kind of space, and not feel out of place even when installed in the owner's living room.
This would be the birth of what is now called "fitness design": for it to be placed in a home, the product must become a piece of furniture, and not just a machine for training muscles.

This is why the company decided to look for an external designer that could bring the needed furniture design experience to the company. The choice fell on Antonio Citterio, a furniture designer with interior and architectural experience, whose works have been selected for the permanent collection at MoMa, and that has been awarded the prestigious Compasso d'Oro Award twice. The decision was also made to introduce the final product at the Milan Furniture Fair, to further underscore the change of positioning for the new product.

"TechnoGym [offers] the first design fitness 'furniture' for the living room or other rooms in the house. It is not bulky and does not get in the way while moving around the house. It actually adds something to the interior of the house. It's even a great addition to the office!"

Nerio Alessandri

The combination of those two concepts, functional training and "fitness design", resulted in a multipurpose training tool called Kinesis, that allows more than 200 different exercises without having to make any adjustment. The product introduces what the company calls the "Full Gravity System": a pivoting pulley and cable system which provides smooth movement in all dimensions, allowing total freedom of motion. The resistance applied to the cables is regulated by a sophisticated patented system that increases the force in a gradual way that is completely quiet and safe for any user. The workload can be selected with just one touch of a rotating dial which circles the small display that indicates the current resistance level (ranging from values of 1 to 20): no weight stacks to be adjusted or complicated settings.

Kinesis is the ultimate in designer furnishing for home fitness. It liberates the user from complicated setups and machinery by hiding the main mechanisms, and by giving the user complete freedom of movement.

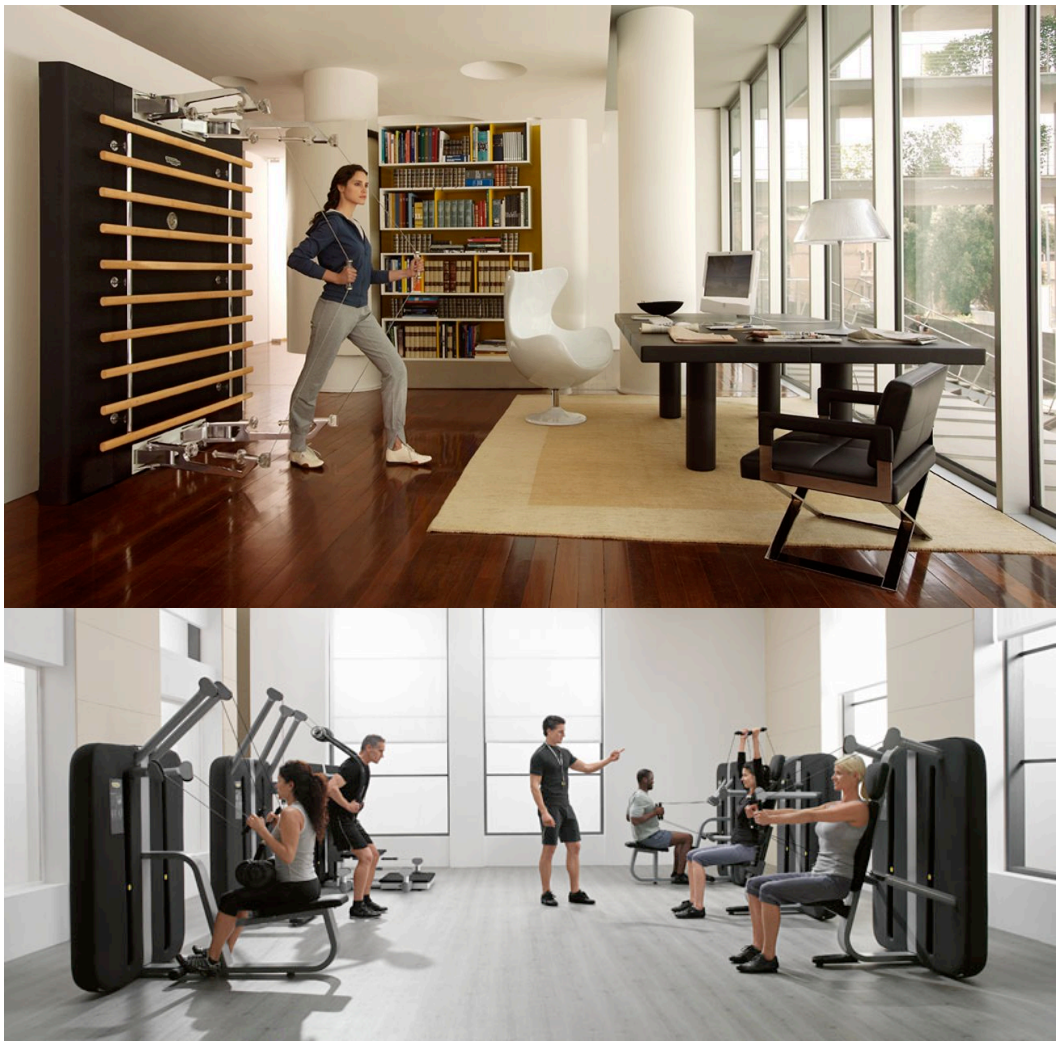
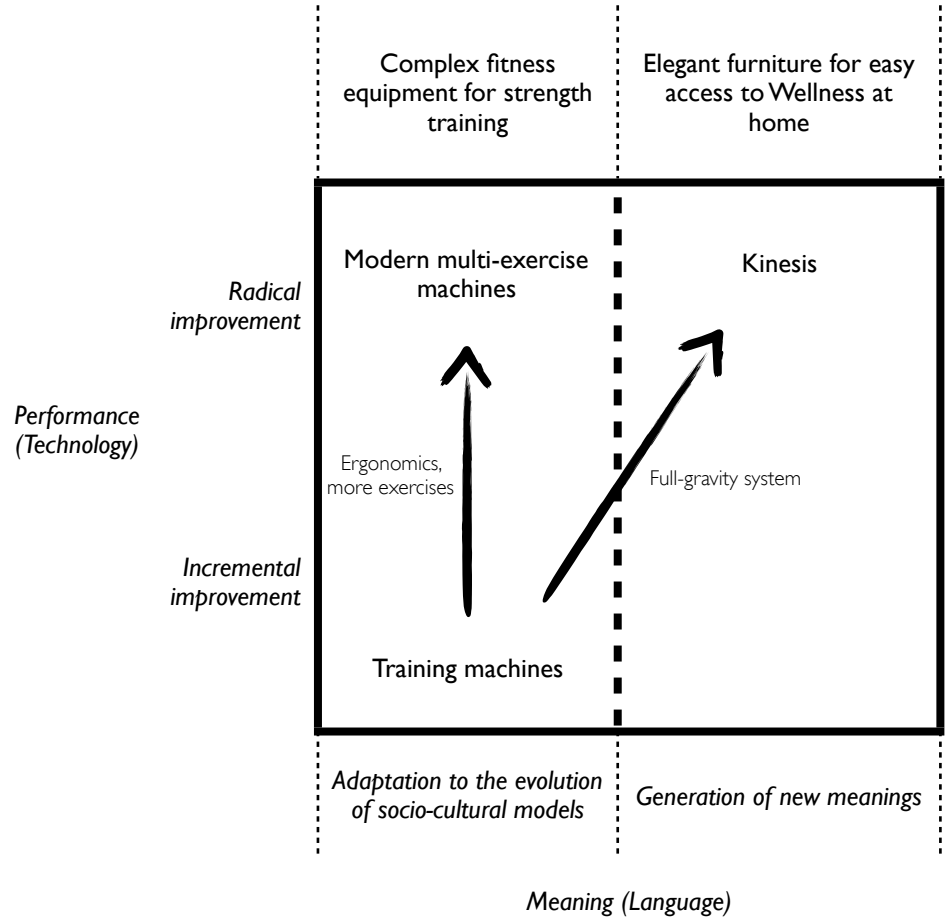


Figure A.2: Kinesis Personal, for home use, and Kinesis Stations, for gyms.

It allows combined movements that work several different muscles synergistically at the same time, returning its owner "to the origins of human movement, freeing [him] to re-discover the four fundamental physical abilities: endurance, balance, strength and flexibility."

"Kinesis provides a unique workout that restores the right balance between mind and body, thereby helping to improve your quality of life."

When not in use the machine almost completely disappears into the wall, becoming a piece of furniture or an object of decoration that can adapt to its surroundings naturally. The company even offers several variations of materials and styles to better conform to the client's home. Kinesis can be covered with a mirror, leather or wood, with each version modifying the appearance of all visible parts of the machine to complement the surface type, and giving it a precious and elegant look and feel.



Kinesis combines a radical innovation of meaning with a radical innovation of technology. It redefines what training is about, shifting from Fitness to Wellness, while reshaping the training machine and transforming it into a piece of furniture. To enable those new meanings, Kinesis introduces the innovative "Full Gravity System", to fulfill the Wellness vision by allowing freedom of body and mind, with synergic exercises and no setup.

> *"This is a total change and a shift in perspective from machines that convey an idea of sacrifice, to a machine that expresses an idea of pleasure."*
>
> *Antonio Citterio, designer of Kinesis*

In 2005 the company introduced Crossover (called Wave in its original incarnation), a new kind of cardiovascular machine characterized by an innovative body

motion similar to skating, which activates more muscle groups than traditional machines and improves coordination and balance. The new product was nominated for the FIBO innovation award, and won the Innovation Award of Professional Wellness.

In the next few years the company launched three new lines of gym machines, with each receiving a prestigious award for its design.
The first two, FLEXability and Easy, extended the wellness concept to new market segments. FLEXability, launched in 2007 and awarded the Red Dot design award, is designed for training and improving flexibility through guided stretching exercises, making them intuitive, safe and accessible to all. While the Easy Line, included in the ADI Design Index, is a set of machines with light resistances that help beginners, injured, and overweight people take the first steps in training their muscles and lose weight.
The last line is called Pure Strength: a set of muscle training machines that takes the opposite approach to all other Technogym products. It's aimed exclusively at serious athletes, and relies on the user to manually load weight plates onto the structure. The machine's levers and struts are left bare and in plain view, taking center stage and giving the product a very distinctive look which has earned the company another Red Dot Design Award.

The company's collaboration with Antonio Citterio has continued, producing two other successful home products: in 2009 the Run Personal, a treadmill for home use, and in 2011 the Recline Personal, a recumbent bike. Both products blend Technogym's characteristic "Fitness Design" aesthetic with its newest entertainment system, called VISIOWEB. These products' design language follows the approach pioneered with Kinesis, relying on the use of rich materials such as glass and aluminium to create clean and elegant devices, which fit into almost any interior. The design of both products has been recognized with Red Dot Awards, among many other prestigious accolades, such as the ADI Design Index Award, and IDEA Award.

Figure A.3: the VISIOWEB entertainment system and Run Personal.

As well as having all the technical features one would expect from high end training machines, those devices feature a generously large touchscreen which allows users working out to operate the company's own entertainment system: VISIOWEB. This touch-screen platform offers Internet access, television and games, as well as planning of the training regime and feedback on current performance. Technogym designed a custom user interface which is kept as intuitive as possible and features enlarged buttons which can comfortably be used while exercising. Easily accessible docks for connecting USB devices, such as an iPod or iPhone, allow users to load their own content into the system.

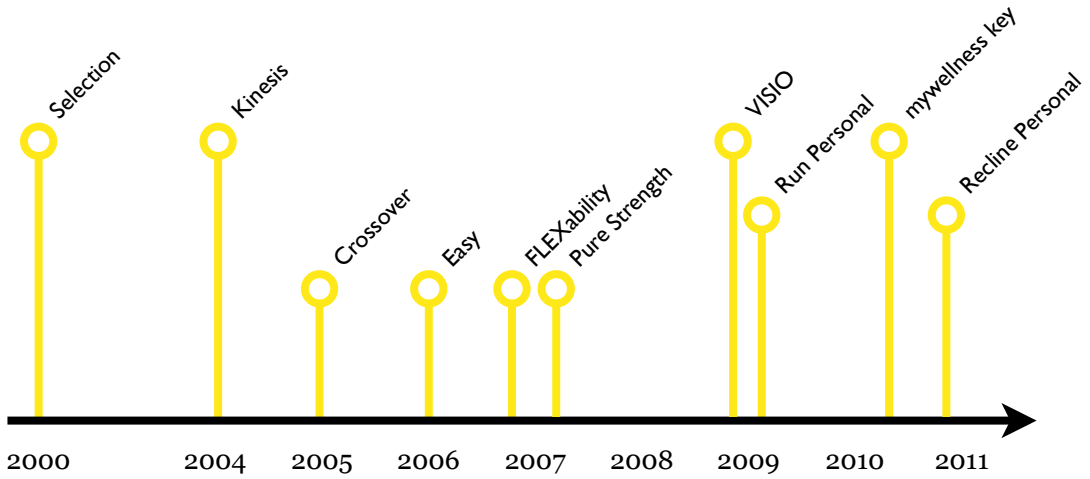
Technogym's high tech approach to training machines is unique in their industry. While its competitors focus almost exclusively on the purely mechanical aspects of their machines, Technogym has always focused on providing users with complete product experiences, by focusing also on the use of electronics and software.

Recently, the company has given a big refresh to its gym management software, which is now called "mywellness cloud". The update gives gyms powerful tools to manage its machines efficiently, as well as ways to offer superior services to their clients by keeping them motivated and engaged. Every client is given a digital key which contains their personalized training program, with specific interactive instructions and coaching. The system also keeps track of their progress and goals automatically, creating leader-boards, challenges and competitions within the gym. The system is fully integrated into the VISIOWEB interfaces of the

machines, and can be accessed by clients through all of their personal devices when at home or on the move.

Figure A.4: a Selection Line machine (left), and the mywellness key (right).

The company has also created a more advanced version of its fitness tracking key, called "mywellness key". It works just like the other keys which gyms use with the mywellness cloud system, but is worn at all times by the user, and measures every movement made throughout the day, providing immediate visual feedback on the amount of daily physical activity through a simple e-ink display on the device itself. A progressive white bar fills up as the user reaches his daily activity goal, motivating him to choose a healthier and more active lifestyle.
Mywellness key was the first device of its kind on the market and received the prestigious FIBO Health Innovation Award in 2011.



Technogym's last decade of design innovation performance

A.2. Investment in design strategy

Technogym has pursued its strategy of innovation by investing every year around 10% of turnover in research and development activities. The company's R&D center employs a diverse group of engineers, designers, sports medicine experts and orthopedists, comprising 15% of the more than one thousand seven hundred Technogym employees.
Located in the small Italian town of Gambettola, the research center consists of three departments: technical research, medical research and product design.

"The real force behind Technogym's growth has always been 360 degree innovation. Innovation includes having vision, dreaming - thinking of becoming the Wellness company of the world - but it also includes the small things, innovating day by day. This approach to innovation is our company culture. It means listening to our clients, placing them and their needs as our top priority at all levels of the company, and at the same time it means we must anticipate, predict, always be slightly ahead."

Nerio Alessandri

WHAT DESIGN IS

According to Alessandri, a good designer "has to know how to interpret the values, the mission, vision and strategy of a company, and be able to create an identity using shapes, colours, and by interpreting the identity of the product itself."

Technogym's approach to design has always been driven by its vision of what training and exercising should be, with the goal of constantly anticipating the market's needs.
When in the '80s Body Building was the trend, the company was already projected towards fitness; when Fitness exploded on the market the company had become "the Wellness Company", the first firm to propose this new philosophy as a new way of life.

"Our customers look for a solution. Technogym doesn't sell products but it proposes a solution, a philosophy, a way of life that we have called Wellness."

Nerio Alessandri

A part of the R&D activity is dedicated to the identification of medium-long term opportunities, concentrating on the analysis of possible future evolutions of the market and on the development of new product concepts. Those processes have been responsible for the company's successful interpretation of new meanings and future trends such as those of Wellness and Fitness Design, and have been used to guide the product development efforts towards the concretization of those concepts.

"Our philosophy dictates that when a product works, it's already obsolete. You must always look forward. You compete by always innovating faster and betting on additional services, like technical and design consultancy. It's important to focus a lot also on research, keeping an eye on both the short and the long term. For us, innovating means anticipating needs."

Nerio Alessandri

At Technogym, this is the starting point for the creation of a new product: identifying the new meaning that needs to be addressed.

For Technogym each product is a piece of art. We consider a product like a sculpture, a painting, an object of decoration and design that must integrate in the best possible way with its surroundings.

Nerio Alessandri

***What** design is*	Style	Product Development and Innovation at large	Meaning

HOW IS DESIGN USED – THE ROLE OF DESIGN IN THE NPD PROCESS

The product design division of the research center is responsible for new developments, and is organized into multifunctional teams. The other two departments of R&D, focusing on technical and medical research, are responsible for identifying new opportunities for future products, as well as providing the design teams with the necessary knowledge and skills to effectively develop and test new products.

Technogym gives designers the role of determining the initial product concept, and of guiding it through the development process.

The company has created a set of design guidelines called the "Human Centric Ap-

proach", which is characterized by focusing on the "Experience Flow" of each product, and its three levels of user interaction.
Let's use Kinesis as an example of how the three levels are used:

- the first level of user interaction is the interface – in the case of Kinesis it's the handle connected to the wires (which have been created and studied in conjunction with the medical research division), and the simple display which allows the selection of the desired resistance (engineered by collaborating with the technical division);

- the second level of user interaction is the product – every detail has been designed to express simplicity and ease of use, and all mechanisms have been hidden;

- the third level is the environment – Kinesis is designed to be placed directly in the living room of the customer, and has been therefore designed accordingly, using materials, colors, lines and veneer appropriate to its final surroundings.

Design's role in the development process is therefore a very central one. It occupies one of the most important seats in the product team and, while all of the company's products are the result of a collaborative effort of all of the team's members and respective functions, design is usually the driving force that leads the development process.

"Regarding their design, those are real machines, in the sense that as "machines" they demand a very complex engineering phase that requires a lot of time and ingenuity. However, technology is never a limitation, but rather an opportunity.

Antonio Citterio

***How** is design used: the role of design in the NPD process*	Function	Multifunctional Team Member	Process Leader

In 1998, Alessandri has reorganized the company around formal processes in an effort to grow the managerial capabilities of the company, which had until that point maintained its original entrepreneurial characterization.

A more well-constructed structure was implemented, providing the necessary managerial skills and spreading the company responsibilities, in order to continue the company's trajectory of growth and development. Alessandri strongly believes this was a necessary evolution, which gave the company a better way of monitoring its performances, maintain its schedule and deadlines, and adopt methods of continuous improvement.

The process of development has also been codified and regulated through a strict linear procedure, with distinct phases followed by verification and control of each output.

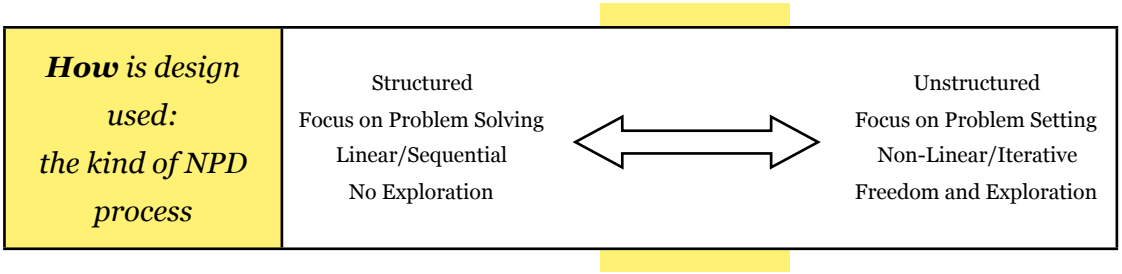
The first phase consists in the ideation of the product concept by the product design team and the company's management. This is the most creative phase, and the one which sees the most freedom to explore new ideas and possibilities.

The product development process then proceeds through a phase of in depth medical and technical research. This is accomplished both with internal research at the company's R&D department as well as by leveraging Technogym's vast network of partners, suppliers and external entities.

Once this phase is done, the engineering phase begins, with the creation of multidisciplinary teams, in which the varied figures that compose the research department come together to finalize the product. Engineers offer their competences to the designers, enabling them to bring their concepts to life, but also offering additional opportunities and solutions that may modify the product profoundly. The synergy between different skills is the necessary foundation to Technogym's product performance.

Finally the products are thoroughly tested for endurance and reliability, as well as for ergonomics and ease of use. The company adopts a combination of mechanical stress tests and field observations, such as focus groups, to ensure that the

final iteration of all products conforms to the required high standards of usability and quality. The company's products are also often tested within the company's Wellness Centers, where employees can train and give feedback on new machines.



WHO DESIGNS

The company has built its culture around innovation, in an effort to instill at all levels of the organization the drive to constantly improve and always create better products for customers.

"Innovation is company culture. Because, contrary to technology, it's something you can't buy or improvise."

Nerio Alessandri

The use of teams for product development encourages members of all functions to contribute to the innovation process and spreads the company's sensibility towards design among a wide percentage of the company.

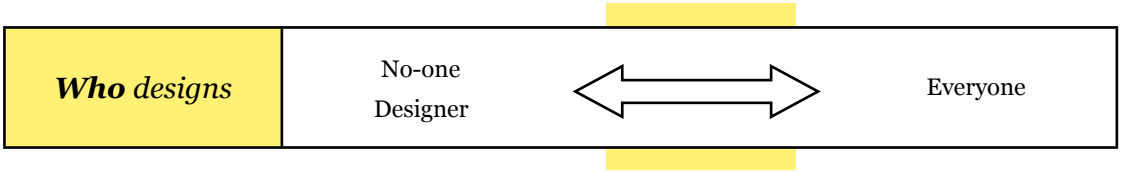
Nerio Alessandri himself, who before founding the company had been studying as an industrial designer and was the sole designer of all of the firm's first products, has an active role in product development and a clear passion for design. Even his business card doesn't say President: "I see myself as a wellness designer," he says.

"I aim to create a complete way of life ensuring the details fit as, eventually, the little things make the difference. A masterpiece is, after all, made up of details."

Nerio Alessandri

The design output of the company, however, appears to be mostly generated by the upper levels of the company, by the designers of the "Centro Stile" and in some cases by external consultants and collaborators (such as in the case of Antonio Citterio), with just few opportunities for the lower levels of the strict hierarchical structure to participate in the design process.

But this is something the company is attempting to change and improve with its relocation into the new company headquarters, which consolidates Technogym's 14 existing facilities into one. It features a much more "open" atmosphere and a structure that purposefully resembles that of a university campus, rather than an institutional building: with common areas for all employees to share, attractive relax spaces and restaurants, beautiful gardens, and, obviously, a huge gym where everyone can show up at any time.



WHERE DESIGN HAPPENS – DISTANCE FROM TOP MANAGEMENT

"For years I've been sustaining that architecture and design in a product are inexistent unless they come to life thanks to the alchemy between an entrepreneur and an architect or designer. Therefore the role played by a good entrepreneur is fundamental to the quality of a project."

Antonio Citterio

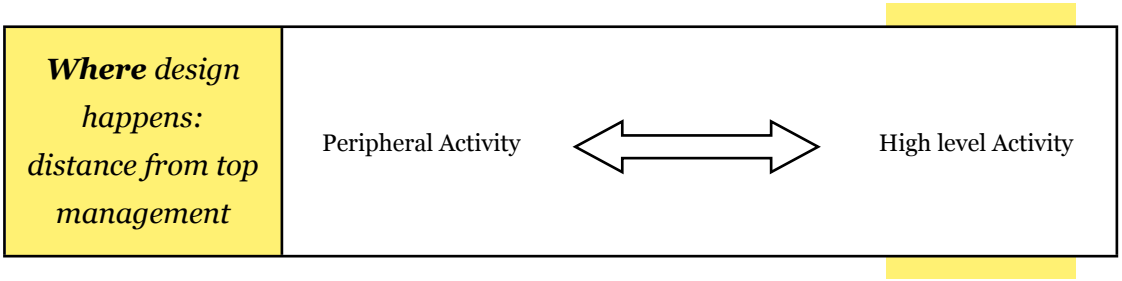
As we have seen, Alessandri is directly involved in the product development process, and even more so, he has been the man behind the company's vision of Wellness (reshaping the company's strategy 10 years after founding it), and has infused his passions and philosophy into the entire organization.

He has also been responsible for choosing and personally maintaining the lasting relationship between the company and Antonio Citterio, which he first approached to construct the new headquarters, and finally ended up collaborating with on some of Technogym's most striking products.
The relationship has grown to the point that today Citterio is considered part of the internal Technogym design team, and one of the leaders of Technogym's future

product developments.

"The role of the entrepreneur is to be able to anticipate the user's needs and to invest, and risk, in innovative projects"

Nerio Alessandri



WHERE DESIGN HAPPENS – DEGREE OF CONNECTION TO THE "INNOVATION NETWORK"

Today, Technogym directly realizes internally only the most critical production phases, and mostly assembles the components purchased externally from several partners. These partners are therefore very important to the company, as many of them share competencies and know-how with Technogym and have been partners since the establishment, constituting an important support for product development.

For this reason, Technogym has always had a strong interest in the development and valorization of the local industrial net, investing significant resources in the promotion and growth of this new industrial district, which the company has named the "Wellness Valley".

The company's new headquarters, called the "Wellness Village", has been created with the explicit goal of becoming the epicenter of this new industrial district.

"This facility has been built for the entire industry, not just for Technogym. If the industry grows, then Technogym will grow too. We hope to have 25,000 visitors each year."

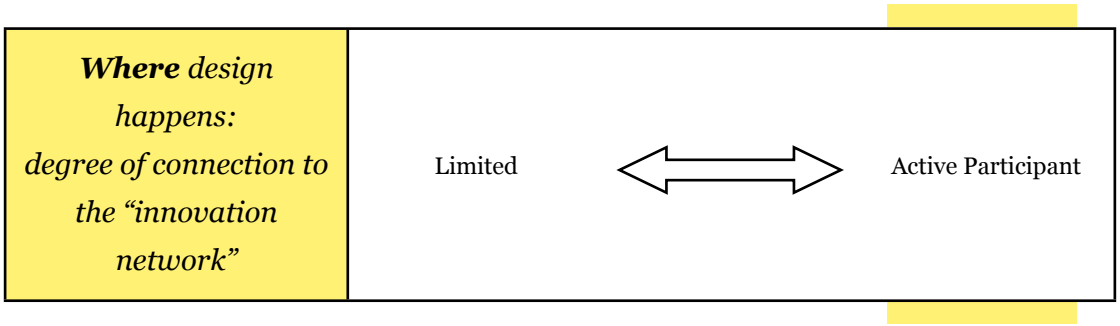
Nerio Alessandri

It even contains the world's first "Wellness University", which will tap the expertise of Technogym sites around the world to offer training to both industry professionals and customers.

Every Technogym product requires in-depth medical and technical knowledge, so the company has forged partnerships with leading international entities to complement its internal capabilities, and constantly assimilate the most cutting-edge advancements available.

On the medical side of things, the company has set up a Scientific Advisory Board, consisting of figures from the world of academics, medicine, and science, that guide the company directly, while at the same time forming tight relationships with external entities such as the IHRSA (International Health, Racquet and Sportsclub Association) and many leading sports organizations.

To supply supplemental technical expertise, in addition to various other partners (such as Apple for iPod/iPhone integration), a strategic partnership and joint venture, named Technogym Japan Ltd., has been formed with Sony in 2003, assisting in the integration of electronics into new products.



WHEN DESIGN IS USED

"Design is first of all research, it's not something that you just add, a superfluous adornment. One shouldn't think that when those machines are created the designer works on the form while leaving the contents to the engineers; in the team various different profiles act together to reach a common goal: an object in which form and function converge. The belief that leads to think "finally, here comes the designer to give the object some beautiful lines" should be discarded; all products are designed, only some designs are good - because there is substance behind them, they aren't just empty shells - while others are bad, but they are always the result of "design", that has been more or less successful."

Antonio Citterio

The company makes use of design at all stages of the NPD process, and especially during the critical early stages in which the scope and concept of the product are decided.

But the company also extends its use of design to the creation of its future vision

and strategy, displaying the characteristics typical of the most advanced approach to design.

***When** design is used*	End of NPD process	During the NPD process	Always

WHY IS DESIGN USED

Technogym's use of design has been shifting over the years from focusing exclusively on physical products, to a more holistic approach.

"Wellness entails not only equipment, but software, content, environment, education, and experience––but, most of all, experience. The fitness industry is composed largely of equipment; the wellness industry consists of models and solutions."

Nerio Alessandri

Ever since its introduction of the Wellness concept, the company has started this process of giving design a say in most of its activities. Examples of this have been its steady hiring of software and web designers to work on its user interfaces and websites, its attention to the design of booths at conferences and events, as well as the decision in 2000 of creating a completely new integrated HQ for the company with the help of Citterio.

The Wellness Village was inaugurated in 2012, and was inspired by the same design principles and philosophy of the company's products, bringing the idea of health and wellness to the workplace.

***Why** is design used*	Product ⟷ Everything (Holistic)

A.3. Competitive performance

Since its inception in Cesena, the company has expanded into a multinational business, with 13 branches worldwide, and exporting 90% of its turnover to more than 100 different countries. Technogym today has more than 55,000 installations worldwide, in 35,000 wellness centers and 20,000 private homes, with estimates suggesting that approximately 20 million people use its products every day.

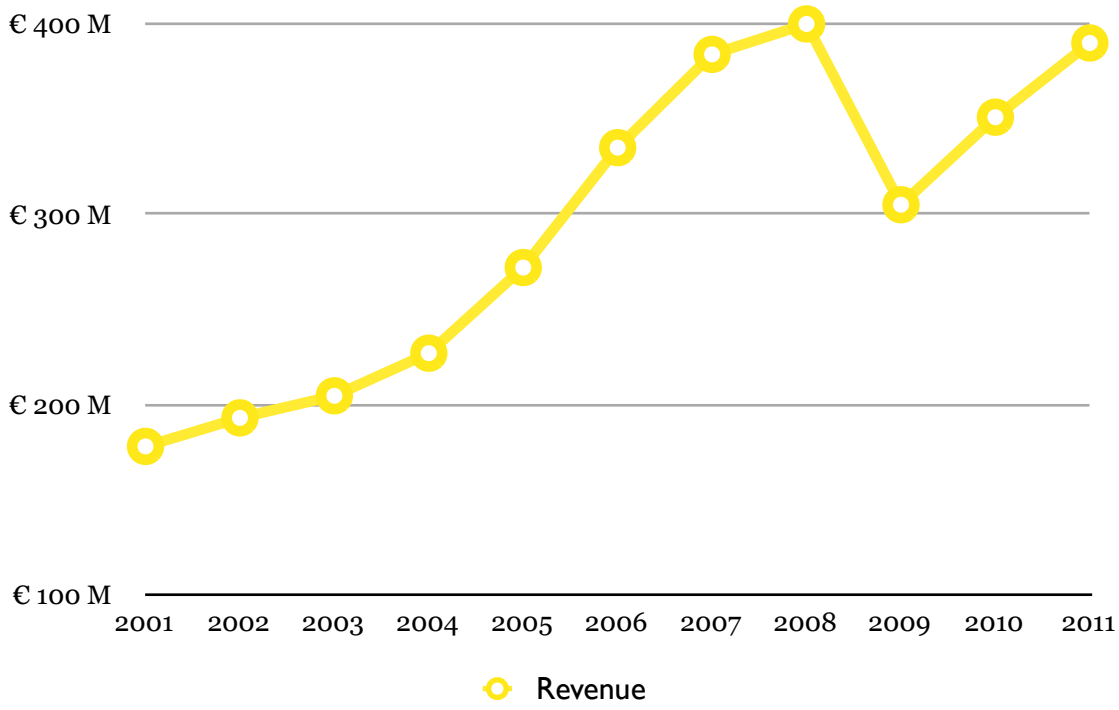
GROWTH

Those numbers have been achieved through a steady double-digit growth over the years, that has led the company's sales to more than quintuple in the decade between 1998 and 2011, to reach over €390 million. During that period the CAGR for the company was 16,8%, a staggering number, especially when compared to the 2,3% growth the global sports equipment sector has registered over the last 5 years[2].

	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Revenue €M	178,3	193,9	204,6	227,8	272,8	335,7	384,5	400,4	305,8	351,6	390,1
Y/Y change	–	8,7%	5,5%	11,3%	19,8%	23,1%	14,5%	4,1%	-23,6%	15,0%	10,9%
Global Sports Equip. Market €B	–	–	–	–	–	–	44,6	45,5	46,1	47,5	48,9
Y/Y change	–	–	–	–	–	–	–	2,0%	1,3%	3,0%	2,9%

(Source: AIDA)

[2] *source: Marketline.*



The company, along with its main competitors, was hard hit in 2009 by the financial crisis, and lost almost 25% of its sales, the first year of decline in most of the company's history, caused in large part by the precipitous decline in the US fitness equipment market, which represents a large portion of global turnover. Since then, however, growth has resumed steadily, and in 2012 the company is expected to surpass the 2008 record of over €400 million.

One of the reasons the company was so affected by the financial crisis, is the fact that it operates at the high end of the market (especially in the home sector), with significantly higher prices than the competition. In order to react to the recession, the company has had to reduce its prices, impacting slightly its product margins. The EBITDA margin still remains slightly below 15%, indicating a high profitability compared to the rest of the market.

	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
EBITDA	30,5	33,4	31,9	36,1	46,5	57,3	58,5	59,8	41,5	50,3	55,1
Y/Y change	–	9,6%	-4,6%	13,0%	29,0%	23,1%	2,2%	2,2%	-30,6%	21,3%	9,6%
EBITDA Margin	17,1%	17,2%	15,6%	15,8%	17,1%	17,1%	15,2%	14,9%	13,6%	14,3%	14,1%

(Source: AIDA)

The company has also been substantially investing in its human resources and facilities. In addition to its new 40 million euro headquarters the company has more than doubled its employees from less than 800 in 2002, to almost 1800 in 2011, adding 15% of those in the last two years alone.

CORPORATE ASSETS

Those values place Technogym as the first training equipment company in Europe and the second worldwide.

The company has also been repeatedly selected as Official Equipment Supplier for the Olympics, and its devices are used in some of the major gyms and top sports clubs, such as A.C. Milan, the Ferrari Formula 1 team, the Alinghi Sailing Team and professional tennis player Rafael Nadal.
This has given the company phenomenal exposure, and, in conjunction with its superior product performance, has established the company as one of the leading brands in the sports equipment market.

"We feel we have no competitors – Technogym is the only company able to provide a total wellness solution made of not only equipment but also, apps, devices and contents, interior design services, training and education programs, marketing support for our clients and a strong after-sales service. We feel that our true competitor is sedentary lifestyle."

Nerio Alessandri

A.4. Within-case analysis

		Design as Style	**Design as Process**	**Design as Strategy**
***What** is design*		Style	Product Development and Innovation at large	Meaning
***How** is design used*	*The role of design in the NPD process*	Function	Multifunctional Team Member	Process Leader
	The kind of NPD process	Structured Focus on Problem Solving Linear/Sequential No Exploration	⟺	Unstructured Focus on Problem Setting Non-Linear/Iterative Freedom and Exploration
***Who** designs*		No-one Designer	⟺	Everyone
***Where** design happens*	*Distance from top management*	Peripheral Activity	⟺	High level Activity
	Degree of connection to the "innovation network"	Limited	⟺	Active Participant
***When** design is used*		End of NPD process	During the NPD process	Always
***Why** is design used*		Product	⟺	Everything (Holistic)

	Technogym	**Training Equipment Industry**
Design Approach	Strategy	Style

Summary of Technogym's approach to design.

Company		Major Radical	Minor Radical	Major Incre-mental	Total	Timeframe
Technogym S.p.A.	*N°*	4	2	4	10	11
	% of total	40%	20%	40%	100%	
	N°/year	0,364	0,182	0,364	0,909	

Competitive performance					
CAGR @[number of years considered since last]			*Profit*		
Technogym	*Market*	*Δ*	*Technogym*	*Market*	*Δ*
12,9% @3y 8,1% @11y	3% @3y (global sports equipment market)*	330% @3y	EBITDA margin 14% average 3y 15,6% average 11y	EBITDA margin 6,23% 2010 (average among top 3 companies in global sports equipment market)*	125%

* source: Marketline

Technogym's design innovation and competitive performance.

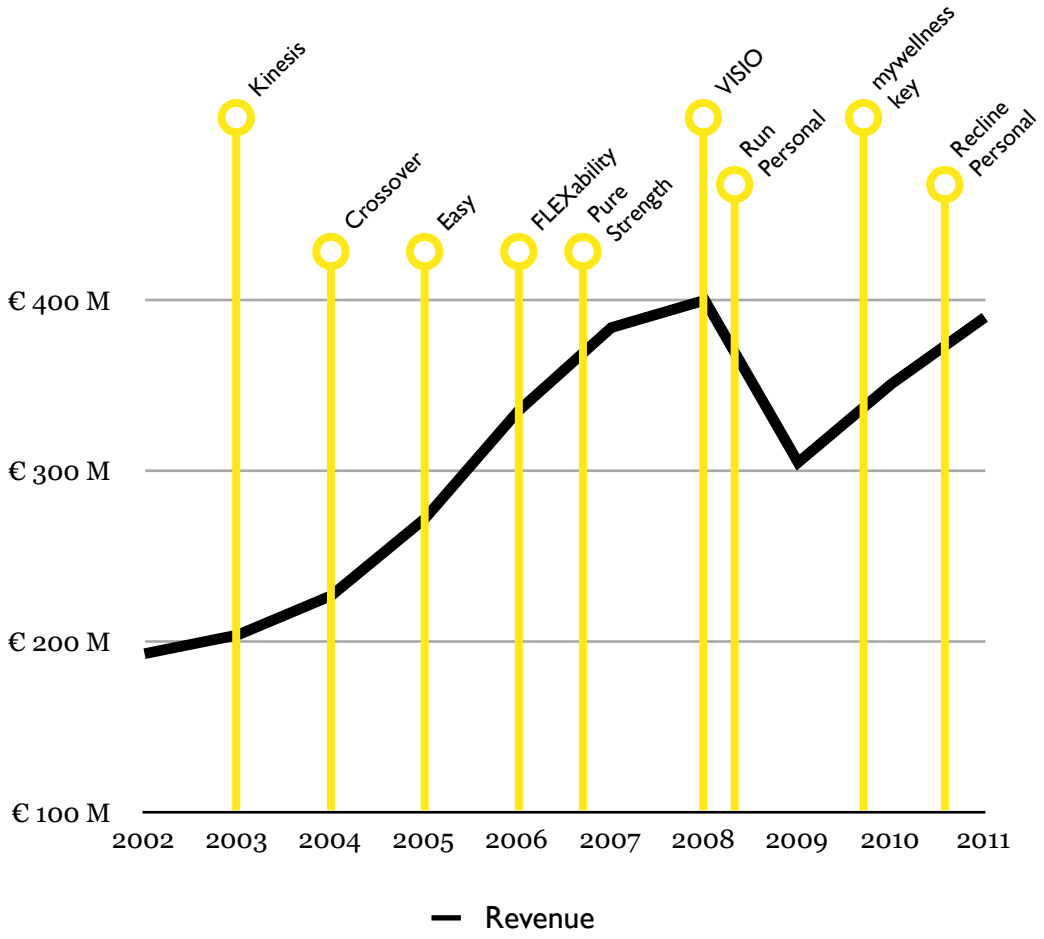
CONSTRUCT ANALYSIS

The training equipment industry makes a very limited use of design, and has a poor understanding of the strategic value of design. On the contrary, Technogym's use of design matches the *design as strategy* approach, denoting a very advanced level of design maturity.

The results of Technogym's investments in design has been a continuous flow of innovative products, answering different needs and addressing various portions of the market. The company has been able to formulate and propose to the market the concept of Wellness, its vision of the future of training, causing all of its competitors to follow in its wake. The company has produced an average of almost one significant innovation every year, with four major radical innovations since 2000.

In terms of competitive performance, the company has substantially outperformed the market. Teachnogym's CAGR over the last 3 years was over four times

greater than the overall global sports equipment market, and its EBITDA profit margin was 125% greater than the average of the three leading companies in the sector.



TIME SERIES ANALYSIS

Technogym has emerged undisturbed as one of the market leaders in the sector, with its competition unable to fully understand the reasons behind its success, and struggling to compete by lowering prices.

The company has been consistently expanding ever since its foundation, but with the introduction of the first products based on the concept of Wellness, such as Selection Line (2000) and Kinesis (2004), the company has almost doubled its growth rates.

The only other significant variation in financial results has been the dip in sales recorded during the 2009 recession. The effects of the economic downturn were particularly strong for Technogym, mainly because of its high market posi-

tioning, with its significantly more expensive products compared to the competition. The company also had to fare with a particularly difficult conjuncture in its home country, as well as an exchange rate that favored its competitors. In 2010 however sales had already resumed their growth at the same rate as before, although with slightly lowered margins.


B.
KUKA

B.1. Design innovation performance and context

In 1898 Hans Keller, a businessman from Augsburg, and Jakob Knappich, a former factory director, purchased an old factory near the Augsburg-Oberhausen railway station. Here the two set up the Augsburg-Oberhausen acetylene factory to manufacture acetylene equipment and metal goods, such as lighting equipment, household appliances and vehicle headlights.

Over the years the original company survived two world wars (including the bombing of its factory), various changes in production technologies and outputs (from refuse vehicles to typewriters), and even a bankruptcy. In 1927 it had adopted KUKA, the telegraph abbreviation for Keller und Knappich "Augsburg", as its brand name, and in 1950 it had become part of the Quandt group, whose interests included BMW, Varta and IWK.

In 1956 KUKA built the first automatic welding systems for refrigerators and washing machines. The German automotive industry was also interested by this innovation: the steadily rising demand for vehicles meant manufacturing facilities needed to be more productive and more efficient, creating demand for newer production technologies. The same year KUKA delivered the first multi-spot welding line to Volkswagen AG.

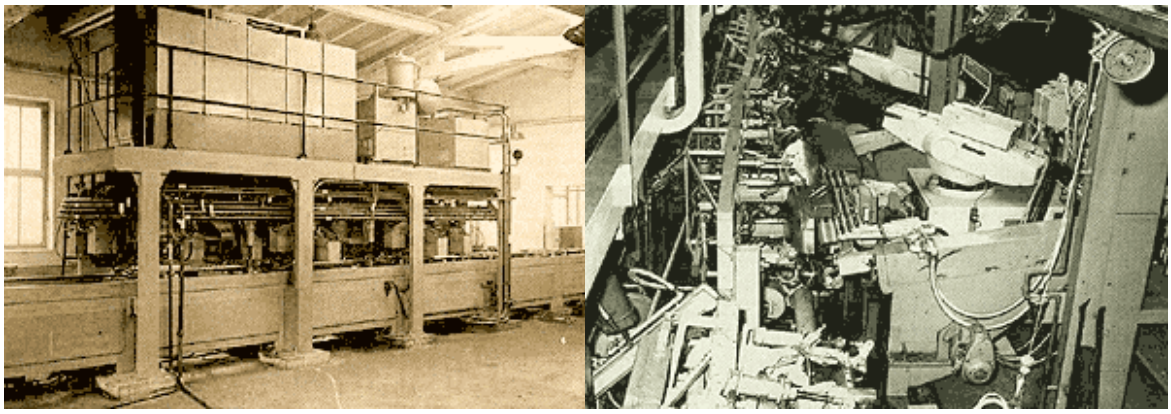


Fig. B.1: multi-spot welding transfer line for Volkswagen (left) and autonomous welding robots at the Daimler-Benz factory (right)

A new chapter for the company would start in 1971, with the delivery to Daimler-Benz AG of a system for the manufacture of automobile side panels, that, for the first time in Europe, made use of autonomous welding robots.

This first system used five-axis robots made by an external US firm, Unimation, but understanding the impact this new technology would have on automotive production the company rapidly introduced its own industrial robots.

Just two years later in 1973 the company was able to leverage the wide range of technological experience gained over the years to introduce FAMULUS, the world's first industrial robot with six electromechanically driven axes.

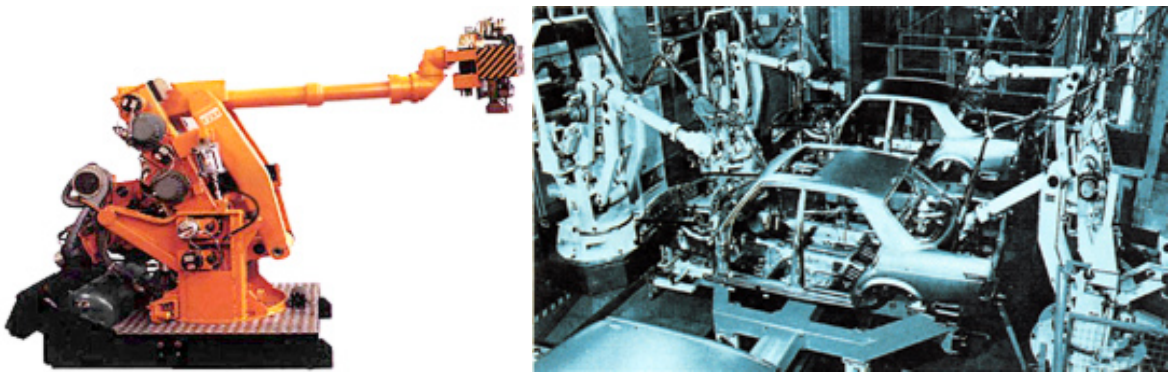


Fig. B.2: the IR 6/60, displaying its innovative parallelogram structure in action for Daimler-Benz in 1978

The company would achieved incredible success a few years later, in 1978, with the IR 6/60 and its evolution, the IR 601/60, an industrial robot whose engineering and performance remained exemplary for several years and the first robot to be produced in series. In many car factories, this model became present in such numbers that a "KUKA" become a synonym for robot.

During the ‘80s the company began a process of global expansion, opening a series of successful strategic bases worldwide, attracting more and more international customers such as Ford, Peugeot and the USSR. The company also introduced a new series of robots that abandoned, for the first time ever, the use of the traditional parallelogram structure, in favor of the more sophisticated Z-shaped (or jointed-arm) design that achieves total flexibility with three translational and three rotational movements for a total of six degrees of freedom.
By the end of the decade there can hardly be a car manufacturer left in Europe who does not rely on welding lines and hence on KUKA’s robots.

KUKA Roboter was spun off in 1996. The same year the company achieved a quantum leap in industrial robot development by launching the first PC-based controller developed by KUKA, marking the dawn of a new era of “real” mechatronics, characterized by the precise interaction of software, controller and me-

chanical systems. It was possible, for the first time, to move robots in real time, thanks to a new operator device, for control and programming tasks, with an integrated 6D mouse.

During those years, the market for industrial robots reached its maturity, with various competitors abandoning the sector, defeated by the emergence of Japanese robot companies. Recognizing the threat, KUKA increased the pace of its innovation substantially. The company also began to make use of design by starting its collaboration with Mario Selic, who would become KUKA's long lasting designer, and help them embrace the rapid development of mechatronic technologies.
His work was immediately noticed, when in 1998 KUKA won its first design award: the "iF 1998" product design award, for the design of the KR 60/100 robot.

Those actions were part of KUKA's new long term strategy: searching for new applications for its products by redefining what a robot is. The company began specifically targeting an expansion of its business in the general industry, moving beyond the heavy industries and exploring new applications in sectors like logistics and medical technology. New research programs were launched, with a particular focus on on human-robot interaction and collaboration, an unusual concept for a company who's usual role had been that of substituting humans workers on factory lines with autonomous machines.

The range was expanded with the introduction for the first time of long-range and heavy duty robots and greater value was given to the software side of the products. In 1999 the company introduced remote diagnosis for industrial robots, allowing errors to be corrected and eliminated through the Internet. The following year KUKA introduced Soft PLC (Programmable Logic Control) into its products, eliminating the need for an external master PLC for industrial robots.

Already in the early 2000s, the new research into human-machine interaction lead to the introduction of two radically new products.

The first was the Da Vinci system, developed in cooperation with the company Intuitive Surgical. The system is used for endoscopic surgery within the human body, and combines a robot and several cameras, to allow a surgeon to perform

delicate operations in non invasive ways. The system translates the surgeon's actions into scaled-down micro-movements to manipulate tiny instruments on the end of the robotic arm. Surgeons can operate with a level of precision that goes beyond human ability, and forget problems such as shaking hands, a condition that can afflict older practitioners, shortening their careers and wasting valuable talents. The system can even operate remotely, through to a high-speed connection, allowing the surgeon to project his knowledge and expertise to distant locations.
This was a massive step forward in medical technology and a radical shift in meanings for KUKA's robots: the Da Vinci isn't an autonomous tool that replaces humans, but a collaborative tool that works under the control of a human operator.

The other new product was Robocoaster: born from the idea of one of KUKA's factory workers, who had a passion for roller-coasters and realized that robots could provide a new kind of ride.

ROBOCOASTER: THE ENTERTAINMENT ROBOT

Robocoaster is a product for the amusement industry whose success has lead to the creation of an entirely new entertainment division within the company.

The idea come from Gino De-Gol, who worked in one of the KUKA's factories, who combined his interest in amusement rides and knowledge of robotics to develop the concept of an interactive passenger-carrying robot that could move humans around in an exciting, entertaining and unpredictable way.

After founding his own company, Robocoaster Ltd., he approached KUKA with a detailed plan seeking a partnership to accomplish his dreams. The proposed "Robocoaster" was considered a joke by all the other industry players approached by De-Gol. One of KUKA's major competitors preferred not to develop a similar robot, arguing that such a product was too dangerous: if something went wrong, such a robot could kill people. But KUKA recognized the opportunity in this new project,

thanks to their new strategy, which was open to new opportunities, and to their research into human to robot interaction.

After introducing the concept in 2001, the Robocoaster became the world's first and only passenger-carrying industrial robot. Most of the technology was already available, and the company only needed to modify one of its industrial robots by adding some precautionary safety features in order to have it certified by the German technical inspectorate TÜV to carry humans. The first version of the new concept was a stationary ride in which passengers boarded roller coaster-like seats at the end of the robot's arm and were put through a variety of highly-programmable maneuvers, which could be customized to endless possibilities thanks to the six axes of motion.

In 2007, the company expanded on the original concept at Innoventions at Walt Disney World's EPCOT, in which it created a motion simulator ride which enclosed guests in small capsules and put them through motions synchronized to video, performing maneuvers and motions no normal simulator could even begin to attempt (for example, flipping riders).

Fig. B.3: the first Robocoaster model, and the advanced simulator version.

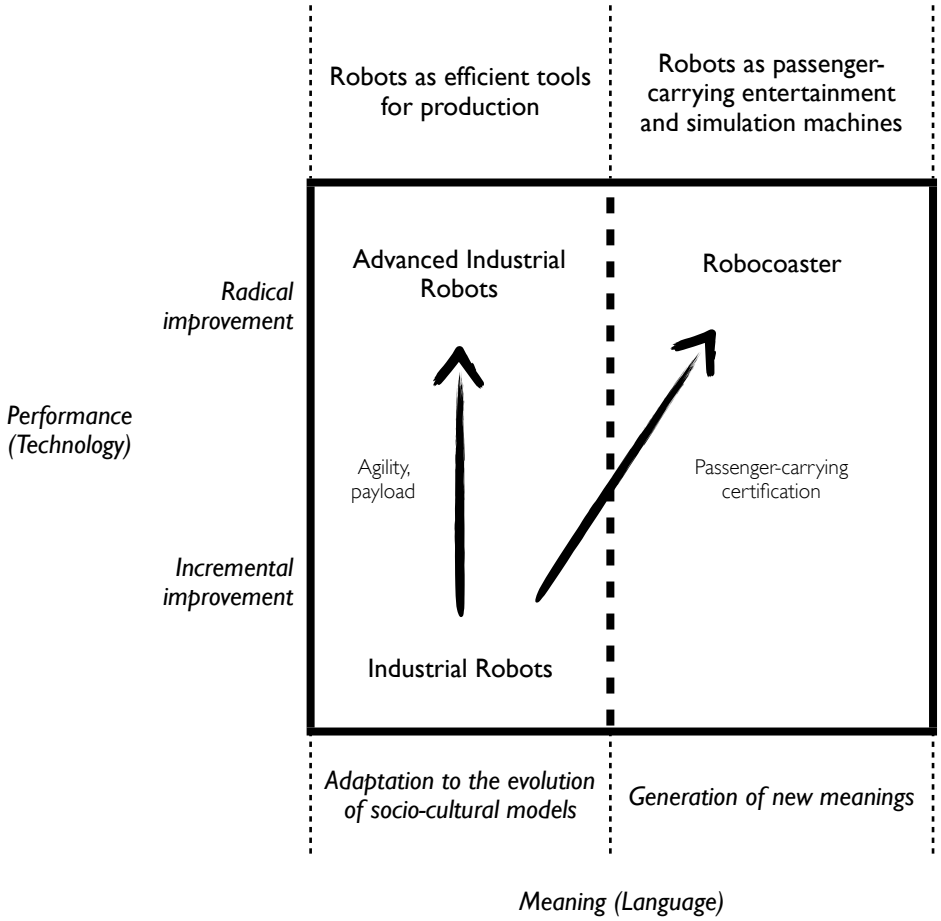
In 2010 the company installed on of the biggest installations of Robocoaster technology, providing its robots for the centerpiece ride of the highly anticipated Wizarding World of Harry Potter section of Universal's islands of Adventure, in Florida. With this ride, KUKA placed massive robotic arms on a track, a concept it first introduced in 2004, in-

creased seating from two to four-passengers, and with Universal's help, immersed guests entirely in the world of Harry Potter.

Today Robocoaster has expanded into an entire product line, ranging from basic 2-seat variants to advanced 4D simulation models, while offering custom versions for dedicated uses in amusement parks and research centers.
Even after 10 years from its introduction, it still remains the only passenger carrying robot on the market.

With this new product KUKA was able to create an entirely new kind of attraction. Robocoaster is a relatively low priced amusement ride, and is surprisingly compact and rapidly deployable (some KUKA concepts even place it on a mobile trailer and allow it to be transported). It can be used for temporary exhibitions as well as complex permanent rides, and can be fully personalized to provide a wide range of motions for many different needs. Not relying on a fixed structure or track, the ride can also be adjusted to the individual rider's desires, adapting to the single user's thrill expectations, as well as providing several different simulations in a single installation. The versatility of Robocoaster is unmatched by any other amusement ride technology. The system has also been used for "serious" simulations in the aerospace sector, evidencing another advantage of this technology which is the ability of being used as a real-time motion simulator.

The success of the Robocoaster has pushed KUKA to expand its horizons on the possibilities of robots as entertainment machines. The company has created a division of the company dedicated to the entertainment and simulation sector, proposing its products not only as amusement rides, but also as tools to be used in movie and theater productions, in public events and fairs, or even in museums and research environments.



KUKA's robots have found their ways into laboratories researching into brain and sensorial perception, have been used to simulate aircraft or the experience of being trapped under avalanches, and have even starred into several Hollywood movies (making a particularly memorable appearance in a James Bond movie, armed with lasers).

The introduction of RoboTeams, in 2004, followed the next year by Safe Robot, continued the company's work on the interaction between robots and humans, allowing multiple KUKA robots to work seamlessly together and in close proximity with people, and improving productivity by requiring substantially less space and equipment.

In 2006 the first prototype of lightweight robots (LWR) was presented. Weighing a mere 14kg, the LWR is the only such robot able to lift its own weight. Each LWR has at least seven axes that can be pushed and manipulated by the operator, who can intuitively hand-guide the robot to teach him a new movement,

substituting traditional robot programming. KUKA's goal was that of minimizing the time required to introduce robots to a new task, opening the doors to new environments and uses previously only feasible for humans.

"Classical" industrial robot	Future production assistant
fixed installation	flexibly relocatable (manually or on mobile robots)
periodic, repeatable tasks; seldom changes	frequent task changes; tasks seldom repeated
programmed online / offline by a robot specialist	instructed online by a process expert supported by offline methods
infrequent interaction with the worker only during programming	frequent interaction with the worker, even force / precision assistance
worker and robot separated by fences	workspace sharing with the worker
profitable only with medium to large lot sizes	profitable even with small lot sizes

Table B.1: KUKA developed a new vision for the future of industrial robots, which guided the Lightweight Robot's development.

The lightweight robot is now available on the market, and it's being continuously enhanced to increase its performance. The company recognizes the incredible potential of such a technology, and isn't limiting itself to just selling the LWR to the industrial sector, but is adapting it for use in highly profitable future markets where robots are not yet used today. In 2010 KUKA established an Advanced Robotics division, to expand the development of new applications of its robots, and accelerate the company's entry into new markets. This division is today an independent company, called KUKA Laboratories, which remains the group's main research and development center, and has been concentrating on developing the lightweight robot, and expanding the share of sales from non-industrial markets. KUKA realizes that in order to expand the use of its robots, it won't just require an advancement in technology, but most of all it must redefine the meaning of what a robot is and what it should be able to do.

KUKA Labs launched "youBot" in 2011, a new line of small scale and cheap robots for the research and academic sectors. In the most advanced versions, those are basic robot arms, mounted on omnidirectional mobile platforms, that can rep-

licate most of the actions of more sophisticated robot systems. Those robots are sold online to privates and institutions, and while the research market may be very small for KUKA, it is not negligible, and offers several other advantages that will finally improve the company's bottom line. First of all, it is an efficient (and even profitable!) marketing instrument, as today's students become engineers and decision makers of tomorrow, and will consider KUKA when choosing an employer or a technological partner. But youBot also gives the company a first row seat into the future of robotics, allowing faster transfer of research results, and involving the firm in many cutting edge experimental programs.

KUKA has not forgotten the industrial sector however. In 2007, the heavy duty KUKA KR 1000 Titan was the first industrial robot with a payload capacity of over 1000kg. Titan is introduced as the world's strongest 6-axis robot. The record was later matched by a competitor, but, underscoring KUKA's incredible design and engineering capabilities, this achievement came at the cost of launching a robot that weighted more than twice the weight of Titan (10 tons, versus 4,6 tons).

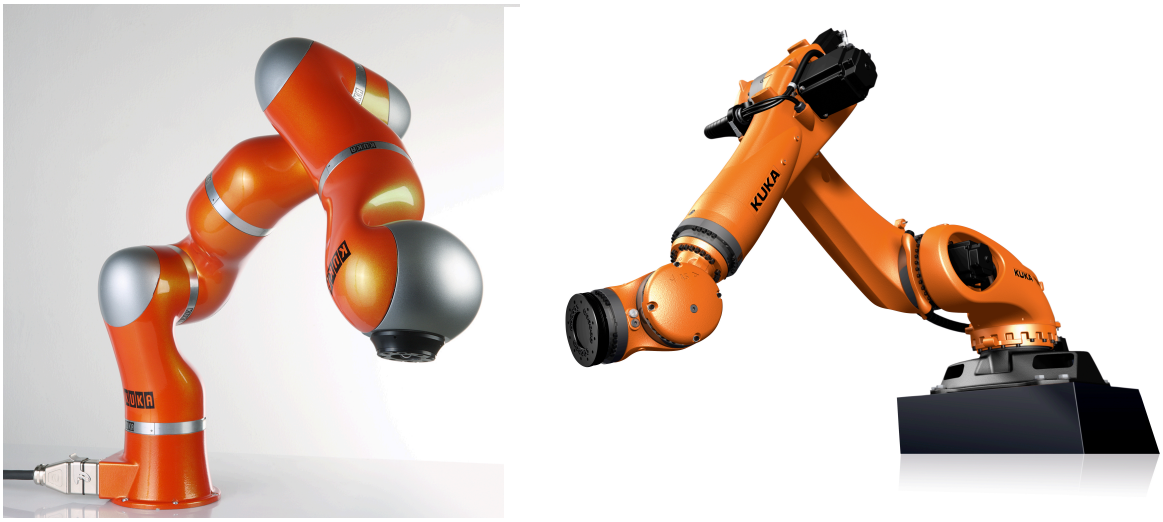


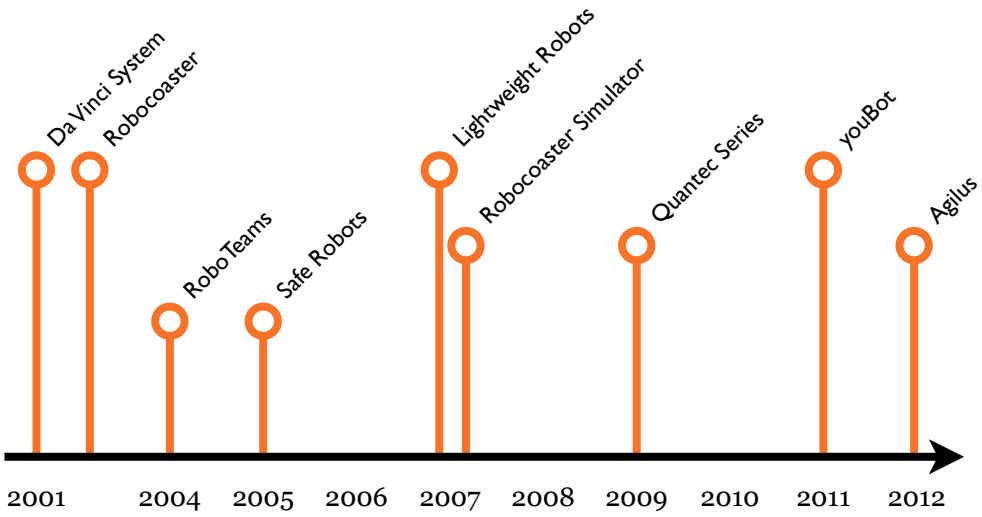
Fig. B.4: the Lightweight robot (left), capable of paylods of around 14kg, and a Quantec robot (right), which can carry over 300 kg.

Today, the company's industrial lineup has been completely revamped with the lunch of a new robot generation called QUANTEC. With its extensive range of models, comprising 15 basic robot types with various mounting options, the KR QUANTEC series ensures that there is a perfectly suited robot for every customer-specific application. For the first time, a single robot family covers the entire high payload range from 90 to 300 kg with reaches from 2,500 to 3,100 mm.

These robots allow an incredible pose repeatability of +/- 0.06 mm and in comparison to the previous series are up to 160 kg lighter and 25% more compact, leading the market in terms of power density and opening up whole new fields of potential applications in production – even in confined spaces.

The latest addition to the KUKA product portfolio has been Agilus, introduced in 2012 and designed for fast tasks and small payloads, enabling the automation of tasks such as material handling and assembly, that previously could only be done efficiently by hand. Agilus was developed from concept to finished robot in less than one-and-a-half years, a record in all of KUKA's history, and a substantial achievement in an industry which is usually quite slow in bringing new products to market. The new Series also features an astonishing 99,99 percent availability over the life of the robot, thanks to many new innovations, including the gear units never requiring a lubricant change, something never seen before in the robot industry.

Over the years, the company has been recognized several times for its outstanding design, winning several of the most prestigious international design awards, including 8 Red Dot Design Awards, 5 IF Design Awards, as well as various other prizes presented by both external observers (MM MaschinenMarkt Awards, Mobius Award) and client companies (Ford, BMW, Daimler-Chrysler).
After winning its first award in 1998, the company's critical success has steadily increased, with its most acclaimed product line being the latest QUANTEC series, that has won eight design and innovation awards alone, including the coveted "best of the best" Red Dot Award.



KUKA's last decade of design innovation performance.

B.2. Investment in design strategy

At the end of 2011, KUKA Robotics division's research and development department employed 258 persons, 22 percent more than the previous year. Half of these employees work on software and hardware development and half work on mechanical design and mechatronics. This is the main product development division for the company, responsible for the major product lines and for work on the current portfolio of solutions.

A spinoff of the main Robotics department is KUKA Laboratories, responsible for the most advanced research and development projects. The focus of this division is on the study of long term opportunities as well as on the development of alternative applications for robots: from creating low-cost robots for the educational market, to advanced service robots for sectors such as health care or assembly and logistics.

GROUP RESEARCH AND DEVELOPMENT COSTS

	2007	2008	2009	2010	2011
Total expenditure in € millions	30.8	33.7	35.6	29.5	37.7
of which KUKA Robotics in € millions	28.3	31.0	33.1	28.2	35.4
KUKA Robotics share in %	91.9	92.0	93.0	95.6	93.9
KUKA Robotics' R&D-ratio in % of sales	6.9	6.5	10.1	6.8	6.2

KUKA's research and development expenditure every year is over 6% of the company's total sales. The R&D budget is spent for the most part, about 70 percent, towards developing new products and applications while 30 percent goes to fundamental technology research.

WHAT DESIGN IS

In conjunction with the internal engineering and design teams, the company has collaborated since the '90s with an external german industrial designer by the name of Mario Selic. The first robot that was born out of this collaboration was introduced in 1998, and won the company's first IF Product Design Award. Since

then Selic has been responsible for the design of the entire KUKA product line and has earned several design prizes for the company.

Selic has been responsible for establishing KUKA's product design language, and applying a coherent and consistent appearance across the entire product portfolio. Selic considered the expectations placed on an industrial robot, and attempted to translate those characteristics, such as strength, speed and agility, into the design elements of the finished product: in the case of the industrial robots, the design objective was to lend them a lean, yet powerful look that reflected their dynamic skills.

First of all, I considered the expectations placed on an industrial robot: it should be strong, but at the same time fast and agile. Like an athlete. I also felt, however, that it had never really been possible to see this performance and ability in industrial robots just by looking at them. I wanted to change that.

Mario Selic

The results have been flexible industrial robots of almost lithe appearance, with organically formed, high-tensile-strength components that give a visual expression of the performance capability and agility of the machines. Their appearance is reduced to the essential and makes no use of superfluous external styling trim – instead, every component has its technical function, reflecting a constant search of simplification and materials economy. Superficially, these robots provide few clues about the enormous complexity underlying their movements, or of the great number of components that go into their construction.

"A product possesses design quality when it for instance withstands many years of use and operation, maintains its attractiveness for years, and still triggers emotions and fascination."

Mario Selic

But Selic hasn't worked only on the industrial lines. He's also had to design various other product for different markets, such as the lightweight robot or the youBot research platform, adapting them to their different environments and giving them a product language appropriate to their different meaning.

"Furthermore, [design] depends on the areas in which industrial robots are to be used. A robot for the service robotics or medical sector must make a different impression than a robot being used in industry. It should be designed in such a way that people are prepared to work closely with it. It needs to inspire more confidence, somehow, and perhaps appear less sporty."

Mario Selic

The constant identification of new applications and scenarios for its products has been the crucial aspect of KUKA's use of design.
The company has long ago realized that the technological barriers that have characterized the infancy of robots are being rapidly overcome: KUKA was the first among its competition to not only concentrate on purely technical research, but also on studying what the meaning of a robot actually was.
While the competition works on faster, more performing robotic tools, leaving to their clients the responsibility of deciding how to implement them, KUKA proposes new ways in which its products may be used, guiding its technical research teams through the identification of what robots will be doing in the future, and presenting to its clients innovative solutions.

KUKA Laboratories has been established with this goal in mind. By exploring emerging technological trends, such as robot-robot cooperation and safe technology that enables human-machine collaboration, the company is working on a new generation of robots. Research focuses on radical new concepts and opportunities, looking for new applications and future uses for robots, even in the most unconventional markets. Since the creation of KUKA Labs, the company has launched products in the field of medical imaging and radiation therapy, as well as lightweight robots for use in assembly lines in close cooperation with humans, or youBot, an open source low cost robot for the research and education market.

***What** design is*	Style	Product Development and Innovation at large	Meaning

HOW IS DESIGN USED – THE ROLE OF DESIGN IN THE NPD PROCESS

At KUKA, the new product development process starts with the search for a new product meaning: by identifying a new field of application for robotics, or a new use for robots within traditional robot markets.
This crucial phase of design is considered by the company a mainly technical problem, so engineers and researchers are responsible for it.

Once a new product concept has been identified, a product team is formed to define the product's characteristics. This is when the designer Mario Selic joins the team as an external consultant (he is the only person working on KUKA's products with a background in "traditional" design).

For Selic, working on such advanced products, technical knowledge of the product, and of the production technologies employed are crucial: he concentrates on the technological aspect of his products first of all, and keeps up to date with the latest developments by visiting major product fairs with engineers from the company.

Industrial design encompasses three areas: marketing, technology and design. The product derives from the intersection of these three areas. Technical understanding is crucial, otherwise I would just end up designing things that leave the engineers shaking their heads.
As a designer, I do not concentrate on design.

Mario Selic

The close interplay of design expertise and engineering prowess results in robots whose external appearance doesn't just look good, but also improves technical functions.
In the design phase, every gram of material is considered, as all superfluous weight has to be moved and accelerated unnecessarily. This reduces material costs and weight, contributing to lower prices, substantial energy savings during use, as well as an increased service life for the products.
The organic, almost anatomic, form components, with smooth transitions between structural shapes improve the mechanical force transmission and increase the component strength, giving the robots a high degree of stability and stiffness, while also enabling the customer to benefit from ergonomic and intuitive operator guidance.

[But isn't quality the most important factor?] Naturally. But the two are not mutually exclusive. We do not just have design effects with KUKA robots. Nothing is added that does not have a functional role. No panels or housings sticking out to impinge upon the agility of the robot. A KUKA robot should look as though it was molded in one piece. Only then is it fully developed. Incidentally, design does not necessarily mean higher prices. Functional or intelligent design reduces costs, as superfluous parts are omitted.
Technical progress opens up new possibilities. New technologies and new constructional elements allow new approaches.

Mario Selic

Collaboration between designer and engineers is crucial, as the absence of ornamental surfaces and covers means that the functional elements of the product themselves are responsible for communicating their message to the final customer.

The role of design at KUKA is therefore halfway between the Multifunctional Team Member and the Process Leader characterization. Design is used to start the development process and create the original product concept, but once the team starts working on the new product the technological side of the project is so intense that it must take leadership over the process. The designer still works on the project as part of the team, collaborating with the engineers to bring to reality the original concept and maintaining the appropriate message.

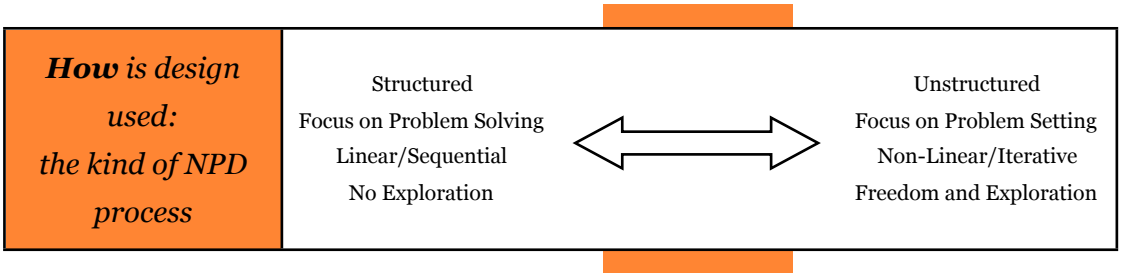
***How** is design used: the role of design in the NPD process*	Function	Multifunctional Team Member	Process Leader

HOW IS DESIGN USED – THE KIND OF NPD PROCESS

KUKA's product development process is necessarily a very linear and structured process, as the high costs of materials and components involved doesn't leave space for many iterations and prototypes and frequent changes of direction.

For this reason, the research phase is where the freedom to explore new ideas is mainly concentrated, and is therefore the most crucial moment in the entire process. Once the product concept has been identified, and the research teams believe that the necessary technologies are available, the process moves to the hands of the product teams, which must be as efficient and fast as possible in bringing

the concept to reality, minimizing risk and costs.

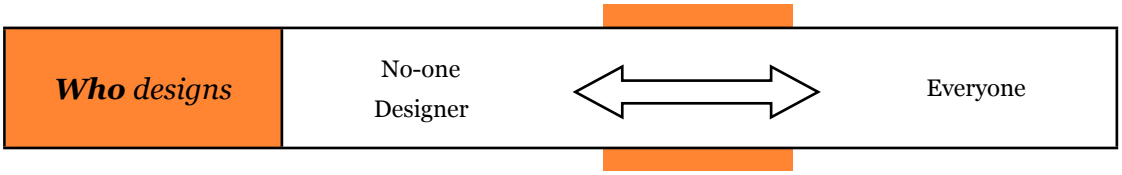


WHO DESIGNS

Belonging to an industrial sector which is very technological intensive, the company has a strong engineering culture. However, design has been recognized as an important part of innovation and has become a part of the company's approach to product development.

A large part of KUKA's design output is generated by the product teams, which collaborate with external designers on new projects. The company doesn't just collaborate with Mario Selic for industrial design matters, but has also worked with other designers to produce its communication materials and its fair booths and presentations.

But the bulk of the company's capability to innovate on their product's meanings comes from KUKA Laboratories, where most of the research and development activity takes place.
While in the rest of the group, design is in the hands of the few working directly on the products, at KUKA Labs it is a much more distributed effort, as one would expect from the main creative source of the company.

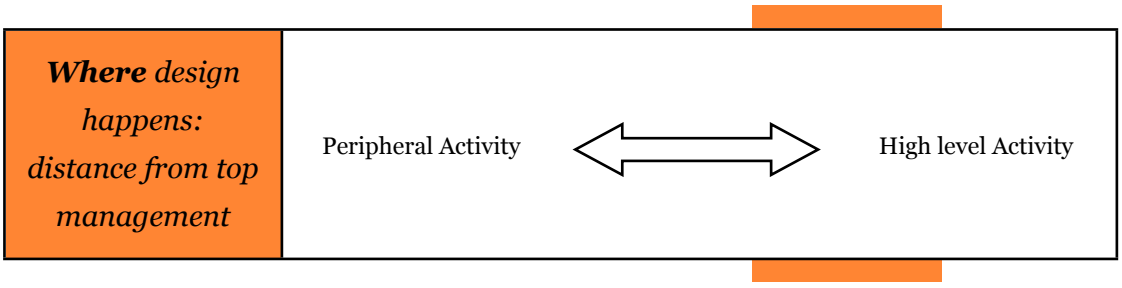


WHERE DESIGN HAPPENS – DISTANCE FROM TOP MANAGEMENT

The company has a complex management structure, based on the concept of empowerment and a flat hierarchy. This system promotes self-responsibility and pushes low level managers to take risk and have the courage to make their own decisions. This results in a very decentralized organizational structure where the group's top management receives reports from the three division leaders responsible for the robotics, systems, and laboratory department.

The company's strategy of exploring new markets and opportunities has therefore been formulated by those low level managers rather than from the very top of the company. Rather than being dictated by one single charismatic leader, the shift in strategy was actually the result of the arrival at KUKA of a team of young executives with no previous experience in the industry. Their external perspective, pushed them to challenge the normally accepted assumptions in the industry and pave the way to the development of breakthrough meanings.

The closeness of management to the design activity increases as one moves towards the divisions producing most of the innovative output: the systems division has the most "sales-oriented" management, while laboratories has the most design-oriented leadership. Ultimately though, the choice of using design has been a strategic one, and, given the high investments involved, the decision to guide the research teams in certain directions, and pursue particular new meanings is an activity that directly involves the company's management.

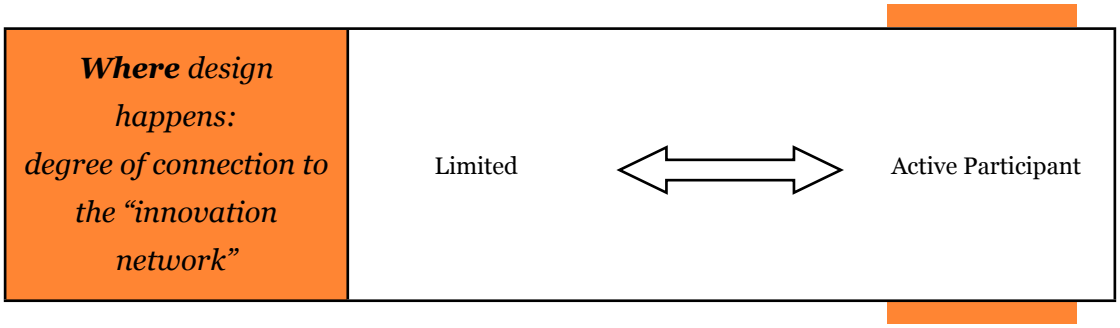


WHERE DESIGN HAPPENS – DEGREE OF CONNECTION TO THE "INNOVATION NETWORK"

KUKA maintains tight relationships with some of the most prestigious universities and robotics associations in the world, in order to maintain its technological

supremacy. The company also collaborates with a vast network of companies to develop its products, and particularly when radically new meanings for its robots. Successful examples of those collaborations have been KUKA's work with Intuitive Surgical on the Da Vinci medical robot system, or the partnership with the Institute of Robotics and Mechatronics at the German Aerospace Center (DLR), which resulted in the Lightweight Robot.

One of the Laboratory's products, the youBot platform, was specifically designed with the purpose of bringing the company closer to the research and academic world, in order to establish relationships with the most innovative developers. This helps the company to generate enthusiasm among researchers for the KUKA brand, and to recognize tomorrow's technologies and trends, as the creative ideas, concepts and experiments which emerge thanks to youBot provide valuable impetus for the other business units within the group.



WHEN DESIGN IS USED

The use of design by KUKA is mostly concentrated in the initial phases of product development, at the idea and concept stage. The researchers start this phase on their own, before passing the project to the final product team, which always includes an industrial designer (usually Mario Selic).

The designer remains with the team for the entire product development, but isn't usually involved when last phases are reached (such as manufacturing and sales).

The company also makes use of design when shaping its vision and strategy for the future, drawing on the experience of its low level managers who are respon-

sible for the research and development departments.

***When** design is used*	End of NPD process	During the NPD process	Always

WHY IS DESIGN USED

Of course design plays a role, even for capital goods. That was already the case [in 1998]. Automotive manufacturers were the first to install glass factories. When customers walk through a plant, the appearance of the machines is not unimportant. But not only there, in my opinion. For purchasers, also, the design of a product is not the least of the evaluation criteria.

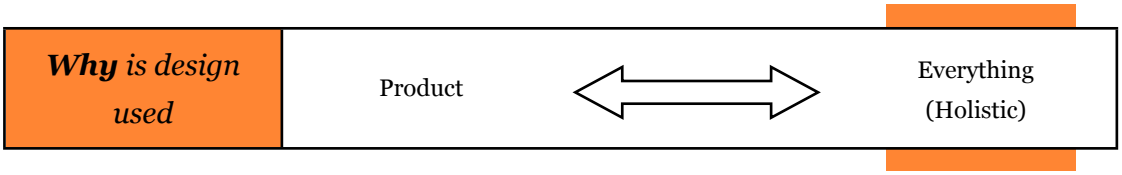
In addition to KUKA Roboter, a large number of other companies in the B2B sector also place importance on design. Heidelberger Druckmaschinen, for example, or Festo. Manufacturers want their products to stand out from the competition with a distinctive corporate image of their own and a high recognition value. An expressive, powerful robot leaves a more positive lasting impression than an unprepossessing, powerless machine.

Mario Selic

With its unique product design, KUKA has been able to establish a high recognition value. Consistent shape characteristics and colouring give structure to the broad product portfolio, defining each robot's specific use, and creating high recognition value.

In addition to its product design, the company has concentrated on its overall corporate design, harmonizing all means of communication, and providing identity and orientation both internally and externally. Everything from its marketing material, to its internal communication is consistently designed, and the company has even won several iF Communication Design Awards for its works: in 2005 it was honored for its work on a multimedia catalog (a book augmented by projecting videos in real time on its pages) used in exhibitions to present the company's portfolio, and more recently for its innovative design of its booth at a major industry conference, as well as for one of its brochures and even its 2008 shareholder's an-

nual report.



B.3. Competitive performance

Today KUKA Roboter is among the top 3 robot manufacturers in the world, and is the largest in Europe, controlling around 15% of the EU market. The company is still the uncontested worldwide market leader in the automotive industry, with a market share in Europe of around 50%.

GROWTH

While KUKA's product performance has remained high over the years, with the introduction of several significant innovations over the last decade, the company has had to contend until 2007 with a tumultuous corporate history that has significantly hampered the company's growth in the first half of the decade.
In the 70's KUKA had merged with Industrie-Werke Karlsruhe AG, a defense company, assuming the name of IWKA AG. The merger proved to be a failure, as the new entity struggled to achieve synergy between the two separate businesses, and leading to the sale of the defense engineering companies. From 2004 to early 2007, the company started a process of concentration on automation technology by selling off gradually its remaining activities in the other business areas. The company was then renamed KUKA Aktiengesellschaft and the headquarters were transferred to Augsburg.

The company had already shown positive signs during, and immediately after, the separation, achieving double digit growth both in 2006 and 2007, but in the two following years, the industrial sector was deeply affected by the financial crisis, collapsing by more than 40% in 2009[1].

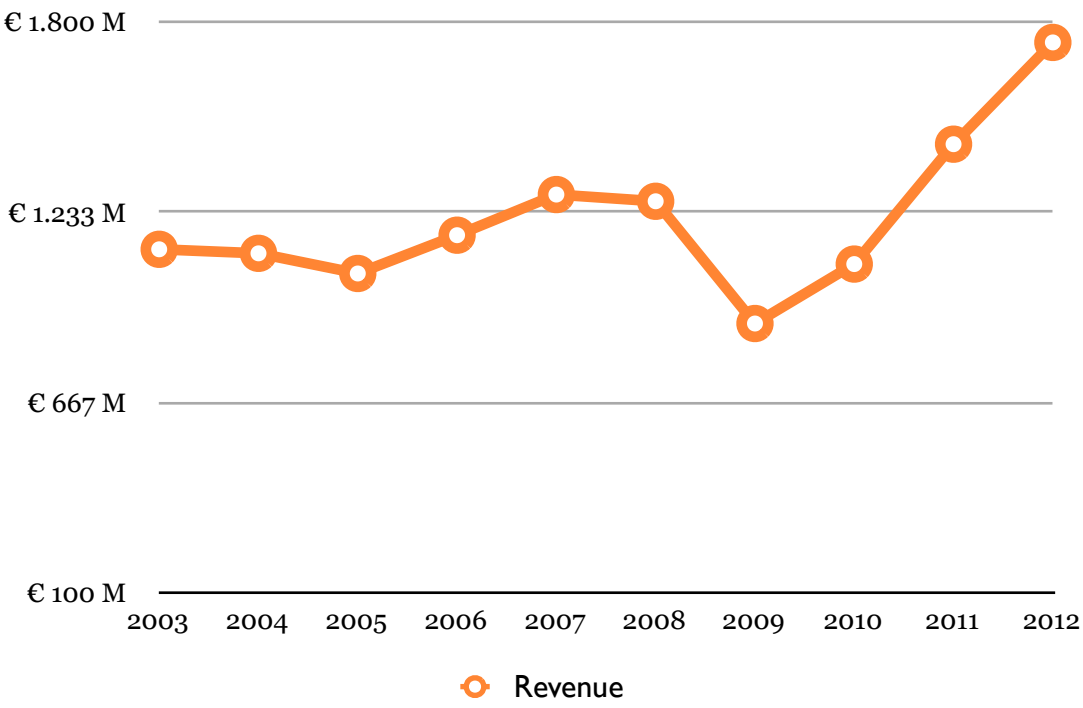
The compound annual growth rate (CAGR) of the global robots market for the period spanning 2007-2011 was 7,3%, compared to KUKA's 2,8%.
The 2009 crisis affected KUKA less than the rest of the market, but in 2010, the market rebounded with more than double the growth rate than KUKA: 47,5% versus 19,6%.

[1] *source for this and all the following market data: Marketline*

Since then however, the company has been growing at substantial rates, with 2011 and 2012 both setting all time records for the company. In 2011 the company's revenues grew 33,1% and in 2012 they grew by another 21,1%, in both cases above the market average and giving the company a CAGR between 2009 and 2012 of 24,5%.
In 2012 the company reached a very high production saturation and increased its order backlog (which has historically always remained high) by 25,6%, compared to the previous year, reaching €909 million and pushing KUKA to announce an increase in production capabilities of almost 50%, by building a new factory in China in 2013 and improving existing facilities.

The new factory in China will solve KUKA's distribution problems in the fast growing asian markets, which has been one of its main shortcomings in the last few years. While ABB, the second biggest manufacturer of robots in Europe has been shipping a third of its products to China, KUKA has been slow at increasing its shipments to the region, something it hopes to rectify by boosting its assembly capacity in China to 5,000 units in 2013, from less than 1,000 two years ago.

	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Revenue €M	1.123	1.111	1.051	1.165	1.286	1.266	902	1.079	1.436	1.739
Y/Y change	–	-1,0%	-5,4%	10,8%	10,5%	-1,6%	-28,7%	19,6%	33,1%	21,1%
Global robot market €B (source: Marketline)	–	–	–	–	14,7	16,1	10,1	14,9	19,5	23,4
Y/Y change	–	–	–	–	–	9,5%	-37,3%	47,5%	30,9%	20,0%



The Robotics division employs a large part of the 7300 KUKA employees worldwide, with over 3000 persons. In 2012 the company workforce grew by more than 10%, of which more than 60% went to the robotics divisions.

PROFIT

While the competitiveness of the industrial sector means robots are usually sold at a very small margin, and sometimes even at a loss, service robots for use in new sectors (such as the medical or entertainment sectors) offer much higher margins.
The sale of a product like Robocoaster, for example, renders about ten times the margin of a traditional manufacturing robot.

While the size of the service market in units is small (but consistently growing), today it represents almost 20% of the company's revenues and an important profit stream for the company, which still remains the only robotics company operating in some of those markets.

The group's EBIT Margin in 2012 was 6,3%, with the robotics division leading the way with 10,8% margin and growing thanks to a 50% increase in divisional EBIT compared to the previous year.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
EBIT €M	58,8	77,7	-53,4	16,7	70,4	52,0	-52,9	24,8	72,6	109,8
Y/Y change	–	32,1%	-168,7%	131,3%	321,6%	-26,1%	-201,7%	146,9%	192,7%	51,2%
EBIT Margin	5,2%	7,0%	-5,1%	1,4%	5,5%	4,1%	-5,9%	2,3%	5,1%	6,3%

CORPORATE ASSETS

Today KUKA Roboter maintains its reputations as a market leader worldwide, especially in the automotive sector, which still remains the largest and wealthiest application for robots.

The highly innovative nature of KUKA's research is evident when examining the high number of patents produced: the Robotics division applied for 216 new patents and design rights between 2010 and 2011, numbers that over the years have continued to grow substantially (in 2008, they soared by nearly 50 percent compared to the previous year).

The company's strong competitive performance is also reflected in its recent stock performance, which has substantially outperformed the rest of the industrial sector in Germany, growing by almost 200% since 2010, while the DAX industrial index grew by around 30%.

The company is leading robotics into a new era. With increased capabilities, lower costs and greater ease of use, KUKA is working on the next generation of robots, destined to spread throughout general industry and maybe even into wide-spread public adoption.

KUKA's stock performance vs. the MDAX index.

B.4. Within-case analysis

		Design as Style	Design as Process	Design as Strategy
What *is design*		Style	Product Development and Innovation at large	Meaning
How *is design used*	*The role of design in the NPD process*	Function	Multifunctional Team Member	Process Leader
	The kind of NPD process	Structured Focus on Problem Solving Linear/Sequential No Exploration	⟺	Unstructured Focus on Problem Setting Non-Linear/Iterative Freedom and Exploration
Who *designs*		No-one Designer	⟺	Everyone
Where *design happens*	*Distance from top management*	Peripheral Activity	⟺	High level Activity
	Degree of connection to the "innovation network"	Limited	⟺	Active Participant
When *design is used*		End of NPD process	During the NPD process	Always
Why *is design used*		Product	⟺	Everything (Holistic)

	KUKA	Robotics Industry
Design Approach	Strategy	Style

Summary of KUKA's approach to design.

Company		Major Radical	Minor Radical	Major Incre-mental	Total	Timeframe
KUKA AG	*N°*	4	3	2	9	12
	% of total	44%	33%	22%	100%	
	N°/year	0,333	0,250	0,167	0,750	

Competitive performance					
CAGR @[number of years considered since last]			*Profit*		
KUKA	*Market*	*Δ*	*KUKA*	*Market*	*Δ*
12,7% @3y* 6,6% @5y*	11,9% @3y* 9,7@5y*	6,7% @3y -32% @5y	EBIT margin 10,8% 2012 robotics division 6,3 % 2012 entire group	EBIT margin 14,69% 2012 robotics division market leader 6,8% 2012 entire group market leader	-26% robotics division -7% entire group

* source: Marketline

KUKA's design innovation and competitive performance.

CONSTRUCT ANALYSIS

KUKA operates in a sector in which design is almost universally ignored, and actually discounted by most companies.
This makes KUKA's very advanced use of design stand out even more, as the company isn't implementing design at the first level of design maturity, but at the highest possible stage of sophistication.

The company does employ practices which push certain variables of the model towards the "Design as Process" category, but it should ultimately be regarded as a *design as strategy* company, as the majority of indicators is consistent with this characterization. In particular, KUKA scored lower on the variable measuring the *kind of NPD process*, and on the one measuring *who is responsible for design*. This is due to its need to cope with the complex technical requirements of its products, as a large amount of its employees is dedicated to the detailed engineering of

components and parts. The high costs involved with materials and advanced components also limits the company's ability to adopt an intensely iterative and unstructured development process.

The design innovation performance for the company has been excellent during the last decade, with numerous new products and several ventures into previously unexplored markets. The company has had an average of 0,75 new significant innovations of meanings per year, with four major radical innovations since 2001.

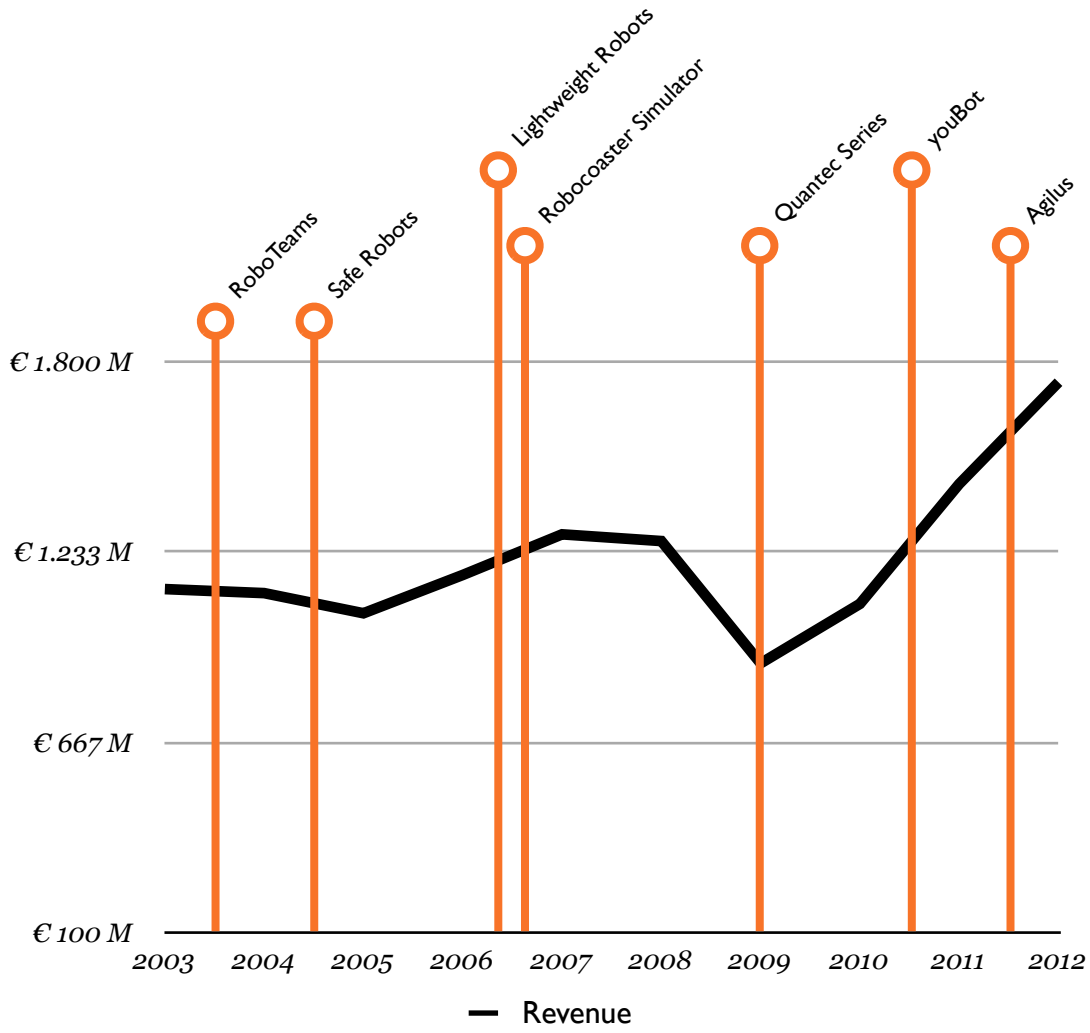
Unfortunately though, the effects of those new products on the company's competitive performance have been impacted by the upheaval of the corporate structure in 2007, as KUKA left the IWKA Group, and later by the economic crisis of 2009.
In the last three years however, the company has been growing substantially, having fixed its internal problems and having consolidated its product lines. Both CAGR, as well as margins have been steadily improving over the last three years, bolstered by the booming robotics market. On the contrary, the company's competitors have been experiencing downward trends on all of their main financial indicators. Perhaps the most clear indication of KUKA's promising future is its stock performance, which has grown by almost 300% during the last three years, as all of its major competitors declined.

TIME SERIES ANALYSIS

Despite the introduction of radical innovations such as Robocoaster and the Da Vinci system, the merger with the IWKA Group had left KUKA in definite distress. In 2000 the defense business was sold, and in 2004 the company started the process of concentrating on its core business of robotics and automation, which lasted until 2007. The financial crisis of 2009, however, hit the company hard and nullified the gains obtained through the process of recovery.

Since then, the company has maintained a steady growth rate, following the successful revamp of its entire product portfolio with the launch of the Quantec series in 2009, followed by youBot and Agilus. In the mean time the rest of the market has also grown significantly, but KUKA has definitely been strenghtening,

managing in 2012 to catch up with the global market leader in terms of growth rate and margins.



The company appears to be just starting to reap the benefits of its investment in design. Given the long product development cycles, the first results of KUKA's adoption of design have only started to trickle onto the company's portfolio, and the share of revenues deriving from the firm's more ambitious projects are just beginning to represent a significant part of the company's business.

C.

C.1. Design innovation performance and context

Elon Musk came to California in 1995 with a goal to commercialize electric vehicles. After graduating in economics and physics from the University of Pennsylvania's Wharton School of Business he moved to Stanford University to complete graduate studies in applied physics and materials science, with a plan to create ultra-capacitors with sufficient energy to power electric cars. Musk quickly realized that commercializing electric vehicles would require vast amounts of capital, so he decided to embark on a wealth-building journey in another sector that excited him but was much less capital-intensive: information technology.

Just two days after being at Stanford he dropped out to start his first successful startup, Zip2, a content publishing company for news organizations, which he sold in 1999 to Compaq's AltaVista division for $307 million. That same year he co-founded X.com, an online financial services company that offered payments via email. This company would later merge with Confinity, a Palm Pilot payments and cryptography company, to become Paypal, the online payments leader ever since. In October 2002, eBay acquired Paypal for $1.5 billion in stock. Elon Musk, owning 11.7% of Paypal's shares before its sale now had an estimated net-worth of $200 million.

By 2002, Elon Musk had launched SpaceX, a space transport business, and had made his interest in space and electric vehicles public. At this time JB Straubel, an energy engineer who had worked on an electric high altitude aircraft and on electric cars, phoned Musk and invited him to meet so that they could discuss their common interests. During their lunch meeting, Straubel mentioned a company called AC propulsion that had developed a prototype electric sports car using a gasoline-powered kit car that used lithium-ion batteries to achieve a range of 250 miles and a 0 to 100 acceleration time of under 4 seconds.

Musk visited AC Propulsion and was particularly impressed. He tried for months to convince the company to commercialize the electric vehicle and even asked them to make one for him, but they had no interest in doing so. Instead, Tom Gage, the president of AC Propulsion introduced Musk and Straubel to another team that shared the same interest so that together they could increase their

potential for success in commercializing an electric vehicle. The other team included Martin Eberhard, Marc Tarpenning and Ian Wright.

They joined forces and founded Tesla Motors Inc. in 2003: Straubel became CTO, Eberhard became CEO, Marc Tarpenning became CFO, and Elon Musk became the Chairman and the Head of Product Design. Ian Wright became Tesla Motors' first employee as VP of Vehicle Development. Musk provided the majority of funds for the startup with $7.5 million of his own personal cash in the first round of capital investment as well as contributing to subsequent rounds. After five rounds of funding, Tesla Motors had raised $187 million. Among later investment partners were Google cofounders, Larry Page and Sergey Brin as well as Jeff Skoll, eBay's former President.

The goal was to commercialize electric vehicles all the way to mass market, starting with a premium sports car aimed at early adopters and then moving as rapidly as possible into more mainstream vehicles, including sedans and affordable compacts. Instead of competing on price, they wanted to make electric cars competitive on other factors such as performance and design. Tesla wanted to produce an alternative fuel car that people actually wanted.

"My goal is to accelerate the advent of the electric car by whatever means necessary. And if we simply tried to sell electric powertrain technology to the car companies we would have had no success. We need to show by example."

Elon Musk

Bringing this concept to reality would prove challenging for the company. There hadn't been a new car manufacturer in America since Ford in 1903, which meant Tesla would have to compete with companies with more than a century of experience. To accomplish this Tesla decided to establish partnerships with existing companies that had the necessary know how to produce the car.
After licensing AC Propulsion's EV Power System design, Tesla entered an agreement with the sports car maker Lotus. The British company would provide advice on designing and developing the vehicle as well as producing partly assembled vehicles based on the Lotus Elise that Tesla would then complete by adding the electric power-train.

While the plan of using an established chassis for the new car seemed relatively simple, the Tesla team rapidly realized that in order to remove the engine block and accommodate the new powertrain and battery pack the Elise would have to be extensively modified. Tesla had also decided that to meet the electric version's weight requirements the body panels would be entirely built using resin transfer molded carbon fiber composite, another substantial variation from the original car specifications. By the end of the design process what was now called the "Tesla Roadster" had a parts overlap of only roughly 6 percent with the Elise.

Fig. C.1: the Tesla Model S followed by a Tesla Roadster.

Even AC Propulsion's power train was substituted by an entirely Tesla designed and built system. Tesla's alternate current induction motor was significantly smaller – about the size of a watermelon – but produced 250hp thanks to a copper rotor assembly instead of the usual aluminium. This was achieved thanks to a breakthrough production process that Tesla has since patented and used for all its motors.

The extensive redevelopment of the vehicle, meant from an economical point of view Tesla would have spent less by designing the car entirely from the ground up. However, from an organizational point of view, the company benefited greatly from its partnership with Lotus. Tesla had been forced to adhere to the strict, and

highly formalized, product development process of Lotus, helping Tesla's startup culture grow into a successful car manufacturer. Tesla internalized many of those processes and even went on to hire a large number of Lotus engineers (a fact that has somewhat strained the relationship between the two companies).

The development of the Roadster required five times the originally budgeted investment and incurred in various time delays. Struggling to complete the project, Martin Eberhard was replaced as CEO by Ze'ev Drori in December 2007. Tesla fired several key personnel who had been involved from the inception and was forced to reduce the company workforce by about 10 percent to lower its burn rate, which was out of control.

The first Tesla Roadster was delivered in February 2008 to Elon Musk himself. It was the first highway-capable all-electric vehicle in serial production in the United States, as well as the first production car to use lithium-ion battery cells, achieving a range of more than 390 km per charge (it currently holds the world distance record of 501 km on a single charge). With a base price of $109,000 it is capable of accelerating from 0 to 100 km/h in 3.7 seconds and can be charged with a regular power outlet in less than four hours.

The fledgling company did not yet have a dedicated internal design team, so it held a design contest which was won by Barney Hatt, Principal Designer of Lotus Design.

Up to this point the only electric vehicles that had been brought to market successfully where golf carts and small industrial vehicles. Early attempts of creating a viable automobile had focused on the creation of small city cars, with limited range and to be used for short commutes. The main focus was on competing with traditional internal combustion cars on price: by eliminating the cost of fuel.

Tesla wanted to enter the market in a completely new way. Electric cars didn't just have the advantage of not requiring expensive gas. An electric motor generates its maximum torque almost as soon as it starts spinning, while a combustion engine needs to rev up. This makes an electric engine ideal for accelerating a car very rapidly, and could therefore be used to create a high performance sports car. This characteristic was coupled with the choice of using lithium-ion batteries, the same

used in laptop computers, in large numbers as a source of power. This tried and tested battery technology is in the process of being commoditized thanks to its widespread adoption and has seen steadily declining prices allowing Tesla to stack the equivalent of 6,831 computer cells to create a Roadster battery pack and achieve the unheard-of single charge range of 390 km.

The Roadster is a serious electric car, that can be used as a person's primary mean of transportation and can actually outperform a conventional vehicle. Tesla's first product was a commercial success, but it was most of all a technological demonstrator. It served the purpose of showing that Tesla's concept of a high performance electric car can really be achieved, and that the technology actually works.

It turned the common perception of electric cars completely on its head. It wasn't a small city car, with limited range and minimal performance (some have defined the first electric vehicles as "glorified golf carts"), targeted for hardcore environmentalists, but a high performance sports car, with enough range and speed to be used as the primary vehicle by the high-end of market.

Tesla received the Global Green 2006 product design award for the design of the Tesla Roadster, presented by Mikhail Gorbachev, and the 2007 Index Design award. The Roadster has also received numerous accolades by publications such as Time, Forbes and Popular Mechanics.

Tesla also decided to innovate the way its cars are sold and presented to the public. It hired George Blankenship, who had been previously responsible for the creation of the highly successful Apple Stores, and in April of 2008 it opened its first "experiential" retail store in West Los Angeles, California. Abandoning the traditional car sales model of the dealership, Tesla's boutique stores were placed in highly trafficked shopping neighborhoods, serving as showrooms for the products, with all purchases of the car done online directly from Tesla's website.

By January 2009, however, Tesla had raised $187 million and delivered just 147 cars, forcing the company to seek once again additional funding. Musk lead a new round of capital, reaching a personal contribution to the company of $70 million, and decided to replace Ze'ev Drori as CEO. With Musk at the helm Tesla

achieved by July of the same year corporate profitability, having shipped a record 109 vehicles during the month and reporting a surge in new Roadster purchases.

In March Tesla had displayed for the first time the prototype for its second product, Model S, a high-performance, premium electric sedan, designed to compete with cars such as the BMW 5-series, following Tesla's plan of expanding down-market from the high performance Roadster. The Model S is the first vehicle that has been completely designed internally by the company, and its chassis, body, motor and energy storage systems are unique to Tesla.

MODEL S: STARTING WITH A CLEAN SLATE.

With the Model S, Tesla had the opportunity to start from the ground up and design the car with the goal of completely capturing the benefits offered by its breakthrough electric powertrain.

The powertrain fundamentally redefined the basic architecture for this sedan. The engineers collaborated with the design team to create a compact platform architecture for Model S, which positions the battery pack, motor and other elements of the powertrain in what Tesla calls a "skateboard configuration". The battery, the most cumbersome and heavy component, is shaped as a flat "board" and is used as the base of the chassis providing rigidity to the frame and keeping the center of gravity of the car as low as possible (the Model S has a center of gravity just 44 centimeters high, comparable to a Ford GT, greatly improving handling and stability).
This base has also been studied to form the basis of several future vehicles, including the planned Model X crossover, enabling Tesla to efficiently and cost effectively launch these new vehicle models in the future. The car cabin and structure are mounted on top of this compact platform, allowing the designers to work freely on the car's body and shape. The modular architecture also affects positively the cost of production by allowing economies of scale and common production lines.

Weight is one of the main concerns in an electric vehicle, as it affects range significantly. For this reason, the structure of the Model S is roughly 97 percent aluminum, which is as strong as the steel normally used in the automotive sector but almost twice as light, improving the car's efficiency and making it the first aluminium car to ever enter series production in the United States.

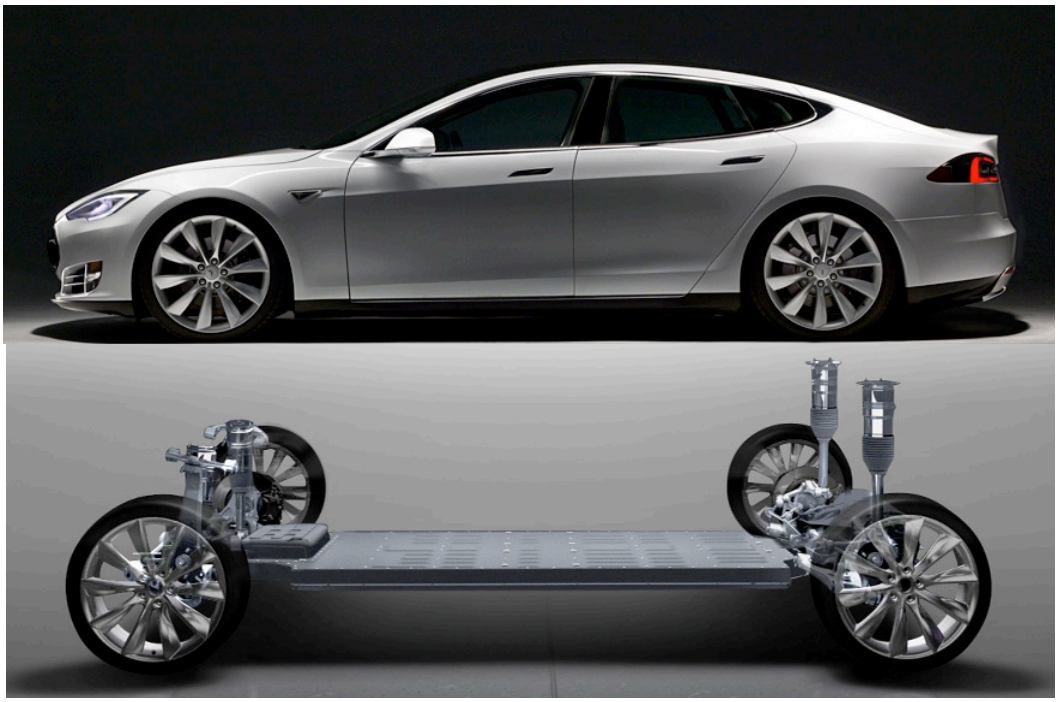


Fig. C.2: Model S and the "skateboard" architecture.

When the team started designing the exterior body, the goal was to minimize the car's aerodynamic resistance, another important obstacle to achieving long ranges, while keeping the cars looks modern and unique to Tesla. The designers explicitly avoided giving the vehicle an unconventional appearance: the Model S needed to be perceived as a car in the same class as existing vehicles in order to be seriously considered as an alternative. It needed to be very good looking, but it needed to somehow look like an ordinary luxury sedan, in order to reassure its buyer that owning an electric vehicle would not require a significant change in their way of using a car.

The team streamlined the greenhouse (the area enclosed by windows) and stretched it to make it feel lower and leaner than usual, to express speed and motion, even when at rest, and giving the car a sporty look. The designers knew that every design cue they used in the Model S would contribute to defining the new Tesla aesthetic, and approached the design constantly considering how their choices would influence the nascent brand in the future.

"The freedom of having a blank slate was also my biggest challenge. In addition to defining Model S, Tesla's brand is still evolving. We're just starting to create the design language that defines "Tesla" as a brand of vehicles."

Franz Von Holzhausen

While considering all those factors, the team was spending many hours defining and redefining the surfaces using a clay sculpture in order to achieve better aerodynamic performance, and finally achieving a drag coefficient of 0.24, the lowest of any production car.

In addition, the car features the largest panoramic sunroof of any production car, and has the most cargo space of any vehicle in its class. Thanks to its unique architecture and lack of a bulky engine, the Model S offers 1042 liters of cargo space, including storage in both the trunk and under the hood (in what Tesla calls the "frunk"), and can carry up to seven passengers (thanks to two optional "jump-seats" for kids in the trunk). By way of comparison, this storage space is more than double the approximately 400 liters of storage available in the 2009 BMW 5 Series sedan.

Another important aspect of the Model S are its interiors and electronics. The car features the largest interface screen of any production vehicle: a 17-inch touchscreen that replaces almost all physical buttons and controls. Through this screen the driver has access to a wide range of vehicle controls (such as cabin temperature, lights, and panoramic roof opening), as well as additional functionality including a music player, navigation maps and an internet browser.

"I've been disappointed in cars where you step inside and it's like going back five years. You have your laptop and your smartphone. I thought that was pretty lame and with the Model S, we decided to be ahead (of the curve) in consumer electronics instead of behind."

Elon Musk

The dashboard, which is also a digital screen, is easily accessible and useable through the buttons on the left side of the steering wheel, dynamically presenting the most important information to the driver.

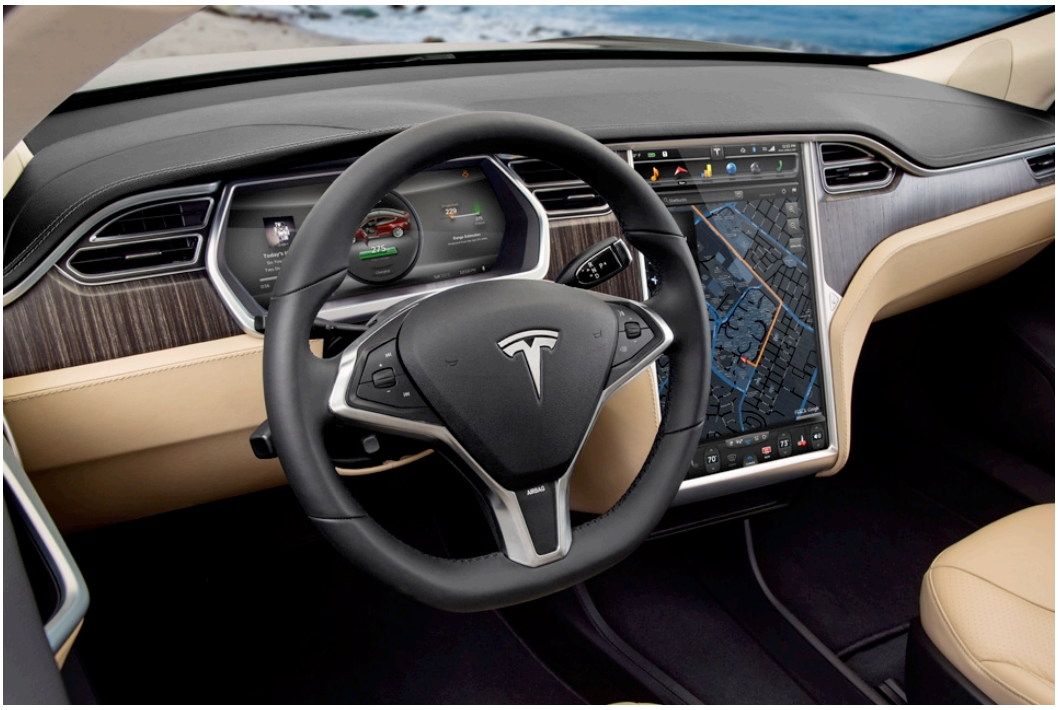


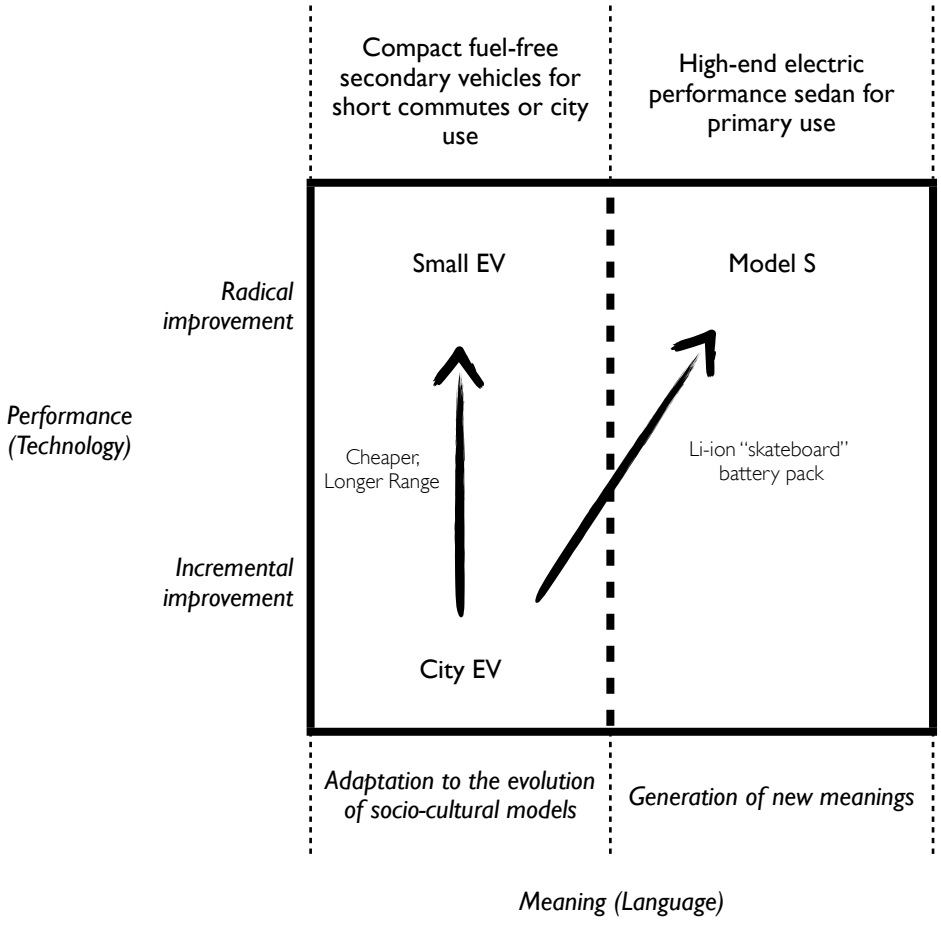
Fig. C.3: the dashboard of the Model S with its 17-inch touchscreen and no physical buttons.

The car uses advanced wireless connectivity to connect with its owner's devices as well as with the internet through 3G connectivity. The connection is also used for maintenance purposes: the vehicle can send its conditions to Tesla's headquarters signaling problems that need to be repaired, or download software updates automatically to enable new functionalities. An app for mobile devices allows the owner to see the car's location and charge levels at all times, and even to control some of its features such as telling it to warm up the cabin in cold conditions.

Even the Model S key is unique. When the owner arrives at the car the door handles extend automatically from the car sides (they retract into the vehicle's body while parked or while driving to improve aerodynamic efficiency), and once inside the car there is no need to turn anything on (the Model S never actually shuts down completely): all the driver has to do is remove the parking brake and push the accelerator.

The Model S's impressive electronics suite never forgets the user's experience, and each functionality has been included after careful consideration: nothing is superfluous and unnecessary, but every detail has been deliberately added to provide value to the user.

The elimination of most physical controls, in conjunction with the simplicity of the electric motor with its single moving part, results in a car that has significantly less components than its competitors. Less parts means cheaper and simpler production and assembly, as well as less maintenance required and less things that can go wrong.



The Model S continues Tesla's "Trojan horse" strategy to the EV market: its an electric vehicle designed to look like a traditional combustion engine car. It leverages the possibilities offered by its radical new product architecture to achieve much better performance than traditional vehicles, but builds upon the usual meanings of cars instead of attempting to carve its own path, with the risk of scaring potential customers.

A substantial and innovative shift from the way electric vehicles have been designed until now.

After the introduction of the Model S, Germany's Daimler AG, maker of Mercedes, acquired an equity stake of less than 10 percent of Tesla for a reported US$50 million. The deal included a supply contract for Tesla's power-trains and batteries to be used in future Daimler projects (one of which turned out to be an electric Smart Fortwo). Just a few months later Toyota signed a similar contract in order to develop a completely electric version of its RAV4 Crossover SUV. The automotive industry was now considering this ambitious California startup as a serious player in the market.

While the company now seemed to have finally reached a sustainable financial balance its next step appeared insurmountable: setting up an entirely new production plant to build its first internally designed car.

The first step needed to achieve this goal would be to increase its capital substantially. On June 29, 2010 Tesla Motors launched its initial public offering on the NASDAQ under the symbol TSLA, raising US$226 million for the company. At the same time, while GM and Chrysler were being saved from bankruptcy, Tesla was approved to receive US$465 million in interest-bearing loans from the United States Department of Energy, as part of an US$8 billion program for advanced vehicle technologies.

Having acquired the necessary funds, Tesla wanted at first to build a new factory from the ground up, with various locations being considered such as New Mexico or California. Tesla's partnership with Toyota however presented the company with the perfect opportunity: the Japanese company was moving one of its production centers from Freemont in California, where it co-owned a plant with General Motors, to Canada. Tesla acquired the plant, a much cheaper option than the ones previously considered, and began working on the extensive retooling necessary for series production of Model S and the final assembly of the Roadster.

Tesla produced the Roadster until January 2012, when its supply of Lotus Elise "gliders" (the name the company gave to the Roadster bodies produced by Lotus) ran out. Its contract with Lotus called for 2,500 gliders, and expired at the end of 2011. Tesla stopped taking orders for the Roadster in the U.S. market in August 2011 and is today selling the last remaining Roadsters in international markets only. The next generation Roadster is expected to be introduced in 2014 and will not be based on the Lotus gliders but instead on a shortened version of the architecture developed for the Model S.

Fig. C.4: the Model X with its distinctive "falcon doors".

In 2012 Model X, the third Tesla product, was unveiled at the company's design studios in Hawthorne California and made available for pre-order. The car, based on the highly scalable and modular structure of the Model S, would enter production in 2013. The Model X is a family vehicle with high-performance, combining the best features of SUVs with the performance possibilities offered by Tesla's electric powertrain (offered in an four-wheel drive variant and capable of achieving 0-100 in less than 5 seconds).

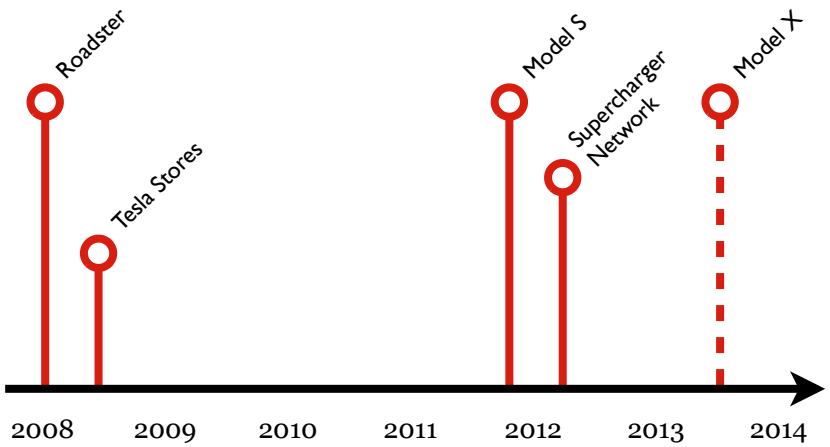
The design maintains the Model S's language, and adds what the company calls "falcon doors", which open vertically to allow easy access to both back rows of seats even the narrowest of parking spots, and various other innovations such as digital rear view mirrors to improve the company's aerodynamics.

The company opened reservations on the day of the model's introduction, and received more than 500 refundable deposits (from $5000 to $40.000 for the signature version) in less than 24h.

Today Tesla has received more than 15.000 reservations for its Model S which it has started delivering in June of 2012, ahead of schedule, despite the complexities of producing a new model. Since then, while the initial production ramp up has been slower than anticipated, Tesla has grown its manufacturing capacity to be able to meet the strong demand for the new vehicle. It has reached a production rate of 20.000 vehicles a year, and has plans to further increase this capacity to reduce the long waiting lines for the new car.

As the first Model S reached customers, the new car was awarded almost every major automobile award, including the first ever unanimous designation as the Motor Trend Car of the Year (also the first to win the honor without running on an internal combustion engine), considered the highest recognition in the automotive industry.

Tesla's latest launch has been its network of Superchargers, high speed charging stations that the company is building across the United States to allow free long range travel to Tesla owners. Powered by solar energy, they are designed to give half a charge in about half an hour (or 250 km of range for a 85 kWh Model S battery) and are placed along well-traveled routes (such as between Los Angeles and San Francisco), and near places a traveller would want to stop at such as roadside diners, cafes, and shopping centers. The first six stations to be activated completely cover California, with 150 additional stations being built across North America by 2015, enabling unlimited range for free.



Tesla's design innovation performance.

C.2. Investment in design strategy

Tesla's main product development team was originally located in a tent just outside the SpaceX rocket plant in Hawthorne, California. Today the design team has grown to over 200 employees and has joined the more than 300 other employees who conduct R&D on powertrain technologies at the company's new headquarters, located at the Stanford Research Park in Palo Alto, the epicenter of Silicon Valley.

The company has an in-house team of designers lead by Franz Von Holzhausen, who has been driving the overall design direction of Tesla, and is charged with creating and leading the growing design team that will work on all future Tesla design concepts and production vehicles. Before moving to Tesla to work as Chief Designer on the Model S, Von Holzhausen was Director of Design at the Mazda North American Design Center, having previously worked at GM and Volkswagen.

WHAT DESIGN IS

"I believe you've got to have a compelling product at the end of the day. Otherwise you're just going to address a very small segment of the population that cares enough to suffer through this horrible product. And it's just never going to scale. We had to show – and I think we have with the Model S – that an electric car can be better than any gasoline car. When you look at it in terms of safety aesthetics, functionality, performance, entertainment, fit and finish – when you combine all those elements, how they combine as a gestalt. Do they all fit together and make sense? I think the Model S does."

Elon Musk

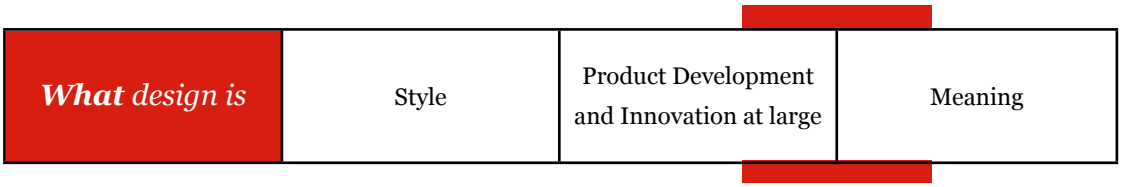
Following the founder's philosophy, Tesla is a company driven mainly by its products. Elon Musk has set up the company following the organizational model of nearby Apple, and has incorporated into the company culture the same approach to product perfection and high quality.

He realized that in order to bring to market effectively the electric car, Tesla wouldn't just have to overcome technological obstacles. The public's idea of electric cars had to be radically changed.

"The mark of a good design is something that has great aesthetics and great functionality."

Elon Musk

Tesla's use of design has been aimed at achieving this goal, while at the same time acting as the connecting function between the different engineering departments, combining their efforts to extract the maximum value from Tesla's technical innovations.



HOW IS DESIGN USED – THE ROLE OF DESIGN IN THE NPD PROCESS

"Tesla is changing the paradigm. We're going to turn the world on its ear and create high demand through design. There is a new hunger in the air for automotive design and looking to where automobiles are going in the future. Tesla will capture this through good design and engineering."

Franz Von Holzhausen, Tesla Chief Designer

Tesla's design team has a close relationship with the vehicle and powertrain engineering teams in order to maintain tight communication throughout product development.

From the outset, the team created the design prototype with fundamental understanding of the realities of production, and designed the exterior to contain the right interior volume. Every millimeter of the car was considered by the design and engineering teams together, displaying a close teamwork that is unique in the automotive sector. This meant that once the initial design prototype had been perfected through a detail-oriented iterative process, the vehicle had to be subjected to only small design changes as the development progressed towards production.

This approach is radically different from the rest of the automotive sector, where the design process produces a prototype independently and hands it off to the engineers, ending there its involvement into the project. This is the reason why automotive concepts never look like the final product.
Looking at the Production Model S from the side, and comparing it to the initial design prototype, or to the Model S Alpha, the centerline (the curve from the hood

to the rear of the car), has not changed, and only minor adjustments have been made.

Design maintains control over the entire process, from beginning to end, and leads it through its collaboration with the engineering teams.

***How** is design used: the role of design in the NPD process*	Function	Multifunctional Team Member	Process Leader

HOW IS DESIGN USED – THE KIND OF NPD PROCESS

Franz Von Holzhausen arrived at the company to work on the first car to be completely designed, engineered and built by Tesla: Model S.
With a team of eleven, he spent eight months of intensive work on the design of the Model S, a timeline that seems preposterously short by the standards of the traditional automotive industry.

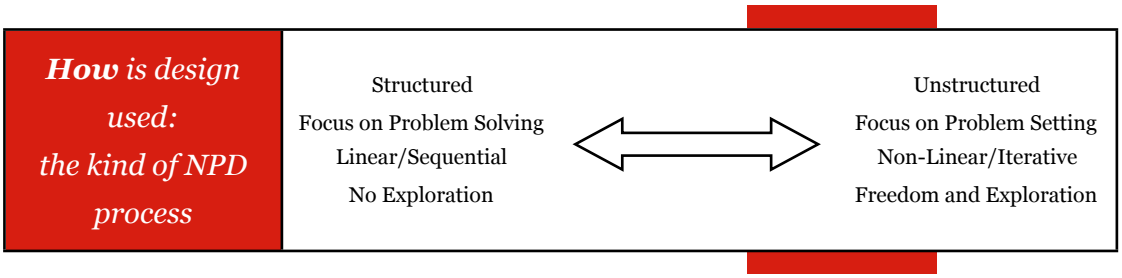
The development process at Tesla is the union between the software development backgrounds of the company's founders, and the automotive experience obtained through the original partnership with Lotus.

The project progresses through "major versions", called Alpha, Beta and Production that gradually increase the parts commonality with the final product. While the initial prototypes are created using design tools and techniques that are traditionally employed in the automotive sector, such as clay modeling and CAD software, the design team takes an unconventional approach to the design process that consists in a tight integration with the engineering teams.

Instead of focusing just on the aesthetics of the vehicle, the design team works with the engineers to directly create an initial design that includes both the technical, as well as the stylistic aspects of the product. This collaboration means that the

two teams inform each other's work, contributing to the innovativeness of the solutions adopted.
Innovations such as the "skateboard architecture" in the Model S, or the large touchscreen controls inside the car have been achieved through this unique collaboration between design and engineering.

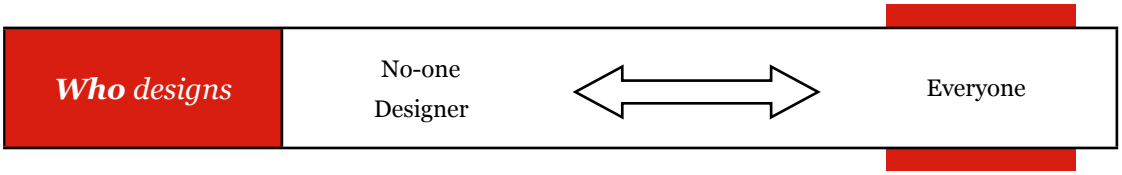
While the process proceeds though precise and well defined development phases, the origin of each product is the result of a creative process that proceeds though iteration, creative exploration, and especially tight collaboration between different company functions.



WHO DESIGNS

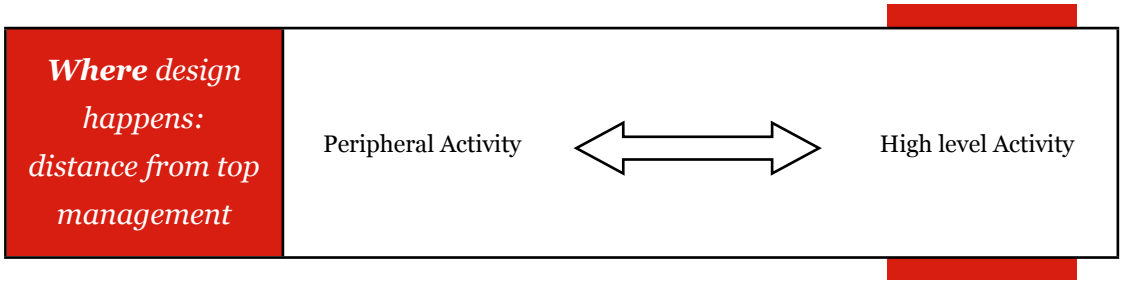
The nature of Tesla's design phase means that design isn't the sole responsibility of the designers. The engineering teams are deeply involved in the process and must take their part in the definition of the product's characteristics.

Even the Chief Executive Officer has his part in the design process, as Elon Musk also holds the title of "Product Architect", and personally participates in and oversees all product developments, together with other members of the executive staff.



Von Holzhausen, is part of the company's senior management with the title of Chief Designer, and is among the top ranking executives in the company.

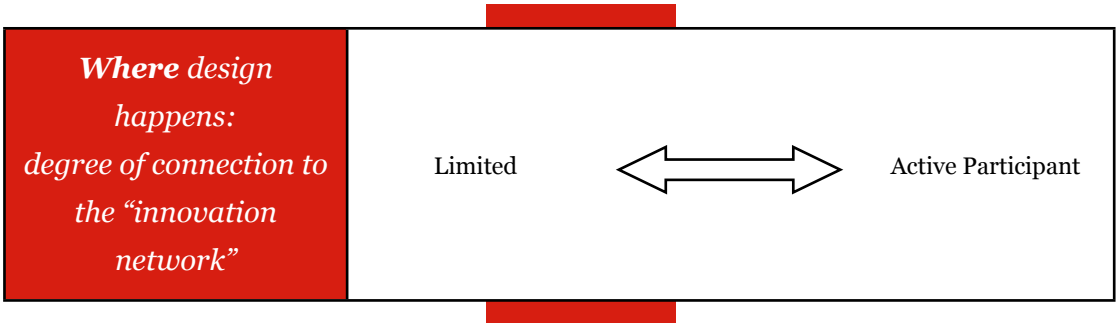
His tight collaboration with Elon Musk, guarantees that design is one of the highest level activities for Tesla, and remains central to all of its strategic decisions.



Tesla has a culture of independence that limits its involvement with other sources of innovation. It designs, engineers, and produces its vehicles completely in house and relies on external companies just for its supply of materials and non essential parts and components.

However, being located in Silicon Valley, it has started to engage with other local companies. Elon Musk has personal relationships with various other important CEO's, some of which have personally invested into the company and may provide interesting opportunities in the company's future (Larry Page and Sergey Brin are major investors in Tesla Motors, and Google has been working for years on self-driving vehicles, opening up the doors to possible future collaboration).
Tesla has also partnered on projects such as the Superchargers with Solar City, a

solar panel company of which Elon Musk is Chairman.



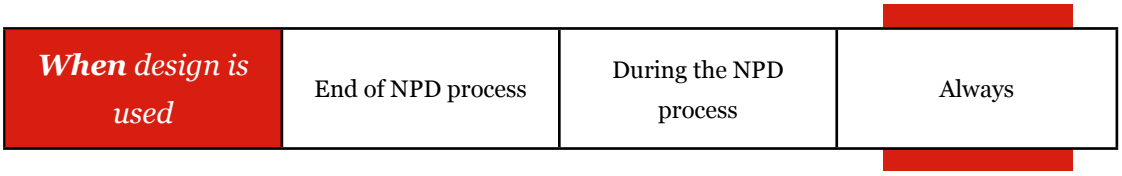
WHEN DESIGN IS USED

"Most traditional automotive prototypes look very little like the cars that make it on the road. In previous jobs at other car companies, I'd hand off a design to production and my input ended. Not so at Tesla."

Franz Von Holzhausen

As we have seen, Tesla's designers remain within the project team for the entire product development process.

At the same time, Von Holzhausen's seat within the company's top managers, in conjunctions with Elon Musk's design sensibilities, mean that design has an impact on the company's strategy, which is in fact very much centered around its product, and around the customer's overall experience.



WHY IS DESIGN USED

In its quest to redefine the modern car, Tesla considered the entire product experience, and hired George Blankenship, who had previously contributed to the creation of the highly successful Apple Stores, as Vice President for Sales and Ownership experience. Blankenship has the task of managing the entire process of

owning a Tesla: from the way the product is bought, to the way it is serviced and used.

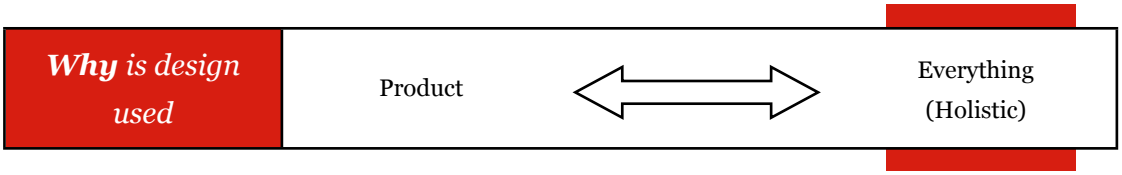
Tesla started opening boutique stores and placing them in glamorous shopping neighborhoods, with all purchases of the car done online directly from Tesla's website. This allowed the company to circumvent the traditional dealership system and to maintain control over the customer experience.
Tesla Stores serve as the company's primary point of contact with its consumers, and is the main marketing expense the company sustains, as the company has never yet made use of traditional advertisement.

The choice of Blankenship hasn't been accidental. The stores feature an "experiential" design, with interactive displays, product cutouts explaining the main features behind Tesla's products, and allowing customers to touch with their own hands the products. Just like Apple stores, they are designed to be "clean, approachable, comfortable and exciting," and invite passers by to enter and experience first hand the products, without any pressure to buy the cars (an annoying aspect of traditional dealerships the company wishes to completely eliminate). In fact the store employees cannot sell cars to the customers directly, but instead assist them with buying the cars through the company's online store, without receiving any economic incentive based on the sales generated.

One of the most important aspects of ownership that needed to be considered was how the car would be recharged. The Model S was designed to be charged with any conventional power outlet, allowing customers to fully charge the Model S battery overnight almost everywhere in the world.
Tesla has also designed a dedicated home charger that can be easily applied in any home and reduces charging times significantly (up to 100 km per hour of charging). Tesla also offers its owners free access to its network of high-speed Superchargers, fast charging stations strategically positioned along popular highways, allowing free long range travel.

But design has had an impact on all of the company's activities: from the way cars are delivered to the customers, to the clean and beautiful factory layout and

including the company's cutting edge websites and mobile apps.



C.3. Competitive Performance

GROWTH

Until late 2012 the company's only revenues came from the sale of components to other manufacturers, and from the small number of Roadsters sold. The launch of Model S, with its significantly bigger volumes has already had a substantial impact on the company's sales, despite the initial slow production rates. At the end of 2012, 2.650 Model S have been delivered to consumers (almost all during the fourth quarter), contributing to over $410 million in sales.

Reservations hit new record levels, driven by the multiple Car-of-the-Year awards, and the appearance of the first customer cars on the roads generating a strong word-of-mouth effect. More than 6000 new reservations were added in the last quarter of 2012, bringing the total number of reservations to 15.000, with deposits valuing more than $138 million.

Those reservations represent three quarters of the entire production capacity for 2012 of 20.000 vehicles, a goal achieved almost exclusively through sales in the U.S. And not counting large markets like Europe and Asia, where Model S has yet to be launched.

Such numbers would place Tesla as the electric vehicles market leader in the U.S., and with a substantial market share, considering that 53.172 EVs were sold in the U.S. in 2011[1]. Already in the first months of 2013, the 2011 best seller, the Chevrolet Volt, which recorded 23.461 units last year at a price of slightly over thirty thousand dollars, has lost the first spot to the Model S, which starts has been selling at an average price of over $100.000 (the starting price is $59900).

The strong demand, and long waiting list, has pushed the company to increase the price of Model S by about 5%, and to start making plans for an increase in production capacity at the end of 2013.

The company has also grown its employees substantially, more than doubling in the last year, and reaching over 3500 full-time employees around the world.

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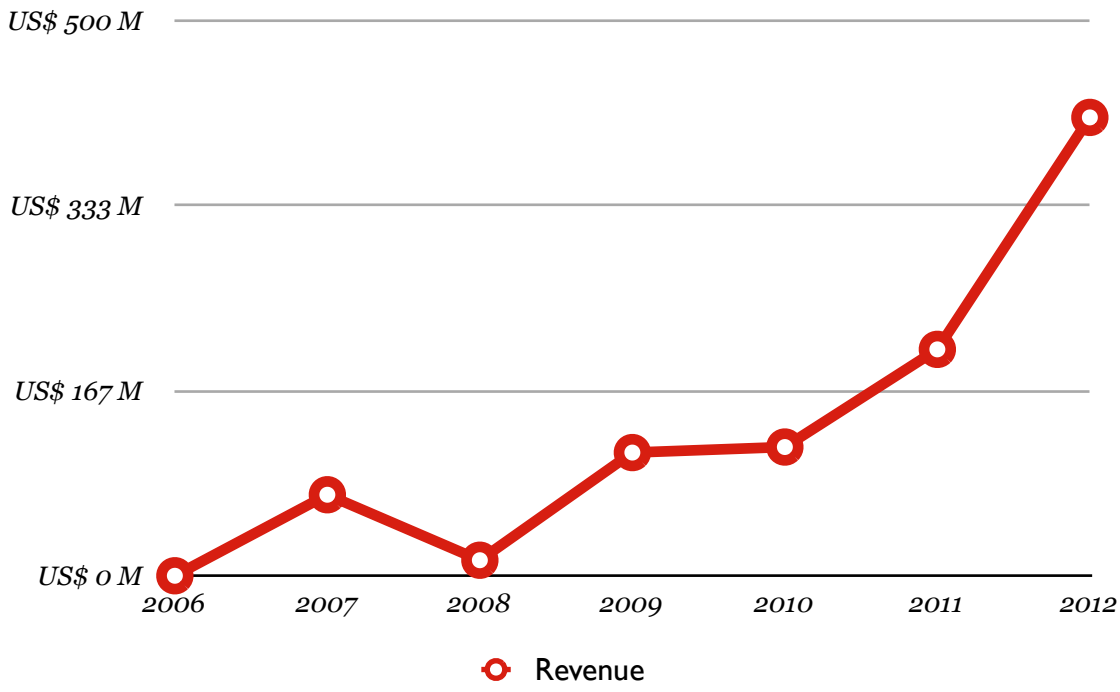
[1] *source: the monthly reports by Baum & Associates for HybridCars.com .*

	2006	2007	2008	2009	2010	2011	2012
Revenue $M	–	73,0	14,7	111,9	116,7	204,2	413,3
Y/Y change	–	–	-79,81%	659,35%	4,29%	74,95%	102,34%
R&D expenditure	25,0	62,0	53,7	19,3	93,0	209,0	274,0
Y/Y change	–	147,86%	-13,30%	-64,10%	382,29%	124,72%	31,10%
EBIT	-30,4	-79,9	-78,5	-51,9	-146,8	-251,5	-394,3
Y/Y change	–	-162,67%	1,79%	33,89%	-182,94%	-71,27%	-56,78%
Operating Margin	–	-109,50%	-532,52%	-46,36%	-125,78%	-123,13%	-95,41%



PROFIT

As Tesla ramps up its production the profit margins have been growing steadily. In its second quarter of sales of Model S (Q4 2013) the company had a gross margin of around 8%, which is expected to grow steadily as production continues and higher efficiency is achieved.

In the first quarter of 2013 Tesla expects to reach profitability for the first time in its history, aiming for a gross margin of around 25% by year-end.

To expand and support the growing customer base, Tesla continued to invest in its infrastructure of stores, service centers and Superchargers.

Eight new stores were opened in the United States in the fourth quarter of 2012, bringing the total number of stores around the world to 32.

With the launch of Model S, visitor traffic soared, recording over 1,6 million visitors in the last quarter of the year. This was almost as many people as those who visited Tesla's stores during the entire first three quarters of 2012.

Tesla plans to open 15 to 20 more stores next year, with about half the openings in Europe and Asia. to support the expansion into these regions during the second half of 2013.

The company also continued building its service centers, reaching a total of 29 locations worldwide and with plans to double this number by the end of 2013, to keep pace with the growing fleet of cars.

Following the successful launch of the first Supercharger network in California, the first few additional Superchargers were built on the east coast at the end of 2012. Customer adoption has been beyond expectations, so while just nine stations are currently active, they will be expanded to over 100 stations by 2015.

C.4. Within-case analysis

		Design as Style	**Design as Process**	**Design as Strategy**
***What** is design*		Style	Product Development and Innovation at large	Meaning
***How** is design used*	*The role of design in the NPD process*	Function	Multifunctional Team Member	Process Leader
	The kind of NPD process	Structured Focus on Problem Solving Linear/Sequential No Exploration	⟺	Unstructured Focus on Problem Setting Non-Linear/Iterative Freedom and Exploration
***Who** designs*		No-one Designer	⟺	Everyone
***Where** design happens*	*Distance from top management*	Peripheral Activity	⟺	High level Activity
	Degree of connection to the "innovation network"	Limited	⟺	Active Participant
***When** design is used*		End of NPD process	During the NPD process	Always
***Why** is design used*		Product	⟺	Everything (Holistic)

	Tesla	**Automotive Industry**
Design Approach	Strategy	Style

Summary of Tesla's use of design.

Company		Major Radical	Minor Radical	Major Incre-mental	Total	Timeframe
Tesla Motors Inc.	*N°*	2	1	1	4	5
	% of total	50%	25%	25%	100%	
	N°/year	0,400	0,200	0,200	0,800	

Competitive performance					
CAGR @[number of years considered since last]			*Profit*		
Tesla	*Market*	*Δ*	*Tesla*	*Market*	*Δ*
54,5% @4y	13,41% @4y (U.S. automotive manufacturing sector)*	306,4% @4y	Gross margin 25% end of 2013 target	Gross margin 23,37% 2012 (automotive sector sector)**	–

* source: Marketline

** source: NYU Stern School of Business.

Summary of Tesla's design innovation and competitive performance.

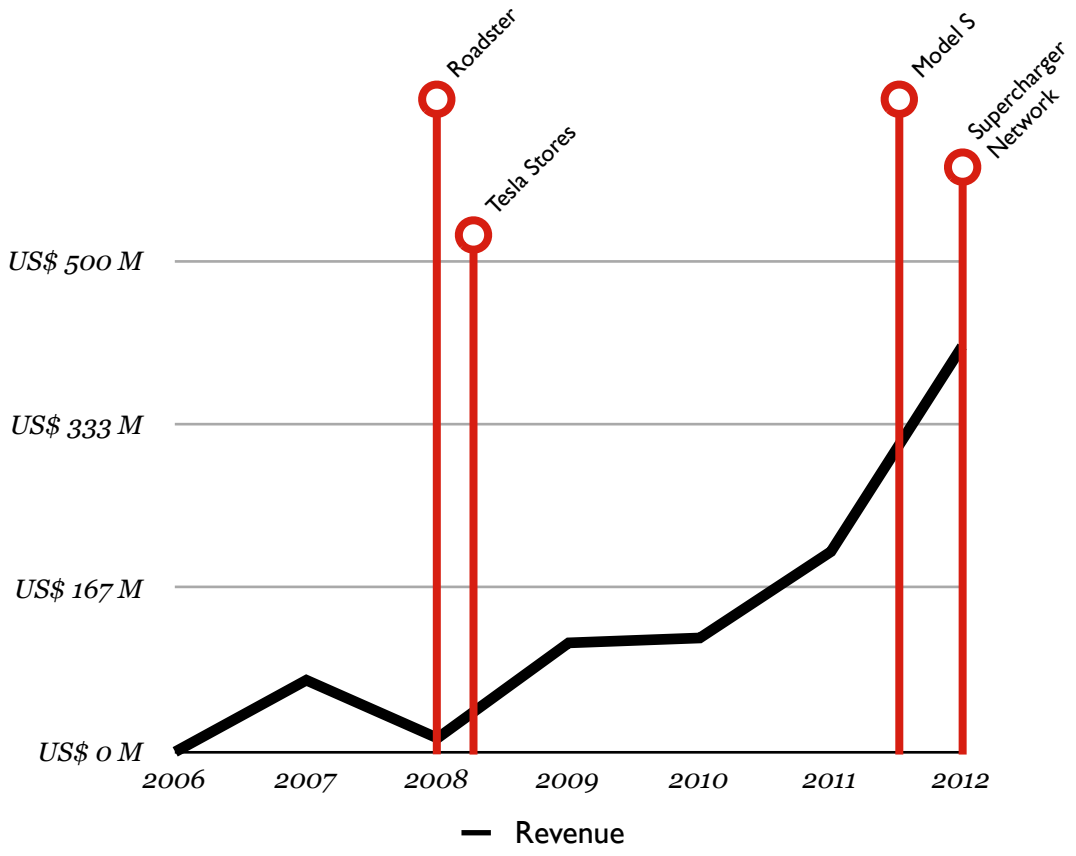
CONSTRUCT ANALYSIS

Tesla is trying to emerge in one of today's most competitive industries by attempting to be the first company to successfully bring to market electric vehicles. Many have failed, or are currently struggling with this goal, but Tesla is the first to combine this technology with an advanced design strategy, and today appears to be in a good position to be the first to succeed.

Other car makers invest significantly in design resources, but continue to adopt design management practices corresponding to the "design as style" level. Tesla's use of design is generally consistent with the *design as strategy* approach, apart from the fact it has chosen to limit its degree of connection to the "innovation network".

The resulting design innovation performance for Tesla has been outstanding, culminating with its latest product being honored with several of the industry's most prestigious "Car of the year" awards.

Ever since the launch of its first product the company has been growing at a tremendous pace, with a CAGR of over 50% over the last 4 years, which represents a four-fold increase over the market average. For 2013 the company also expects to reach around 25% gross margin, which would be in line with the industry's average, a remarkable feat after just one year since the launch of the first model using the completely new production line.



TIME SERIES ANALYSIS

The company is starting to see the first financial returns from its superb product performance, having recorded exceptional demand for its models, and selling most of 2013's production before the start of the year.

The Roadster allowed the company to grow substantially until now, however, Tesla's launch of the more ambitious Model S will bring the company to a new order of magnitude in sales. While 2012 showed the potential in the company's future, the next several years will tell if Tesla's design-driven approach was successful at making electric cars a reality.


D.
dyson

D.1. Design innovation performance and context

James Dyson's career as an inventor began in 1970 with the launch of his first product, the Sea Truck, a flat-hulled, high-speed watercraft, similar to a small landing craft, presented by Dyson as part of his final project at the Royal College of Art in London, where he was studying architecture.

A few years later, while renovating his home, he discovered a number of problems with the conventional wheelbarrow he was using while renovating his property. The wheel sunk into the mud, it was unstable and was prone to punctures; the steel body caused damage to paint work and became covered with dried cement. These problems got Dyson thinking about improvements, and by 1974 he had created the first prototype of the Ballbarrow, which used a ball instead of a wheel, stopping it from sinking into soft ground. Dyson then went on to use the same principle for his next products, introducing the Trolleyball, a trolley that launched boats, and the Wheelboat, which could travel at speeds of 64 kilometers per hour (40 mph) on both land and water.

Fig. D.1: the "Ballbarrow" (left), one of James Dyson's early inventions, and one of the 5127 prototypes for the first bag-less vacuum cleaner (right).

The breakthrough came in the late 1970s, when Dyson bought a Hoover Junior vacuum cleaner. He had rapidly become frustrated by how the Hoover became clogged quickly and lost suction as the bag filled up over time. The machine only worked well with a fresh bag, it lost suction over time. He resolved to develop a better vacuum cleaner that worked more efficiently. During a visit to a local saw-mill, Dyson noticed how the sawdust was removed from the air by large industrial

cyclones that operated for many hours without any loss in suction. Dyson wondered if the same principle might work, on a smaller scale, in a vacuum cleaner, so he removed the bag from the Hoover Junior and fitted it with a cardboard cyclone, and immediately found it picked up more dust.

It would take Dyson 5 years and 5,127 prototypes to finally complete the world's first cyclonic bag-less vacuum cleaner. When he offered his invention to major manufacturers however, they turned him down one by one, apparently not interested in the new technology. They seemed determined to continue selling bags, a market worth $500 million every year. Later, Hoover's Vice President for Europe, Mike Rutter, said on UK national TV: "I do regret that Hoover as a company did not take the product technology off Dyson; it would have lain on the shelf and not been used".

Ultimately in 1983, a Japanese company, Apex, licensed Dyson's design and built the G-Force, which appeared on the front cover of Design Magazine the same year. In 1986, a production version of the G-Force was first sold in Japan for the equivalent of £2,000. Its strikingly innovative design (it even had an attachment that could turn it into a table to save space in small Japanese apartments) and superior performance, allowed the new vacuum to win the 1991 International Design Fair prize in Japan and turned it into a status symbol in the Japanese market.

Using the income from the Japanese license, James Dyson set up the Dyson company, opening a research centre and factory in Wiltshire, England, in June 1993. His first production version of a dual cyclone vacuum cleaner featuring constant suction was the DC01, sold for £200.

The DC01 also incorporated solutions to many other problems Dyson had noticed in conventional vacuums. It incorporated a stair hose that could stretch all the way up the stairs, on-board tools, tough ABS plastic construction, and improved edge cleaning. Another first for the DC1 was the controversial clear bin. Market research showed that people wouldn’t be happy with a transparent container full of dust and dirt, and even retailers thought it was a terrible idea, but Dyson and his team though it would be interesting to show the inner workings of the machine and believed that showing the results it obtained would be satisfying to the user. Despite the negative feedback the company went with it and the idea

turned out to be a popular and enduring feature, which has been heavily copied by the competition.

The Dyson vacuum wasn't like an ordinary vacuum cleaner. Its complex appearance left all of its parts in plain view, and even allowed the user to see the inner workings and results of using those machines. They had a cutting edge, high-tech feel that communicated effectiveness and power, and distinguished them from the bland and powerless look of its competitors.

In just 18 months the DC01 became the best-selling vacuum cleaner in the UK.

Fig. D.2: the DC01 bag-less vacuum cleaner with its clear dust bin.

In 1997 the company's launched its second product, the DC02, a canister vacuum based on the same technology of the DC01, with a compact chassis that was shaped to sit on stairs.

The original team of 3 Dyson engineers grew to 350 scientists in an entirely new research center, looking for new ways to improve the products: their goal was to create vacuums with even higher suction, so the team set to work developing an entirely new type of cyclone system.

They discovered that spreading higher airflow through many cyclones generated even higher suction power, which picked up more dust from the floor. The newest Dyson cylinder machines today have three distinct stages of cyclonic separation - each engineered to capture smaller and smaller particles. Air velocity increases at each stage: its 20 metres per second in the outer cyclone, 50 metres per second in

the core separator, 80 metres per second in the inner cyclones, subjecting the dust particles to forces up to 100,000 G.

In 2000, Dyson expanded its appliance range to include a washing machine. Dubbed the ContraRotator, it added a second rotating drum that moved in an opposite direction in order agitate clothes more vigorously and simulate hand cleaning, a much more efficient way of cleaning clothes than that of a traditional washing machine. The range had the characteristic high tech Dyson look, and came in the bright colours, rather than the traditional white, grey or black of most other machines. It was an innovative product, featuring 120 patents and patent applications, but in 2005, the company discontinued its manufacturing. The ContraRotator was extremely expensive to manufacture, comprising twice as many components as other machines, and, being specifically designed for the UK market, it was never able to obtain the manufacturing efficiencies possible with a global market.

"Retrospectively, we should have charged more or done the technology without using so much machinery. As a washing machine, it was a great success. As a business, it wasn't. We made a washing machine that was too expensive; it had too much technology. We had automotive technology like a gearbox to switch the drum direction."

James Dyson

While initially all production had been localized in Wiltshire, in 2002, in a highly controversial and bitterly opposed move, Dyson moved its manufacturing plant from England to Malaysia, leaving 800 workers redundant, and maintaining only the company's headquarters and research facilities in Malmesbury.

Despite the failure of its washing machine division, in early 2005, Dyson cleaners had become the market leaders in the United States by value (though not by number of units sold) and were expanding significantly all around the world.

That same year Dyson's continuous effort to improve its vacuums had produced a radical new design. The engineering team revisited the wheel ball from Dyson's original Ballbarrow concept, and incorporated it into its DC15 vacuum cleaner, creating the Dyson Ball. This vacuum had 182 patents – one for every week of its development – and used a glass-reinforced polypropylene ball to house the motor and its components, lowering the machine's center of gravity and thus reducing weight in hand. Compared to traditional wheels, the Ball, in conjunction

with a special hinge, can move in any direction, and allows the user to steer the vacuum in any direction by simply twisting the handle towards the desired side.
Once again the company was taking a bold step in rethinking the way a vacuum cleaner should work, and look, earning the company an iF Product Design Award, the fourth for the company so far, as well as a Red Dot Award with one of the later versions.

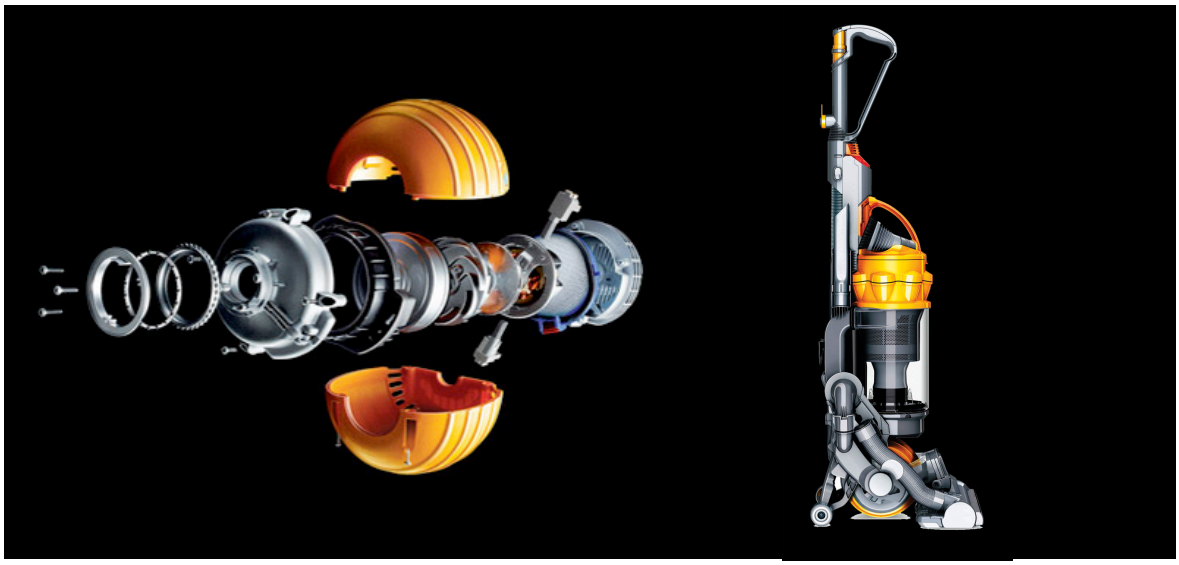


Fig. D.3: the Dyson Ball vacuum.

At the end of 2006 the company tried once again to branch out into a new market and launched the Airblade, a fast hand dryer for public spaces.
The company was working on a product that never saw the light of day, which involved water and powerful slivers of air. One day an engineer attempted to dry his wet hands with the airflow: "we all noticed, and suddenly said together, 'Hand drier'" recalls James Dyson.
Instead of blowing hot hair to evaporate the water on the user's hands, it's based on a completely different principle: it uses a thin slit to create a 650 km/h uniform flow of cold air that acts as an invisible wiper blade, actually scraping water from the hands. This results in a hand dryer that takes just twelve seconds to dry hands and uses 80% less energy than dryers using warm air. At the heart of this new product is what Dyson calls a Digital Motor. The result of seven years of development, it is a brushless electric motor half the size and weight of a traditional model but which doubles the efficiency (84% versus 40% of the average small electric motor).

The product was a commercial success, and was immediately awarded several prizes for its ingenious design by some of the most prestigious international organizations.

Having developed the Digital Motor, the company started thinking of new ways of using this new technology. In 2007, it introduced the DC16 the first product in a new line of handheld vacuum cleaners. It united the Digital Motor to Dyson's cyclonic vacuum technology to create a lightweight and compact model, with extremely high performance.
Within three weeks this new model had become the market leader in several countries and to this day is one of the most profitable lines for the company.

In 2009 the company introduced its latest product line, making use once again of the Digital Motor: called the "Air Multiplier", it is a bladeless fan that uses the same high-speed airflow of the Airblade, but in this case to create a refreshing column of air. The product is today also available with a heating element, to be used as a heater fan, and in different sizes and configurations, creating an additional product line for the company.

THE AIR MULTIPLIER: INNOVATION IS ACCIDENT.

While developing the Airblade hand dryer the engineers rapidly discovered there was a side effect to the product's jet-like exhaust: the 600 km/h sheet of air was dragging a considerable portion of the surrounding air with it. Dyson and his staff started studying the air flow, which was akin to a comfortable breeze, and realized that, due to a process of inducement, much more air was being accelerated than what the hand dryer was blowing out.

"We had no intention to make a fan. But the failure made us curious. We asked, What could we do with this high-speed air?"

James Dyson

The engineers thought they could harness this wind, but it didn't really apply to any existing products. So they moved on to consider what other everyday household products could be improved if they generated a focused and homogenous breeze, and decided on the typical electric fan,

which uses rotating blades to hack air into pieces that are then propelled at an uneven pace.

> *"[Innovation is] accident. Serendipity--but the serendipity that occurs through never giving up and through just going on and on and on, testing, searching new avenues. And going up many, many blind avenues!"*
>
> *James Dyson*

Once the team decided that the extra air generated by the Airblade's inner mechanisms could be used in a new type of fan, the team began designing the new product. To give the new device a form that signaled what it did, they created a silhouette that suggested a standard table-top fan. The actual fan and motor were placed at the base of the product with openings through which air could be sucked in, just as in the Airblade, and moved up to the ring.

The ring's curved surface features a 1-mm slot, and when air passes through the slot onto a slightly angled tier of plastic, it creates a suction-like effect that increases the airflow. This effect, in combination with the inducement action they had noticed with the Airblade, accelerates up to eighteen times the amount of air ingested by the motor in the base, eliminating the need for the external blades of a conventional fan and providing a much smoother movement of air that feels like a natural breeze. The product also encases all moving parts, making it easier to clean and safer to use.

The initial design had an amplification ratio – how much air is dragged along for each unit of primary flow – of six to one, which needed to be improved substantially for the finished product. Developing the annular ring with the conventional rapid physical prototyping process would have required two weeks to build and test each new iteration. The engineers decided therefore to use fluid dynamics software to develop up to 10 different designs per day and letting the computers run simulations during the night so that new results would be available each morning. This allowed the team to investigate 200 different design iterations using simulations, and to finally use physical testing to validate the final results.

The motor used for the Air Multiplier is based on the Dyson Digital Motor introduced with the Airblade. This brushless DC motor carbon, with an impeller made of a carbon fibre-reinforced polymer that spins at 104,000 rpm, has been in development for more than a decade and is what makes those products possible, thanks to its compact design, and powerful performance.

Fig.D.4: the Air Multiplier in two of its configurations.

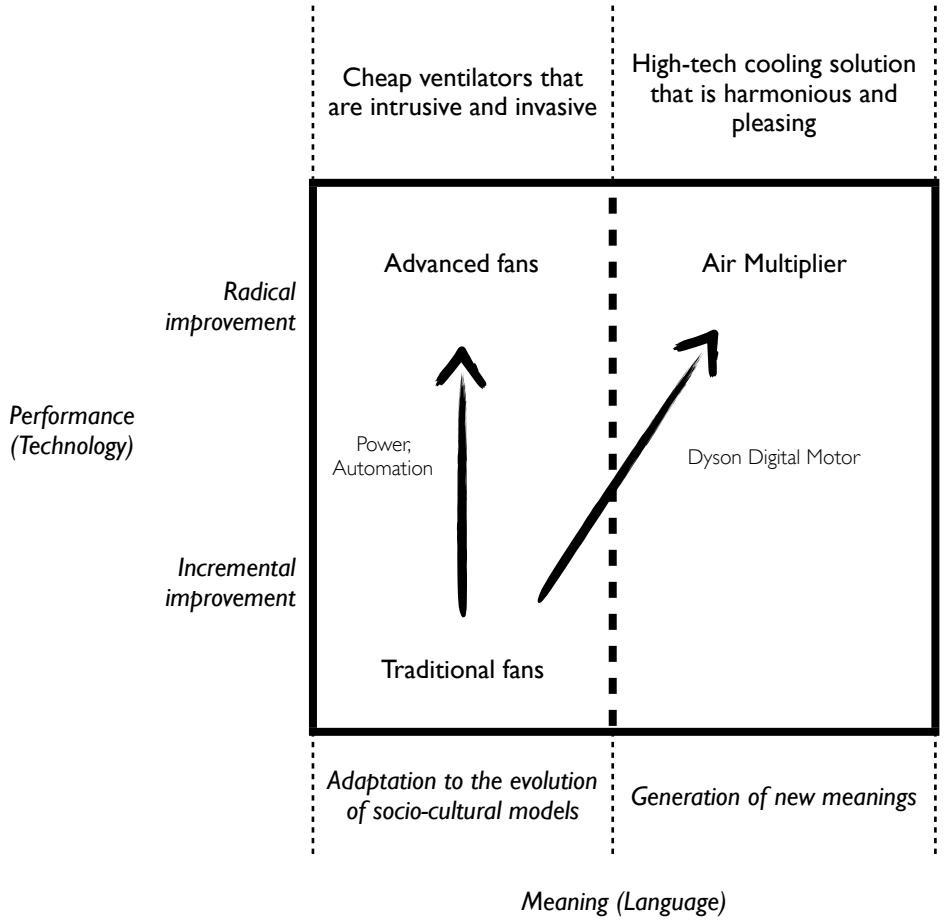
It took about three years to develop the Air Multiplier. Released to wide international recognition in 2009 – including being named in Time magazine's list of best gadgets for the year.

At first the fan was made available only at design-conscious boutiques in selected cities, as well as online though the Dyson website, at a retail price over four times higher than the competition. Once the product proved successful the company expanded the distribution to large retail chains such as Best Buy and Target in the U.S., but maintained the significantly higher prices, underscoring how this product belonged to a different category than its competition.

The Air Multiplier has been the first step in the creation of a third product division for the company, which today produces this new kind of fan in various shapes, and forms. In 2011 the line has been expanded fur-

ther with the introduction of the AM04 Hot, an Air Multiplier which also produces hot air, working as a fast and efficient room heater.

Even with the new versions, every detail has been considered and appropriately designed: the slim remote is curved and contains a magnet that allows it to be placed securely on top of the fan ring, a sensor shuts down the fan if it is accidentally knocked over (making the heaters more secure), and a smart thermostat allows the user to set the desired room temperature, which is then automatically maintained by switching the heating element on and off appropriately.
The fans can also be effortlessly tilted with a touch, thanks to the weighted swinging base, to precisely adjust and direct the cool (or warm) stream of air to where it is needed.



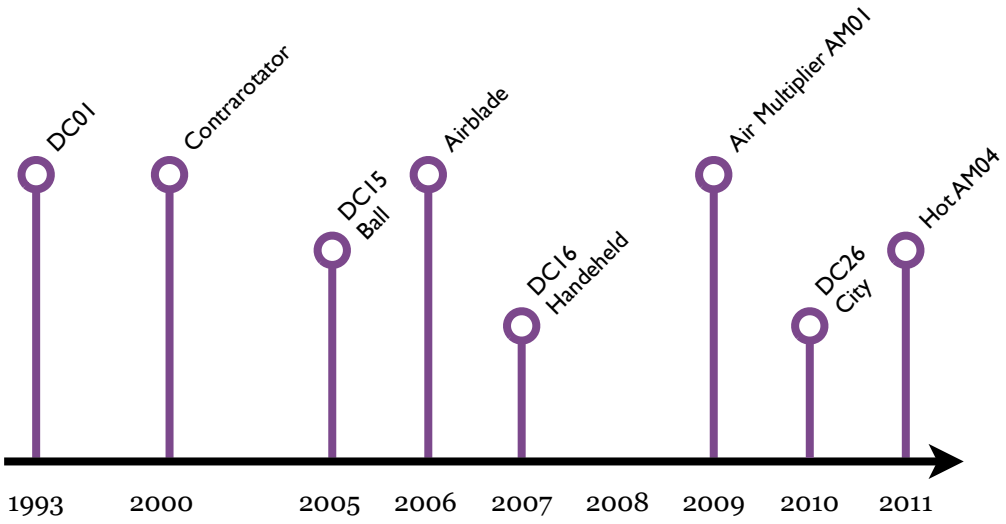
It is interesting to notice how the company has adopted with this product a design language that is at complete odds with the one used by its traditional vacuum cleaner lines.

While Dyson's vacuums expose the user to the inner workings of the product, leaving components of the product in plain view, and even allowing the owner to see the product's action through the clear bin, the Air Multiplier completely hides all of its moving parts and mechanisms, intriguing the customer with the mystery of its new way of moving air.
While its underlying technology remains "mysterious", its use is immediately clear to the user, thanks to the use of visual clues that bring to mind a traditional fan, and immediately identify the product's function. The product's minimal appearance is also quite different from the colorful and intricate look of Dyson's vacuums, and is designed to blend into a wide variety of environments.

Given the different meaning of the Air Multiplier when compared to the other Dyson products, those choices are appropriate, and reflect the company's ability to properly use design in a sophisticated manner.

Both the original AM01 Air Multiplier, as well as the AM04 Hot that followed, were awarded with numerous design awards, including the Red Dot and the iF design awards.

In 2013, Dyson plans to completely revamp its hand dryer offering. It will introduce a new kind of dryer which is based on the Airblade principle, but is fully integrated into the tap, so that hands can be washed and dried directly over the sink without dripping on the floor while moving around the bathroom.
While the original Airblade will just receive an efficiency upgrade, it will be joined by a new, more compact version, called Airblade V, which has a different design that protrudes just 10 centimeters from the wall.



Dyson's design innovation performance over the years.

D.2. Investment in design strategy

In 2011, at its Wiltshire HQ, the company employed around 1,450 people, of which more than 700 are engineers working at the Research, Design and Development department. Dyson operates almost exclusively with internal research and therefore covers a wide area of competences as diverse as fluid, mechanical, electrical, thermal, acoustic, and software engineering, and even includes a microbiology laboratory.

Dyson defines Research and development as the "lifeblood" of its business model: more than 1 million a week is invested in research and development projects, totaling 59 million pounds in 2011.

WHAT DESIGN IS

For me, design is about how something works, not about what it looks like. It's what's inside that counts. Good design solves problems and changes something for the better. Aesthetics should be a by-product of the design, not the other way around.

James Dyson

The company is characterized by a deeply rooted engineering culture, and has banished almost all forms of decoration in its products. With the possible exception of colour, Dyson's product aesthetics are almost entirely driven by function, with design seen as a step in the product development process, to be performed by the engineers themselves in order to allow them to solve complex problems and discover new approaches and ideas.

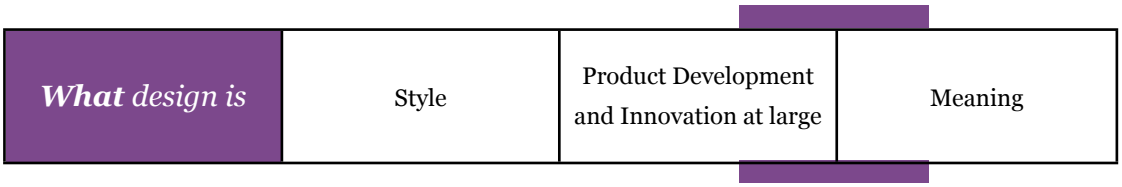
Form has a role because it's often people's first impression. But I'd rather say that when you look at the object, you've got to be able to tell what it is and what it does, and be taught something, and be excited in some way. And that isn't necessarily form following function, but rather something probably much more complex than that. So, for example, part of the reason for the clear bin is so you can see the technology inside, and you can see how it works. And not concealing the pipes on our products isn't because we want to do form follows function, but because I think it's important that people understand how they work

James Dyson

As the company expands its portfolio to new sectors and product categories, it is also realizing that design defines the meaning of a product, and are learning to adapt their design language to the product's meaning.

With their fans and hand driers they have taken a different approach than with their vacuum cleaner line, adjusting to the different environments of use and communicating different messages through the appropriate combination of technology and product language.
The Air Multiplier, for example, uses the opposite design language of Dyson's vacuums: instead of allowing users to see the machine in action, it completely hides from the user all of its mechanisms and moving parts, to the point that it appears to be working almost "by magic".

The company considers design as something that goes much deeper than the surface of a product. It is the main driver of innovation within the company, and all employees are taught to always be "designing", in order to identify new innovative opportunities, and constantly improve products.



HOW IS DESIGN USED – THE ROLE OF DESIGN IN THE NPD PROCESS

The company doesn't have a traditional "design" function, and employs no industrial designers. Instead it gives every new employee a crash course into basic design skills, and teaches them the company's guiding design principles.

During the entire product development process the "design engineers", as the company defines them, employ the skills they have been taught and constantly refer to the company's set of design guidelines.
One of such principles is "poka yoke" design, a Japanese phrase which means "fool-proofing": imagining what could go wrong and then designing it so that it's no longer possible. This principle instructs design engineers to never lose sight of the person who'll use the product they're designing, and to consider that they may not always use it in the way the designer had in mind. This leads, for example, to adding some kind of protruding teeth to all locking mechanisms, making it impossible to connect something incorrectly when using the product.

Design engineers are also taught to always consider their personal experience. Almost no ethnographic research is conducted by Dyson, and the little market research that is indeed conducted is usually not considered particularly trustworthy.

I suddenly realized that what I should do then was follow my instincts. I use these products every day. I understand them. So therefore I'm in the position of the consumer, and don't need to do all this research; I'm the researcher.
But in order to change these things you've got to break all the existing rules and take a big risk. And I think if you use the product, and understand it yourself, you know you can do that. You know you're taking a risk and that you believe that you're right because you use it yourself.
We have done some ethnography. But I'm always slightly suspicious of it; I think in many ways, watching people is interesting, but you're not quite hearing what they're thinking while they're doing it.

James Dyson

Design is therefore the driving force behind Dyson's innovation, and guides the company in the identification of new opportunities and markets, as well as during the actual product development process.

***How** is design used: the role of design in the NPD process*	Function	Multifunctional Team Member	Process Leader

HOW IS DESIGN USED – THE KIND OF NPD PROCESS

Ideas for new products at Dyson are first of all born from frustration. The engineers focus their attention on currently available products and rethink all of their features and characteristics. Every time a machine has finished development, a fresh team of engineers is tasked to take it apart and to interrogate each component to determine how and what could be improved.

At the same time the development process itself generates new ideas: through the intensive use of prototyping, new technologies and solutions are often discovered (sometimes accidentally) and twice a week the top management conducts a review of all ongoing research, looking for new opportunities and discoveries.

A dedicated group, called the New Product Innovation team, is responsible for determining early on which ideas could work and which ones should be shelved. If an idea gets the go-ahead, it's then passed to the product development teams, and the development process begins.

The development process itself is well defined by specific phases and procedures, but within each step of the process the design team is left with a lot of freedom to explore and experiment with radical new solutions, and at no time the procedure takes over the actual development of the product.
This is evidenced by the company's ability to set aside ongoing projects, no matter their stage of development, when a new, more promising idea, emerges during the process, or if the final result isn't completely satisfactory.
Examples of this can be found in the accidental birth of the Airblade and Air Multiplier, which happened while developing other products, or on Dyson's well known decision to momentarily set aside a robotic vacuum cleaner project, preferring to discard a fully completed project it had invested several years of research on, rather than to release a product whose performance didn't convince fully.

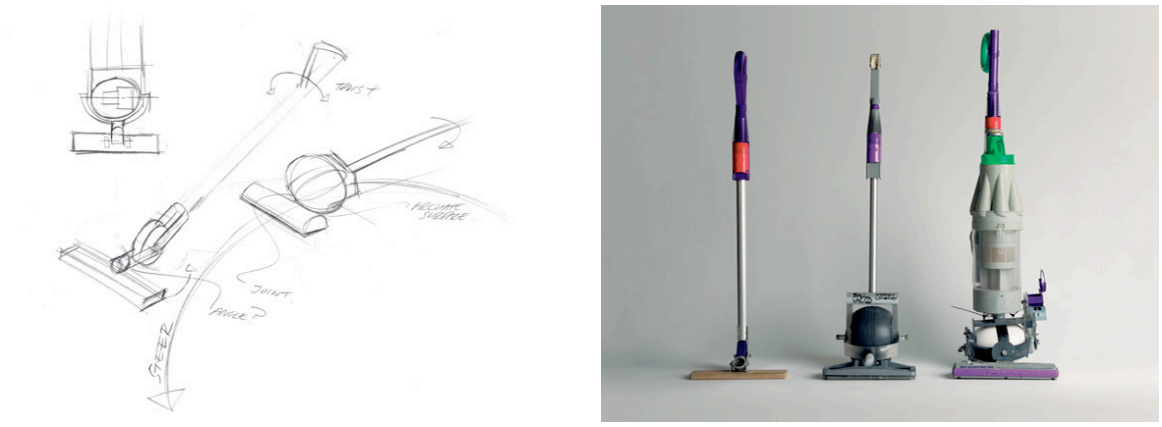


Fig. D.5: the Dyson Ball from concept to prototype.

The first step in the process is the creation of a new design brief that explains the challenge that must be answered by a product and the parameters within the design engineer must work. The design brief is then translated by the design engineers into a vision specification, which is a first basic diagram of what the machine will look like and what features it will have, including a list of requirements relating to how the product will be used and how it will look. The next step for the engineers is to develop a much more detailed engineering specification. This sets the

limits the machine must work within, including size, weight, power and noise, and will be referred to throughout the design process.

The most crucial part of the product development process, the Research and Idea Development phase, can now begin.
This phase cycles through three main activities: sketching, prototyping and testing. The cycle is repeated over and over again at an almost feverish pace generating an enormous number of product variations and prototypes.

Design engineers work in teams, discussing and sketching their ideas. Through hand sketching the engineers come up with the first ideas to put to to test and determine which areas require additional research. Drawings are an important bridge between the engineer's concept and the next vital step: creating basic prototypes.

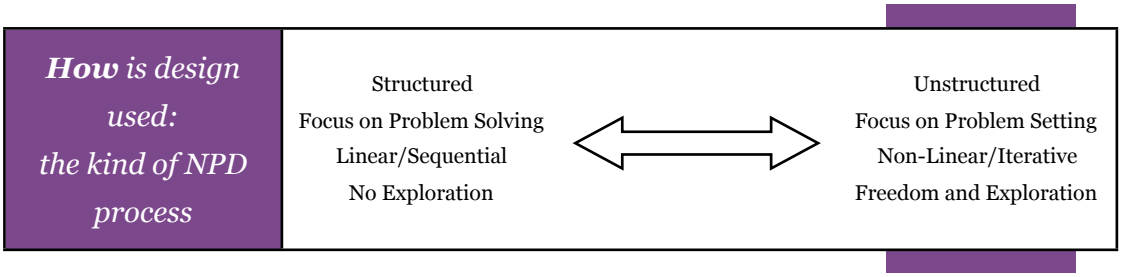
There's a myth about inventors that all you need is one good idea and you'll make your fortune, but the fact of the matter is it doesn't work like that. You start with a problem that you're trying to solve and you build prototypes – hundreds, or perhaps even thousands of them. And very often the original idea or the original problem doesn't look anything like the final problem or the final solution. The important thing is the journey from prototype to prototype.
During that process you get hundreds or thousands of failures - and the failure is the starting point, because when something fails you understand why it fails and then you start to think of ideas of ways that you can overcome that failure.

James Dyson

In the early stages, cardboard, glue and tape are used to construct layouts and model basic functions quickly and cheaply, giving the team a feel for things and uncovering the subtle design flaws you don't get from a computer screen. As the design develops, computer-aided design (CAD) software is used to plan the detail and create more complex prototypes that can be used for testing. The most advanced test articles are usually obtained through cutting edge 3D prototyping machines, to obtain mockups that can be manipulated and tested realistically. The team can also count on a large number of sophisticated tools such as high speed cameras or advanced fluid dynamics simulation software to help in researching and to speed up the development process by allowing rapid simulations of possible designs.

Each prototype is then tested until failure, identifying any potential weak points. With the aid of sophisticated robotic procedures as well as cruder methods

(such as home testing by the engineers or slamming hammers against the products) each design iteration is thoroughly examined. The failures from these tests help create new ideas and new prototypes, which are tested again. This testing isn't saved for the end of the design process: it's a crucial part of engineering a new product and goes on throughout.



WHO DESIGNS

By looking at the long list of design awards won by Dyson's company over the years one would find it hard to believe it, but the company actually doesn't employ any industrial designers whatsoever. It focuses on hiring mostly people with engineering or scientific backgrounds and then uses their first months in the company to teach them basic design principles and the company's interpretation of how design should be used: the result is what Dyson calls a Design Engineer.

I saw this as absolutely the way forward for product design or engineers; that the two shouldn't be separated. So actually, how we now work at Dyson is exactly how I worked, which is that the engineers develop the technology, engineer the product, and design it all themselves. They do the whole thing. Nobody comes along and says, "I'm the design expert," "I'm the engineering expert," or "I'm the R&D expert." We do have specialist scientists in that mix, but the main product people are engineers who've trained as designers. And we have one or two people who came to us through a slightly unconventional route, as artists or furniture designers.

James Dyson

Following James Dyson's vision, the company's engineers practice an integrated approach to design where they view designing, engineering, model-making, testing, and machining as overlapping disciplines without boundaries.

When I finished college at the Royal College of Art, one of the things I found worrisome was that if you were an industrial designer, you did the styling; if you were an engineer, you did the engineering; if you were a scientist, you did the R&D. And I looked at people like Buckminster Fuller, or Brunel, the Victorian engineer, or Andre Citroen in France--and here are people who did the R&D, the engineering and the design of the product all at the same time. And I could see that that's where my heart lay. […]
We don't actually employ any industrial designers. They're all engineers or scientists. Now, after I left college, 10 or 15 years later, the Royal College of Art and Brunel University started teaching engineers design.

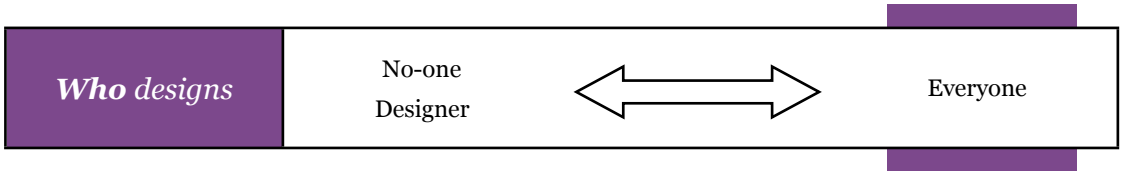
James Dyson

Dyson prides itself on its recruitment strategy, hiring graduates straight from university. By hiring young individuals with no previous working experience the company believes it can train them more effectively to become risk takers and to challenge the status quo.

"You get the best and you get them before they are indoctrinated in the wrong way, where their minds are still open, when people are ready to take risks. They don't know what is wrong and that is good. They are not conventional and we do not want them to become conventional."

Dyson CEO Max Conze

Those new design engineers, as well as all other employees including senior executives, are all encouraged and given the responsibility to come up with Dyson's next great idea. On their first day they are presented with a box containing the parts to a vacuum cleaner and asked to assemble it. Once completed they are allowed to keep the vacuum, and are also given a personal confidential notebook, in which to record their work and new ideas, which they sign and date daily to help protect their intellectual property.
This practice sends the message to every new employee that Dyson's priority is innovation, and that each of them should get directly involved in the process and experiment themselves.



WHERE DESIGN HAPPENS – DISTANCE FROM TOP MANAGEMENT

Sir James Dyson announced in March 2010 that he would step down as chairman of the company. His new title will be that of “chief inventor”.

James Dyson, who is still the sole owner, has always been mostly focused on inventing and engineering, and has always been closely involved in all work on the products; research engineers are expected to make presentations to him as part of the twice-weekly research reviews.

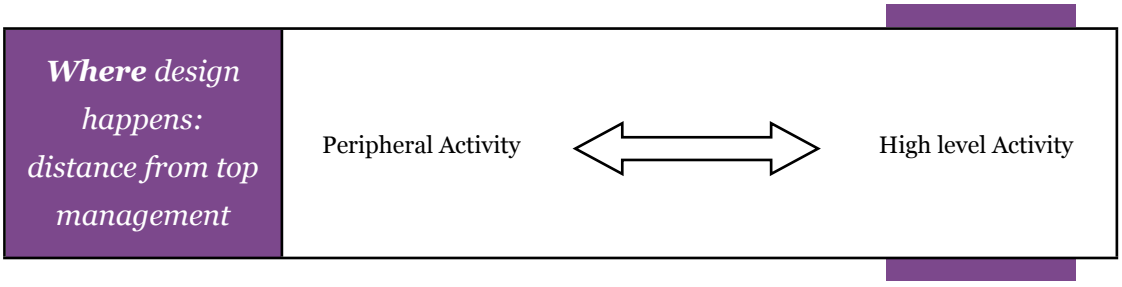
Dyson also believes in staff freely sharing ideas. That's why the design engineering floor of the company’s headquarters is entirely open plan. Employees from different departments interact and share their work and are trusted not to tell even their partners about what they're working on before a product launches. The lack of segregation throughout the floor tightly enmeshes the different competences of the workforce and allows everybody to see the latest developments and prototypes.

"Normally companies would keep R&D groups separate, so nobody knew for security reasons what was going on; but we've decided to go down the other route. There are merits in that – it sparks off ideas and people suggest things, not in their field but in some other field. But it is risky."

James Dyson

The staff is also asked to minimize memos and emails: "if you're sending an email you're probably not thinking, you're probably not interacting to create something", he explains, inviting everybody to directly talk in person.

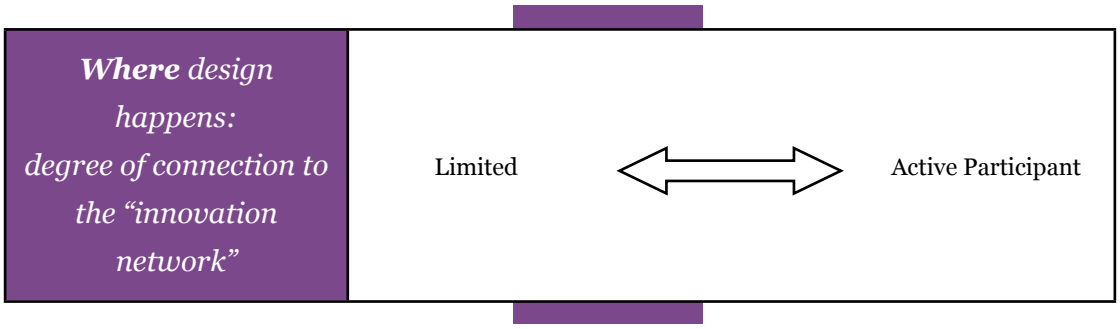
Design and innovation is a very “bottom up” process at Dyson, but the company’s management is directly immersed in it and is in the position to observe and act on it.



WHERE DESIGN HAPPENS – DEGREE OF CONNECTION TO THE "INNOVATION NETWORK"

While within its walls Dyson has a very open approach to product development and innovation, it operates in a very closed and secretive manner and with very little relationships with external entities.
Thumb scanners are placed on all doors at the Dyson HQ, and all employees are required to maintain absolute confidentiality regarding their work on new products.
The company has also equipped its labs with all necessary equipment and competences to design and test its products, allowing it to operate exclusively through its internal resources.

The one exception to Dyson's doctrine of isolation, is the James Dyson Foundation, which is supported by the company and has established relationships with many prestigious design and engineering schools and universities around the world, to support the education of future innovators and engineers, as well as medical and scientific research.
It also promotes an international design award, with the goal of promoting and supporting the best innovations and ideas from the next generation of design engineers.



WHEN DESIGN IS USED

Design engineering is deeply engrained into the company's culture, making it a constant activity for all employees.

They are encouraged to be "designing" at all times, and are especially pushed to constantly question the status quo when at home, using any kind of product, as

frustration with what the market currently offers has been the source of many of Dyson's innovations.

***When** design is used*	End of NPD process	During the NPD process	Always

WHY IS DESIGN USED

Dyson applies its design philosophy to everything they do.

The most famous example of this is Dyson's iconic TV advertising, which features James Dyson himself "teaching" to the audience what the problem with the current options on the market is, and how Dyson has ingeniously solved it: he explains simply how the product works and even how the improvement was achieved.
Those ads are a 60 second long summary of the company's philosophy and approach to product development.

The company has also engineered its headquarters to create the temple of design engineering. The Dyson Research, Design and Development Centre in Wiltshire was designed by renowned architect Chris Wilkinson, and opened in 1999. It follows the company's design strategy with the goal of inspiring the company's engineers, and constantly reming them of the Dyson values.

It is highly efficient and has a minimal environmental impact: there's no air conditioning for example, as displacement ventilation is used to blow cool air in at floor level while warm air naturally rises and is dispersed through vents in the

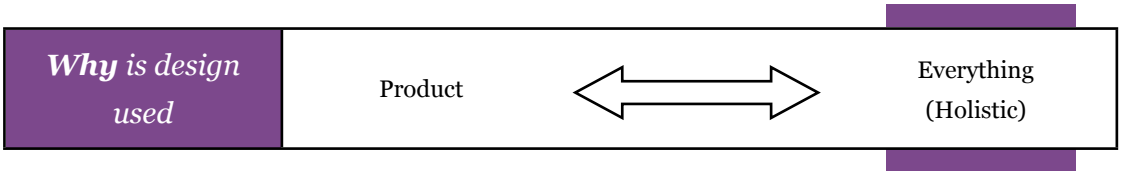
roof.

To encourage collaboration, the engineering floor is entirely open plan, with sculptures that look like students talking dotted about the site. The sculptures themselves are a monument to the company's values of engineering and curiosity: they are made from recycled copper foundry parts and are left partially open, with gaps on their sides that invite to peer inside.

"We want people here to feel that they're at the cusp of discovering something.
I very much wanted that feeling through the campus – I've never called it a campus before, but I suppose I could start doing that – and for it not to feel like a factory."

James Dyson

Various design and engineering icons are displayed around the building, including a harrier jump jet parked in the company's front lawn.



D.3. Competitive performance

Dyson has managed to completely disrupt a market which hadn't changed much since its birth, dethroning the companies which had controlled it for more than 50 years, and establishing itself as one of the leaders in the home appliance market.

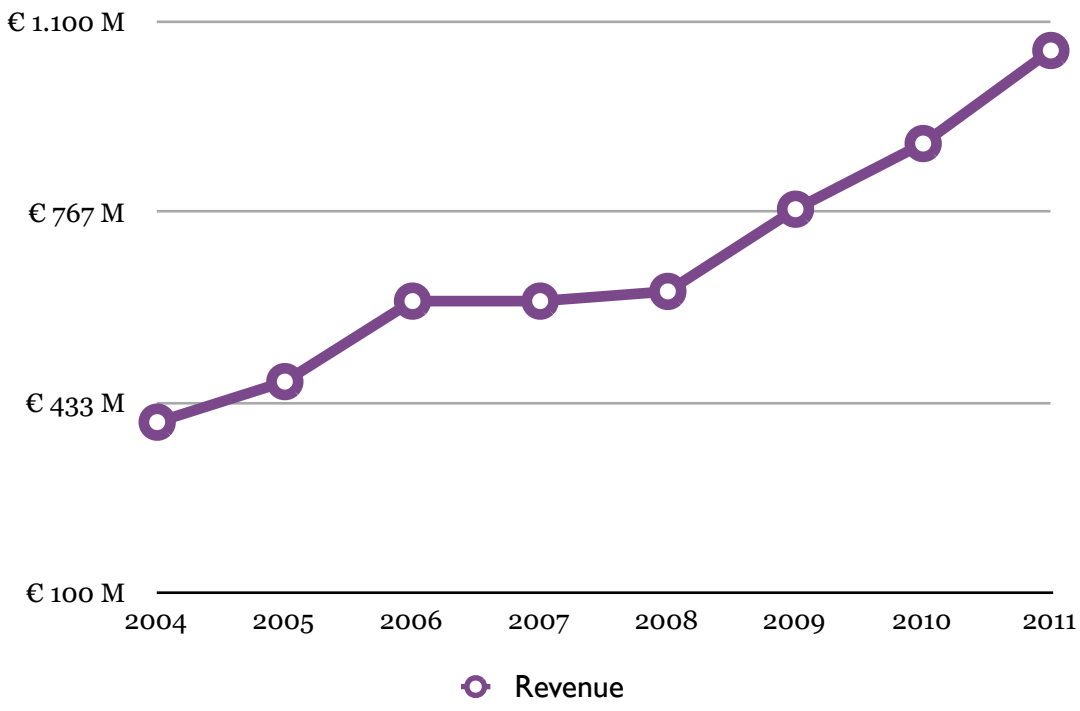
GROWTH

Compared to its competitors, many of which are today declining or growing at a negligible rate, Dyson has achieved a spectacular growth trajectory over the years.

Between 2007 and 2011 it has achieved a CAGR of 14,5%, several times higher than the global household appliances market growth rate of around 3,5%. In 2011 revenue surpassed for the first time the billion pounds mark, increasing 18% over the previous year.

The company has had particular success with its newest product lines, with its hand dryers and fans now accounting for a fifth of total profits. The Air Multiplier in particular, introduced in late 2009, has allowed the company to maintain its strong growth, after revenues had stagnated in 2007 and 2008.

Dyson's ambitions haven't yet been satisfied however, with plans to continue growth by increasing the company's employees and R&D resources.
In 2011, the company hired 200 new engineers for its research departments, to reach a workforce of 1500 at its Wiltshire HQ, and with a goal of 2000 researchers in 2013. Counting the entire worldwide workforce, the company employed over four thousand people in 2012.



	2004	2005	2006	2007	2008	2009	2010	2011
Revenue £M	399,0	470,4	611,0	611,0	628,0	772,0	887,8	1.050,0
Y/Y change	–	17,9%	29,9%	0,0%	2,8%	22,9%	15,0%	18,3%
Global household appliances market €B (source: Marketline)	–	–	–	177,1	182,9	186,2	194,3	202,9
Y/Y change	–	–	–	–	3,3%	1,8%	4,3%	4,4%

PROFIT

Dyson enjoys incredibly high profit margins from all of its product lines. Its products usually sell at a higher price point than the competition, allowing the company to achieve an average operating profit margin of almost 20%, in a market where its competitors struggle to maintain operating margins of around 5%.

Its latest products in particular, such as the Air Multiplier line, enjoy an even higher profit margin, and have boosted the company's EBIT significantly, pushing

the operating profit margin well beyond 20% and almost to 30% in 2011.

	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
EBIT	24,0	43,2	75,4	96,5	82,8	88,8	90,0	189,5	206,0	306,3
Y/Y change	–	80,0%	74,5%	28,0%	-14,2%	7,3%	1,4%	110,6%	8,7%	48,7%
Operating Profit Margin	–	–	18,9%	20,5%	13,5%	14,5%	14,3%	24,5%	23,2%	29,2%

CORPORATE ASSETS

Dyson's innovative products haven't just rewarded the company financially.

When Dyson debuted it mostly sold its products exclusively in the UK. Today, the company operates in over 50 countries, and has been increasing the amount of products it sells outside the UK: last year it sold 85% of its machines outside the UK, compared with 30% in 2005.

The company has achieved incredible market shares worldwide, and, in 2011, was the top selling upright vacuum cleaner brand in the US, with a near 27% market share. It also leads in the UK, its home market, with 40% of the country's market share by value, as well as several other countries like Canada, Australia, France, Belgium, Spain, Switzerland, Ireland and New Zealand.

New products have also conquered significant market share.
The Dyson Air Multiplier, for example, was first introduced in the Australian market (the company wanted to launch in summer) and, within 6 weeks of launching, represented 64% of the market for desk fans, by value.
The success surprised even the company, which was expecting to sell a much lower volume of the bladeless fan (which costs over 300$, more than 10 times a low cost desk fan), and struggled to meet demand.

Over the year the company has accumulated a large number of patents on many innovative solutions and ideas. On average, Dyson files a new patent every

day, making Dyson second only to Rolls-Royce in terms of the number of UK patent applications presented every year.

D.4. Within-case analysis

		Design as Style	**Design as Process**	**Design as Strategy**
***What** is design*		Style	Product Development and Innovation at large	Meaning
***How** is design used*	*The role of design in the NPD process*	Function	Multifunctional Team Member	Process Leader
	The kind of NPD process	Structured Focus on Problem Solving Linear/Sequential No Exploration	⟺	Unstructured Focus on Problem Setting Non-Linear/Iterative Freedom and Exploration
***Who** designs*		No-one Designer	⟺	Everyone
***Where** design happens*	*Distance from top management*	Peripheral Activity	⟺	High level Activity
	Degree of connection to the "innovation network"	Limited	⟺	Active Participant
***When** design is used*		End of NPD process	During the NPD process	Always
***Why** is design used*		Product	⟺	Everything (Holistic)

	Dyson	**Household Appliances Industry**
Design Approach	Strategy	Style

Summary of Dyson's approach to design.

Company		Major Radical	Minor Radical	Major Incre-mental	Total	Timeframe
Dyson Ltd.	*N°*	3	2	2	7	11
	% of total	43%	29%	29%	100%	
	N°/year	0,273	0,182	0,182	0,636	

Competitive performance					
CAGR @[number of years considered since last]			*Profit*		
Dyson	*Market*	*Δ*	*Dyson*	*Market*	*Δ*
14,5% @5y	3,5% @5y (global household appliances sector)*	314,3% @5y	EBIT margin 25,6% average 3y	EBIT margin 16.56% 2012 (household products sector)**	55%

* source: Marketline

** source: NYU Stern School of Business.

Summary of Dyson's design innovation and competitive performance.

CONSTRUCT ANALYSIS

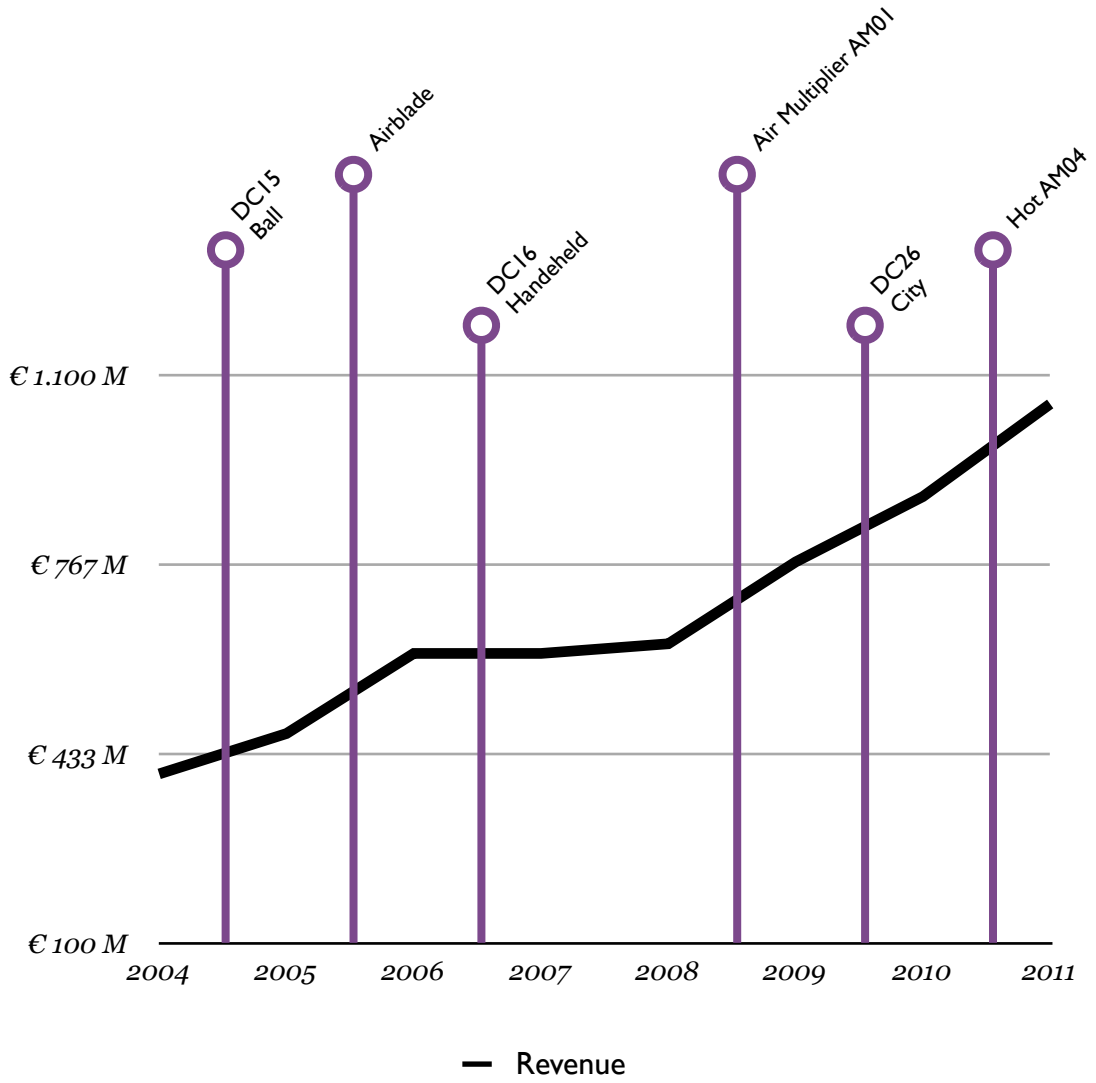
Dyson has taken by storm a stagnating mature market, overcoming the many consolidated incumbents and their apparently well consolidated positions.

The company entered the sector implementing a *design as strategy* approach, the complete opposite of its competitor's basic or negligible use of design, and achieving extremely high degrees of product innovation. Its competitors reacted by increasing their financial investments in design, but not actually improving their design management practices to move beyond the level of *design as style*.
Dyson's design management practices are all generally in line with the highest stage of design maturity, with the notable exception of the company's tendency to operate in isolation from the rest of the market and maintaining minimal relations with the rest of the "innovation network".

Over the last decade the company has averaged 0,64 significant innovations, however, this number reaches the significantly higher value of 0,857 by choosing 2005 as the starting point for the timeframe, and thus removing the effects of the

Contrarotator's failure. In fact, the company had limited resources to invest in new products between 2000 and 2005, and restricted product launches to recover the the product's failure.

The company's high product performance has allowed it to achieve over the last 5 year period a CAGR which is more than four times that of the market. The company has also enjoyed substantially higher products margins, recording in 2012 an EBIT margin which was 55% higher than that of the household products sector.



TIME SERIES ANALYSIS

As competitors struggled to keep up with Dyson's disruptions, the company has iterated incessantly on its highly successful vacuum cleaner lines, while taking risks in new market segments and markets.

With the exception of the Contrarotator washing machine in early 2000, in all other cases those risks have payed off, and the company has been able to grow rapidly and at a steady pace over most of the last decade.

Around 2007 and 2008, as the company reached the leading position in the vacuum cleaner market, sales growth started slowing. The company was able to resume its rapid expansion by branching out into the fans and heaters market, and by differentiating its vacuum cleaner's offer with different form factors.
The positive response to Dyson's entrance into the fans market, also protected the company from the effects of the 2009 financial crisis, which instead affected the already sluggish global appliances market.

E.

E.1. Design innovation performance and context

In January 2004, Mark Zuckerberg, a 20-year-old student at Harvard University, began writing the code for a new website, known as 'thefacebook'.
The goal was to create a centralized website where students could upload their pictures and information, and contact other people around the university. At first the site's functionality was limited to the essentials: users could create profiles that contained their personal details and contacts, and could interact with other people by adding them to their "friend list", and exchanging messages.

"Everyone's been talking a lot about a universal face book within Harvard. I think it's kind of silly that it would take the University a couple of years to get around to it as I can do it better than they can, and I can do it in a week."

Mark Zuckerberg

According to Zuckerberg's roommate, Dustin Moskovitz, "When Mark finished the site, he told a couple of friends – then one of them suggested putting it on the Kirkland House online mailing list, which was three hundred people. [...] By the end of the night, we were actively watching the registration process. Within twenty-four hours, we had somewhere between twelve hundred and fifteen hundred registrants."

Membership was initially restricted to students of Harvard University, and within the first month, more than half the undergraduate population at Harvard was registered on the service. By March of that year, with the help of his college roommates and friends, Zuckerberg expanded Facebook to Stanford, Columbia and Yale, and later opened to all Ivy League and Boston-area schools, and finally reached most universities in Canada and the United States. Facebook was incorporated in the summer of 2004, and the entrepreneur Sean Parker, who had been informally advising Zuckerberg, became the company's president. The company also received its first outside capital, with Peter Thiel making a $500,000 angel investment in the social network for 10.2% of the company and joining Facebook's board.

Since the late 1990s, user profiles had been a central feature of social networking sites, allowing users to compile lists of "friends" and search for other users with similar interests. This generation of social networking sites had began to flourish

with the emergence of SixDegrees.com in 1997, followed by Makeoutclub in 2000, Hub Culture and Friendster in 2002. The incredible success of this last website, Friendster, was especially responsible for bringing the concept of social networks into the Internet mainstream.
In 2003 Friendster had already several million users, and it was being hailed as "the next Google" by the media. Friendster was followed by MySpace and LinkedIn a year later, and eventually Bebo. Attesting to the rapid increase in social networking sites' popularity, by 2005, it was reported that MySpace was getting more page views than Google.
Today, most of those websites have disappeared or have been eclipsed by the success of Facebook.

So how did Facebook win in such a crowded space, and after arriving last into the market? It turns out that, while Facebook worked the same way as the other sites (it was essentially a clone of the popular Friendster) and used the same tools and technologies as they did, it had a completely different meaning.

The other social networking websites were built to allow users to create online profiles that could be used to meet strangers and make new friends (or lovers), and were competing on features and performance: powerful profile customization tools, simpler interfaces, better friend management. But Facebook was something different: they were using the online profile to present their users' real identity online, allowing them to stay in touch with people they already knew in real life.
Users weren't choosing screen-names and creating elaborate profiles with custom images and colors, they were using their real names and could only personalize their profiles by uploading their picture and by writing a few lines of personal information. Facebook users connected with friends they knew and trusted from their university or school, not with random strangers somewhere in the world, and used those connections to generate a new social layer.
Users on Facebook also had a space on their profiles called the "Wall", which allowed friends to exchange public messages, and displayed events that happened to the user's profile, such as when information was changed, when they changed their profile picture, and when they connected with new people, among other things. The wall was the online manifestation of a person's identity, which users would check to keep up to date and stay connected with their friends.

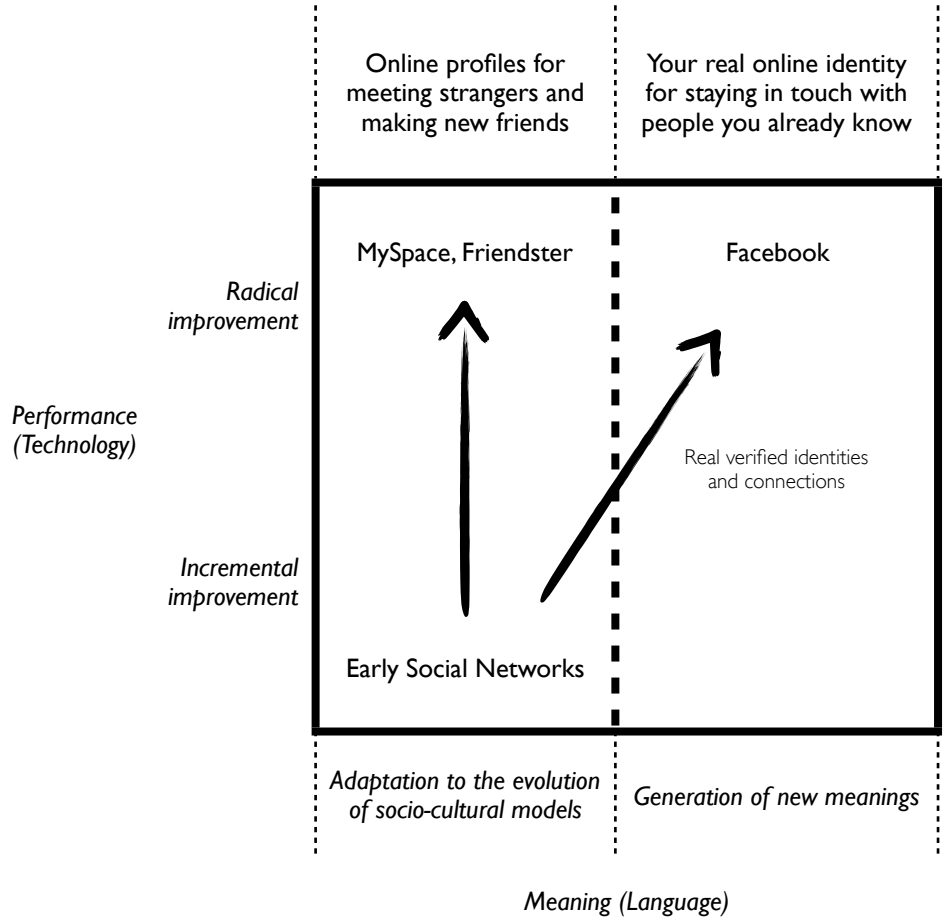


Table. E. 1: The original Facebook as a radical innovation of meaning.

On the 26th of September of 2006, Facebook was opened to everyone ages 13 and older with a valid e-mail address, leading to an explosive growth that , in just six moths, took the site from fewer than 10 million active users to more than 20 million.

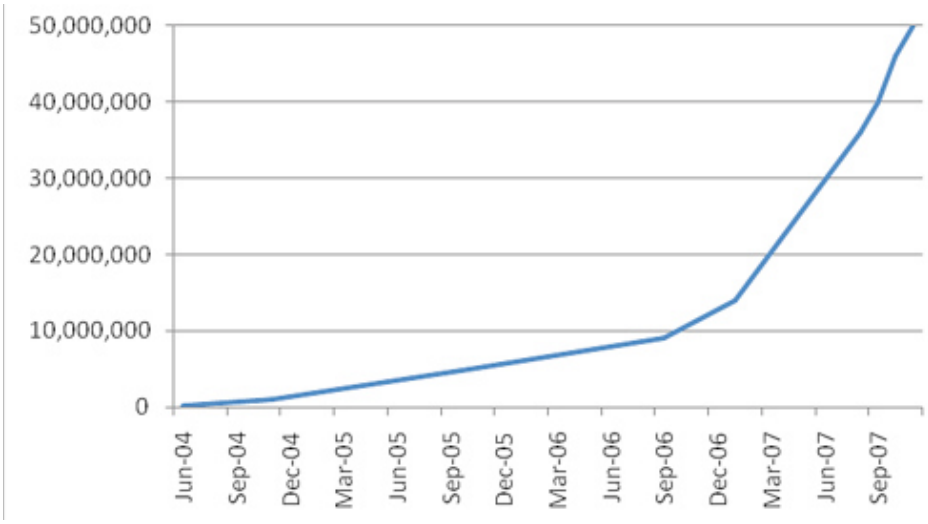


Fig. E. 1: the number of Facebook users between 2004 and 2007.

The company had grown and matured, and the interactions on the site had evolved accordingly.

"When we first started out, it was important to us to build a system that actively maps people's relationships in the world–offline"

Soleio Cuervo, Facebook's second designer

The company moved beyond a purely profile and wall driven website and introduced the News Feed. Originally, when users logged into Facebook, they were presented with a customizable version of their own profile. The new layout, by contrast, created an alternative home page in which users saw a constantly updated list of their friends' Facebook activity, personalized based on his or her interests and the sharing activity of his or her friends. By highlighting information such as profile changes, upcoming events, and birthdays, the News Feed solidified the role of Facebook as a new online social layer, giving users a quick way of keeping up with their friends' activity.

This major new feature was initially met with resistance by users, who thought that their information was being disseminated too widely, and that they were losing control over their privacy. Many had not yet understood what Facebook actually was, and how much their social status would be affected by their use of this new medium. Now that their activity on Facebook was available for all their friends to see, users became aware of the fact that the site had become a virtual reflection of their real identity, and the website permanently settled into its future role. Zuckerberg responded publicly by writing an open letter titled "*We really messed this one up*." The team added clearer privacy controls, but never looked back and advanced boldly with its vision for what the social network should become, and today the News Feed is one of Facebook's most important features.

Another important addition to the product were "Status updates", which launched in 2006, and allow users to post messages on their profiles for their friends to read. Facebook prompted the status update with "Username is…" and users filled in the rest, to inform their friends of their current "status", including feelings, whereabouts, or actions.

The next major step in the social network's evolution came a year later, when the company introduced the Facebook Platform.

Having succeeded in becoming the online identity for its users, Facebook moved on to unleash the full potential of this achievement by enabling new social experi-

ences. The Facebook Platform provides a set of APIs and tools which enable third-party developers to integrate with the "open graph" (Facebook's immense stash of information about the user and his friends), both through applications on Facebook.com and through external websites and devices.
Facebook was now moving beyond the confines of its own website, to offer social interactions throughout the web. By sharing a portion of a user's social graph, it allows external services to offer better experiences, and receives in exchange new information and new content.

The company also extended the concept of online identity beyond individuals. Realizing that users used products, services and companies to define who they were and what their interests were, Facebook introduced in November of 2007 a feature called "Pages". Users, or organizations, can create pages allowing supporters of an individual, company, product, service, or concept to "become a fan" and subscribe to the page posts and updates. Pages look and behave much like a user's personal private profile, and their owners can send updates to their fans, creating an entire new way for firms and brands to communicate with the market.
A similar approach had been taken with groups created by users. Individuals can create and join groups, that are used for discussions, events, etc. and are a way of enabling a number of people to come together online to share information and discuss specific subjects, or organize activities. Those features strengthen the importance of Facebook in the social fabric, by bringing the online and offline experiences closer together.

The service continued to grow, and as it surpassed 100 million users worldwide the company's total valuation reached between $3.75 billion and $5 billion. Facebook did not stop to constantly improve its product and to embrace new emerging technologies. In 2008, following the rise of smartphones, it launched its first mobile app for iPhone, today one of the most downloaded of all time.

In early 2009, the "Like Button", one of the most iconic and ubiquitous features of today's Facebook, was introduced. Users can like almost all content on Facebook, such as status updates, comments, photos, links shared by friends, and advertisements. When a user clicks the Like button, the content appears in the News Feeds of that user's friends and is added to their profile. The button also dis-

plays the number of users that liked each piece of content, and a list of those users, creating what Facebook describes as a way for users to "give positive feedback and connect with things [they] care about." The like button is an evolution on the "become a fan" concept introduced with Pages (which it substitutes), and helps users to add to their profiles the things they enjoy and support. At the same time it expands the presence of Facebook over the internet, as the like button can be added to any website so that users may share external content with their friends with just one click.
The product team's goal was that of creating a "universal commenting system" that was simple, easy, and understandable across cultures, nations, and generations. The like button is an obvious and elegant solution which carries a powerful meaning but requires very little effort to use and understand.
This is the perfect example of what Facebook calls "social design", one of the guiding principles of the company. New features and products are developed based on people and their online behavior, not technology and algorithms: by improving how people build human-to-human, versus human-to-interface, connections online.

As Facebook reached 500 million users in 2010, it launched a new messaging system, to replace the messages function it had been using since the site's birth. The new system combines text messaging, instant messaging and email into one centralized system that works across devices and for all Facebook users. Later it even added video and audio support with the help of a partnership with Skype. No matter what method is used to deliver a message, it's stored in a unified inbox, where a single conversation with each friend is always available.

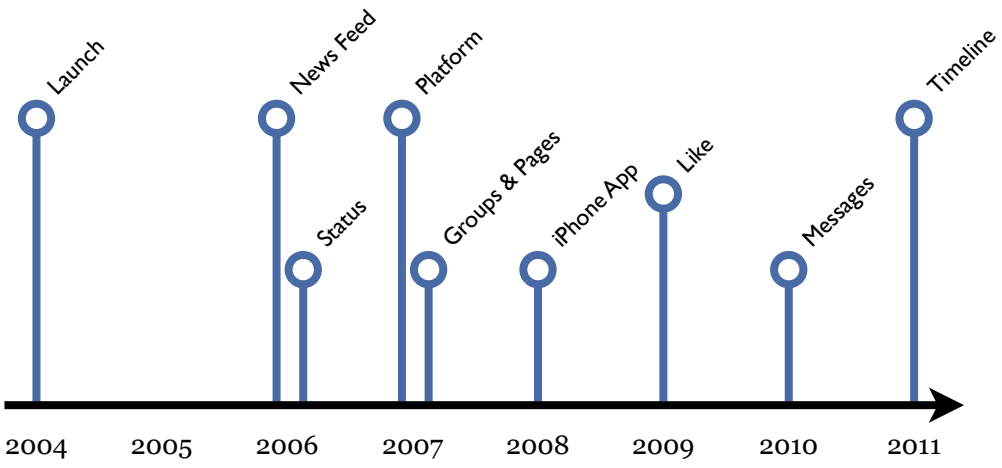
The last major change in the website came in December of 2011, with the launch of the "Timeline", the third major evolution of the user profile in the site's history. Timeline is the new virtual space in which all the content of Facebook users is organized and shown. Replacing the traditional Facebook profile and the "wall", Timeline categorizes the photos, videos, and posts of any given user according to the period of time in which they were uploaded or created. Posts and events are displayed along a timeline that runs through the center of the profile: it starts at the top of the page with a large cover image chosen by the user, and scrolls down all the way to the date of birth of the user. Along the way major events in the life of

the user are highlighted, while less important events are aggregated and hidden, so that the Timeline can be rapidly scrolled to relieve the most important moments in a user's past.

This is the ultimate evolution of Facebook's original concept of online identity: everything the user is, condensed into one page that touches upon all of the most defining moments in his life. The company defines Timeline as a "searchable personal chronological narrative". It represents a shift from the profile of the first Facebook: now a user's page lasts a lifetime, it acquires a sense of longevity that the original profile, which was only relevant when displaying current information, couldn't have.

On May 17, 2012, Facebook became a public company with a valuation of $104 billion, the largest to date for a new firm. Zuckerberg retained a 22% ownership share in Facebook and still controls the company by owning 57% of the voting shares.

A few months later, the 4th of October, Facebook reached 1 billion total active users on the site.



Facebook's design innovation performance since its launch.

E.2. Investment in design strategy

Over the years, Facebook has organically grown from a simple website with a strong underlying concept, real online identity, to a complex new social layer with profound impacts on society at large.

Ever since the early days, the company has given design an important role within the company, scaling its investment in this strategy as the company grew and giving it a predominant position within the company's organizational structure and culture. In the past three years alone, Facebook's design team has grown from 20 people to 120; those represent a small portion of the over 4,600 employees at the company, but Facebook's investment in design goes far beyond the number of designers it hires.

"The tech community used to think it was about the back end, so it focused on efficient code bases and faster software. These will always be very important, but technology companies are beginning to realize that winning customer hearts is as important as winning their minds and that success lies in those little moments of delight when a product doesn't just meet expectations, it exceeds them. This is the province of designers—and it's why we're now taking center stage."

Kate Aronowitz, Director of Design

WHAT DESIGN IS

Facebook has a very sophisticated understanding of what design is, which goes far beyond just style, and is very different from what most of Silicon Valley believes.

"Facebook was built on the idea of putting people at the center of everything, of human-to-human interaction. We call this principle 'social design,' and it's the heart of everything we do here."

Kate Aronowitz, Director of Design

According to vice president of product Christopher Cox, instead of obsessing about making tasks easier or making the interface more beautiful, Facebook is getting its product out of the way, with the goal of making "the experience of using Facebook as seamless and easy as talking to people in real life."

While most designers in the computer industry have focused on helping humans interact with machines, Facebook is about human-to-human interaction, or what the company calls "social design". "We don't want people to remember their interactions with Facebook," says director of design Kate Aronowitz, "we want

them to remember their interactions with their friends and family."
It isn't about making the product look pretty, but, according to Cox, social design is "more like designing a plaza or a restaurant, the best building is one where the people inside get it and work together and are connected. That connectivity is created by how everything is arranged."

Facebook designers strive to design interfaces that catalyze emotions, rather than simply enable users to accomplish tasks. They want their users to have the same positive feelings that they would have when interacting with friends and family in person. "Serotonin", the neurotransmitter that sparks feelings of happiness, is the codename the design team has given to this design principle within the company. According to Cox, "It's the science of things you can't reason about, that you just feel," he says. "So when we're going off to create something new, it's important to be iterating in that mindset."

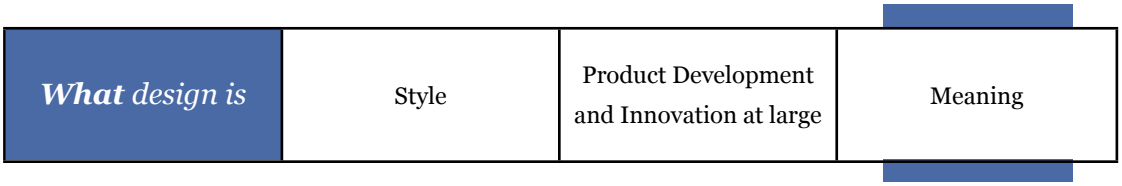
This mindset has come natural to the company, driven by the fact that Facebook targets billions of users worldwide, appealing to people ages 13 and up, with diverse cultural backgrounds in more than 70 languages. This customer diversity has pushed the design team to adopt a neutral and essential design language: Facebook has a neutral and minimalistic look that some perceive as plain, dull and the opposite of a "designed" interface.

"Yes, we've had negative press, in terms of our 'lack of design'. But honestly, when we're doing our jobs right as a design team, we do not want people to remember interactions with our brand; we want them to experience real connections with each other and with content. That is most important."

Kate Aronowitz, Director of Design

This self imposed restriction means the design team moved on to concentrate on more than making the site just look pretty. According to Cox:

"You can design a place with the coolest-looking windows or the most beautiful archways, but that doesn't mean people will want to sit down in those spaces and stay there, the problem or challenge that we face with creating social products that work online is that the subtlest of gestures are what makes them comfortable."
"Instead, we use common words. We recede into the background. We design a place where there aren't new objects to trip over. Photos are photos. Chat is chat. Groups are groups. Everything just is."



HOW IS DESIGN USED – THE ROLE OF DESIGN IN THE NPD PROCESS

Facebook works by creating small ad-hoc teams for each new product. When a new project emerges, designers sit with the engineers and product managers, creating little pockets of entrepreneurism within the company. While Facebook is today a big public company, it continues to work internally as a cluster of many small startups, allowing the teams to move faster and communicate more easily. Product development is a process of tight collaboration between designers and engineers. Aronowitz says:

"Engineers work with us directly. We don't throw documents at them with specs. We all focus on the site's user experience versus the code."

Soleio Cuervo, Product Designer

"I've seen this in pockets, but not as a company's culture," she says. "When I come into work in the morning, for instance, I see designers sitting in different places all the time. One day, it's with an engineer, another a product manager. In other companies I've worked at, people owned, say, branding, or they owned wireframes. They passed on directions to engineers."

The designers' involvement is so deep that they often partner with product managers to lead feature teams. Sometimes they even take the lead on their own. It is not uncommon for the top designers at the company to be given the task of thinking about what new features and pro ducts they believe Facebook should be doing next. The company gives them free reign to come up with their own portfolio. "We're not just responsible for the pixels," says Nicholas Felton, product designer. "We're responsible for a lot of the core ideas for how the product works."

"At the same time, our most experienced designers have taken a seat at the table with Zuckerberg, Chris Cox and the other executives as they decide the direction the company will take. Designers now have a say, not just in the products we're working on, but in how Facebook on the whole will evolve over the years."

Kate Aronowitz, Director of Design

While engineering has a huge responsibility in ultimately making new Facebook products successful, it is design that takes the lead and guides the com-

pany during the product development process.

***How** is design used: the role of design in the NPD process*	Function	Multifunctional Team Member	Process Leader

HOW IS DESIGN USED – THE KIND OF NPD PROCESS

Facebook has a name for the rules that guide its development process: they call it the “Hacker Way”.

> *"The Hacker Way is an approach to building that involves continuous improvement and iteration. If the hacker way has one enemy, it's the status quo.”*
>
> *Mark Zuckerberg*

This set of rules has been designed to allow the company to cultivate its own brand of managed chaos. The anarchic mentality of the Hacker Way is instilled into new recruits through training programs and internal communication, with the goal of keeping the company as lean and as fearless as a startup.

Facebook's product development is as unmanaged as possible, and the entire organization is kept flat and devoid of hierarchical structures. This is achieved primarily through extremely small development teams, an approach to product management taken directly from neighboring Apple. The ubiquitous "Like" button for example, one of the most recognizable and important features of Facebook, was developed by a team of just three people: a product manager, a designer, and a part-time engineer, all meeting about once a week with Zuckerberg himself.

Fig. E.2: one of the teachings of the “Hacker way,” in an internal poster.

The small teams usually don't require much supervision and self manage, organizing their schedules independently and not following any formal development process. No one keeps track of time, and employees may enter and leave the office at any time (many even sleep in appropriately furnished areas, or directly in their office).

The level of collaboration within those small teams is increased by requiring that all designers have some coding experience. One of the crucial mantras of the Hacker Way is to "get your hands dirty", and designers do this by understanding how web code works and writing a bit of HTML, CSS, and PHP (the main programming languages used by Facebook). This eases the relationship between design and engineering, creating a productive balance between the two worlds, and allowing designers to tend to bugs and build quick prototypes. By understanding the medium in which they work, designers become aware of the limitations and may design more effectively.

An interesting practice exemplifies the flexibility of the company structure. Every year, engineers are required to leave their teams to work on something different for at least a month. The swaps can be uncomfortable for many who have developed expertise in a particular area, but ultimately, more than a third of engineers end up transferring to a new team. This process constantly brings new blood and ideas to engineering teams, allowing employees to develop new skills and preventing stagnation.

The Hacker Way is also strongly based on experimentation and iteration.
The teams work through constant gradual iterations of a product until every detail is "just right". This is driven by a very prototype-heavy culture, where teams are invited to start every new project by creating a simple mockup of the idea.

> *Our designers often hack an idea together in a few days just to show it off, even if it's raw, and see what people think. If the seed of an idea is good, other designers can pick it up and help turn it into a polished, ready-to-go product. This way of working can sometimes be surprising for people new to the company; a lot of designers like to take their projects and disappear into a private room for a few days before emerging with a grand reveal.*
>
> *Kate Aronowitz, Director of Design*

This creates an atmosphere of out-in-the-open ideation and experimentation that helps designers obtain feedback rapidly and move on to the next iteration.

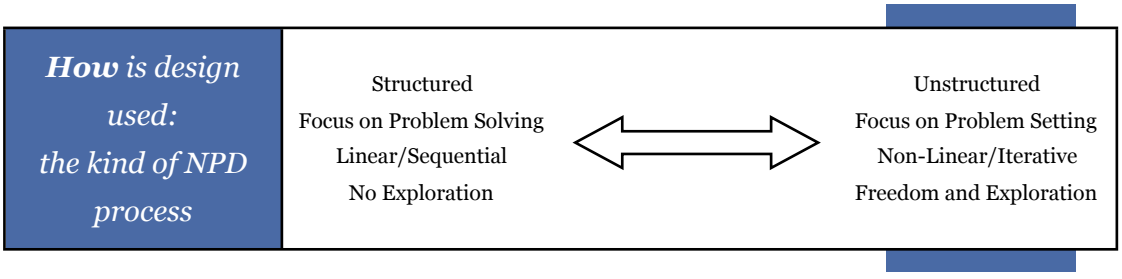
Prototype projects are often made accessible for the entire company to play around with. There is no creative director at Facebook, so this bottoms up process is crucial to get alignment within the entire organization.
The company has also developed some internal tools to share more effectively (mostly based on Facebook itself), such as Pixelcloud, which serves as an online gallery with commenting.
Rarely external users are brought in to evaluate new designs, as the company mostly relies on "dog-fooding" techniques, where the employees themselves test out new features and provide feedback. To help with higher-level decisions the team also leverages Facebook's enormous store of quantitative data on its user's habits and use of the site, helping them make data-driven choices.

The Hacker Way also fully embraces software's impermanent nature, instead of fighting it. One of the principles is "Don't fall in love", and it teaches not to settle for what's great today, as the fast moving pace of the software industry will mean you will rapidly fall behind. The longest standing design at Facebook was the front page from 2004, which stayed live for 18 months without modifications.
This also means that if a design – even one that took months to create – isn't working, Zuckerberg never hesitates to toss it out entirely.

"It is nerve-wracking for new designers, I think of the stuff we do [as being] like building sand castles."

Soleio Cuervo, Product Designer

But most importantly the team is given complete freedom to experiment by Zuckerberg. There's a lack of attachment to the way things have been done previously, and the company is not afraid of starting over, especially when designing some of the most established features of the website.



WHO DESIGNS

Facebook's design team is comprised of people from a variety of backgrounds: such as communication and product designers, user interface engineers, writers, content strategists and user experience researchers. This gives the team the necessary breadth of skills to impact the company at all levels and in many different areas and projects.

Facebook belongs to the growing number of Silicon Valley companies whose senior management, starting with the CEO, understands design as a sustainable competitive advantage. Zuckerberg himself, despite being a computer programmer, is involved in all design activities, and in addition to personally reviewing most of the work done by the company, has contributed substantially to the design of various new features and products, focusing on the smallest of details, as well as stepping back to reexamine the big picture.

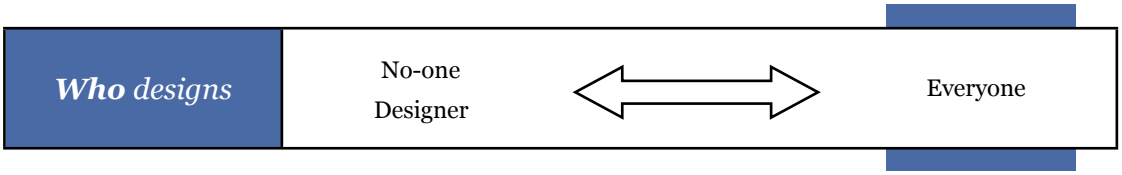
This appreciation of design means that just as designers must be able to speak the language of programmers, engineers must also possess a design sensibility. Activities such as the Analog Research Laboratory, or the Facebook Arts Initiative, which we will later describe in detail, distribute knowledge of design and art across the entire organization. At the same time the tight collaboration between engineers and designers naturally produces an exchange of views and approaches that educates all engineers in the value of design.

Facebook realizes that good ideas can come from anywhere. Aronowitz, the director of design, meets with designers regularly one on one to talk with them about where they see opportunity, so that new ideas can be spotted and encouraged.
Anyone can show Zuckerberg a new idea he had during the CEO's open office hours, and about every six weeks, the company organizes an internal "hackathon", one of the most famous (and somewhat controversial) traditions at Facebook. Hackathons are 24-hour periods in which employees voluntarily set aside their usual projects and work on some completely unrelated idea they have in mind. Apart from this crucial rule, and the fact it must be completed within 24-hours, everything else is allowed and there are no limits to the kind of project one may

work on: the results range from beer serving machines that post photos of the drinker online, to the original concepts behind the like button and the timeline.

> *"It's a way to experiment with ideas in a low-cost way. Lots don't make it into products, but every hackathon tends to result in four or five things implemented on the site. A couple have changed the direction of the company."*
>
> *Pedram Keyani, manager of engineering and organizer of Hackathons*

The company has a Facebook group called Hackathon Ideas, where in the week leading up to a hackathon, people post ideas, and groups form organically around those ideas in which often people have never talked before.



WHERE DESIGN HAPPENS – DISTANCE FROM TOP MANAGEMENT

Facebook has no private offices or cubicles. Everyone sits out in the open with their teams, and moves around the office space as his projects change. This choice is reflected in the way the design team operates.

> *We start every Monday with a team meeting to discuss what's going on across the company and take a look at the different projects people are working on. Throughout the week, there are as many as five critique sessions where designers can present their work and ask for feedback. Every Friday, Mark Zuckerberg stands in front of the whole company and answers questions from the audience. This means that everyone from an executive down to an intern gets the same, unfiltered access to the CEO and founder—every single week."*
>
> *Kate Aronowitz, Director of Design*

The core design team occupy desks that form a U-shape around Zuckerberg, demonstrating the influential role of design in Facebook's strategy. The open space facilitates the impromptu executive-designer desk-side conversations and hallway conferences that employees say is one of the keys to the company moving fast and generating breakthrough ideas.

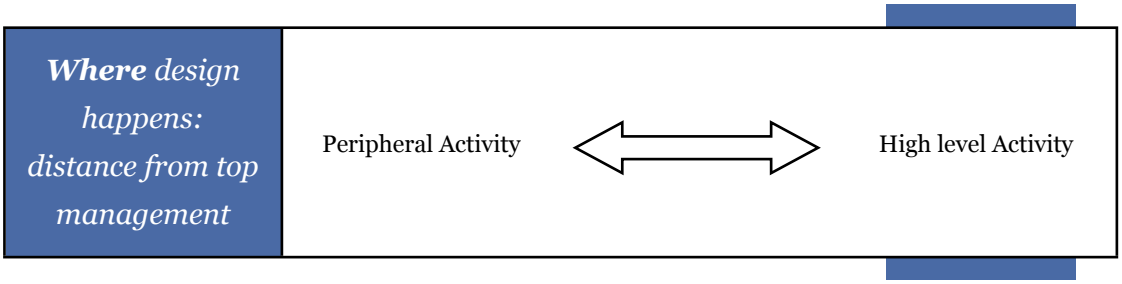
Zuckerberg himself is not fond of formal corporate organizations, with staff meetings and hierarchical reports. He prefers to interact directly with the people who are working on products, drilling down on details no matter how small. He does this by not separating himself from the rest of the company, and by frequently walking around the engineering offices, to see what various groups are up to.

Zuckerberg also works directly with the designers developing new products, spending the bulk of his days in product meetings, working closely with designers and product managers, hammering out the company's next feature sets.

"Our most experienced designers have taken a seat at the table with Zuckerberg, Chris Cox (vice president of product) and the other executives as they decide the direction the company will take. Designers now have a say, not just in the products we're working on, but in how Facebook on the whole will evolve over the years."

Kate Aronowitz, Director of Design

Designers at Facebook are treated as the top management of the company, and have the chance to "set up the definition of what they're doing," directly alongside the company's founder and CEO.



WHERE DESIGN HAPPENS – DEGREE OF CONNECTION TO THE "INNOVATION NETWORK"

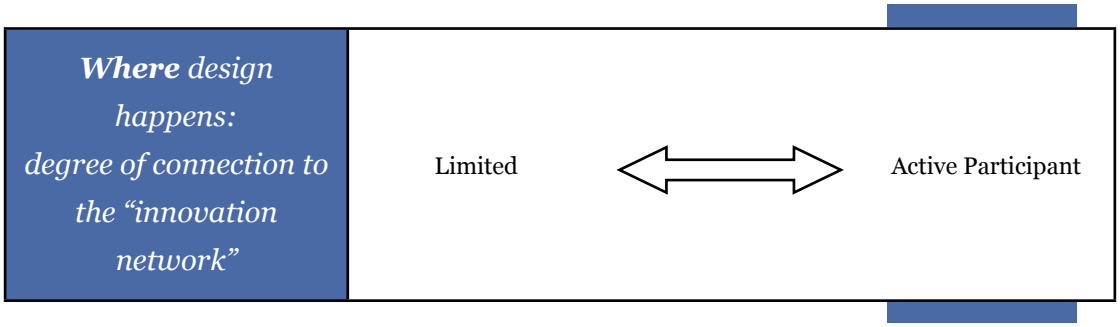
Facebook is profoundly immersed into Silicon Valley's network of innovation. Through the Facebook Platform, which has become the backbone service of most new startups, it has instant access to many of the most innovative ideas and products and has the means of rapidly identifying when those new companies are successful.

The design team themselves maintain a Facebook Group called Design Recruiting in which they post the names and portfolios of interesting designers they

discover. Kate Aronowitz regularly surfs through apps, looking for flashes of genius, and often travels to other companies to see how they work.

They access the resources provided by their network by mostly hiring designer's who's work they admire or acquiring the entire company responsible for new interesting ideas, with the goal of incorporating their talents into their team.

An example of this practice is Nicholas Felton, the designer responsible for the design of the Timeline, which arrived at Facebook after the design team noticed his stunning layouts chronicling his life (which have earned him a spot in an exhibit at MoMA) and decided to buy his startup, called "Daytum".



WHEN DESIGN IS USED

Facebook spends a lot of time making sure designers are there from beginning to end. The designers are there from strategy to launch, or, as a Facebook employee would say, from start to ship.

"Here, the designers will be in almost every conversation about their product"

Kate Aronowitz

Designers don't sit in a corner and wait for people to toss requirements at them, but rather enjoy an unusually high level of involvement in the product, starting at the very beginning as executives and product leads discuss what they should build.

The design team also takes part in defining the vision and strategy for the company, and are regularly included in meetings in which the company's future

roadmap is determined.

***When** design is used*	End of NPD process	During the NPD process	Always

WHY IS DESIGN USED

Facebook uses design as a strategy that influences all of its activities.

An example of this fact can be seen in the declarations of one of Facebook's in house legal counsels: when asked about the site's controversial privacy policies, this attorney was quoted as saying that the company would "apply the Facebook design experience that we bring to everything we do and extend that to our privacy policy."

Fig. E.3: some of the work by the Analog Research Lab, including the company's "red book" (right), titles "Facebook was not originally created to be a company".

This "Facebook design experience" is applied to all areas of the company and especially to aspects such as the company's architecture and internal communication.

Two designers at Facebook, Ben Berry and Everett Katigbak, independently created during their free time a space now called the Analog Research Laboratory.

Originally it was meant as a place where communication designers, like the lab's co-founders, could create branded marketing materials – T-shirts, for instance — for developer conferences and other Facebook events.

> *"You can learn a lot about a company by what's literally on the walls. We don't have clinical-looking logos on ours. They're adorned by stuff designers have made in the analog lab and that people have put up, with no direction from me. We have a rogue, emergent, generative culture. We show people that when they come into Facebook, they start creating."*
>
> *Christopher Cox, vice president of product*

Today, the lab is shaping Facebook as both an organization and a social-networking platform. The Laboratory is an autonomous entity within the organization, which follows a self-guided goal of reinforcing corporate culture through physical actions such as printing aspirational posters, consulting with architects on the Facebook work environment and convincing Facebook's engineering crew to get their hands dirty with the artistic process. It has been defined as a sort of propaganda press of the company, with Berry being defined as the "minister of propaganda".

There are no staff members who work full-time in the lab; the resource exists to encourage designers to play and create with non-digital tools such as a manual printing press. The design team uses its free hours to experiment with simple fonts and sleek iconography that will eventually influence what appears on the website.

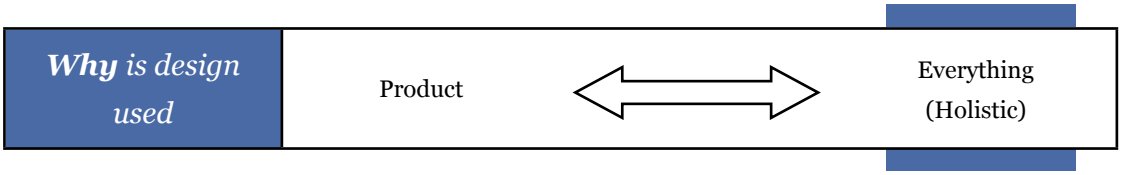
The creations made at the lab adorn the company's walls and constantly remind the employees of various slogans and principles of the Hacker Way: "done is better than perfect," reads a poster, "move fast and break things" says another, bright yellow stickers proclaim "this journey is 1% finished". Anyone can pass by the lab and pick any of those creations to use however they like.
When the company acquired its billionth user the Lab placed on every employee's desk a little red book entitled "Facebook was not originally created to be a company", filled with global photography and countless original, inspirational one-liners that reference Facebook's humble origins, tireless work ethic, and hacker ethos.

The Lab is also starting an artist-in-residency program to expose employees to more forms of analog creation, called the Facebook Arts Initiative. Artists whose values fit with Facebook's culture are invited to further decorate the company's walls with murals. They are given total freedom to use the office's white walls as

they prefer.

This initiative has been received with enthusiasm by Facebook's employees with have started using the office as a giant canvas themselves.

> *"Every day, I stumble across things employees are doing on the chalkboards and in the stairwells, and it surprises me and makes me happy. If you're empowered to just grab a can of spray paint and spray something on the walls, I think that sense of power translates into the risks you're willing to take within the products you're developing as well."*
>
> *Ben Barry, co-founder of the Analog Research Lab*



E.3. Competitive Performance

GROWTH

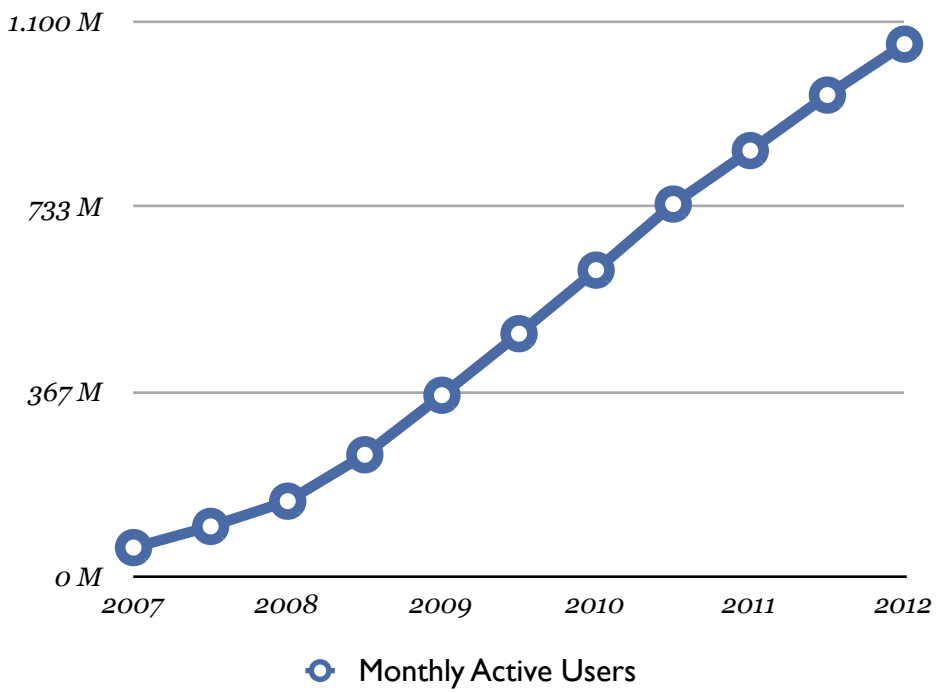
Since 2007 Facebook's user base has been growing every year by an average of 84%. While this growth rate is understandably slowing down, last year the number of monthly users surpassed the 1 billion mark, recording a 25% increase over the previous year. This is a significant portion of the estimated 2,4 billion worldwide internet users[1], and even more so if one considers that the over half a billion internet users in China are not allowed by their government to access the social network: this means that over half of the available worldwide internet population uses Facebook at least once a month.

But most Facebook users connect to the website much more often than once a month; in fact, in december the website had 618 million daily active users, meaning that the majority of the user base interacts with the site at least once a day.

The same number of users also connects to the social network through mobile devices, twice as much as the previous year, one of the biggest shifts in user activity that Facebook has had to contend with during its lifetime.

	2007	**2008**	**2009**	**2010**	**2011**	**2012**
Monthly Active Users	58	150	360	608	845	1.056
Y/Y change	–	158,62%	140,00%	68,89%	38,98%	24,97%

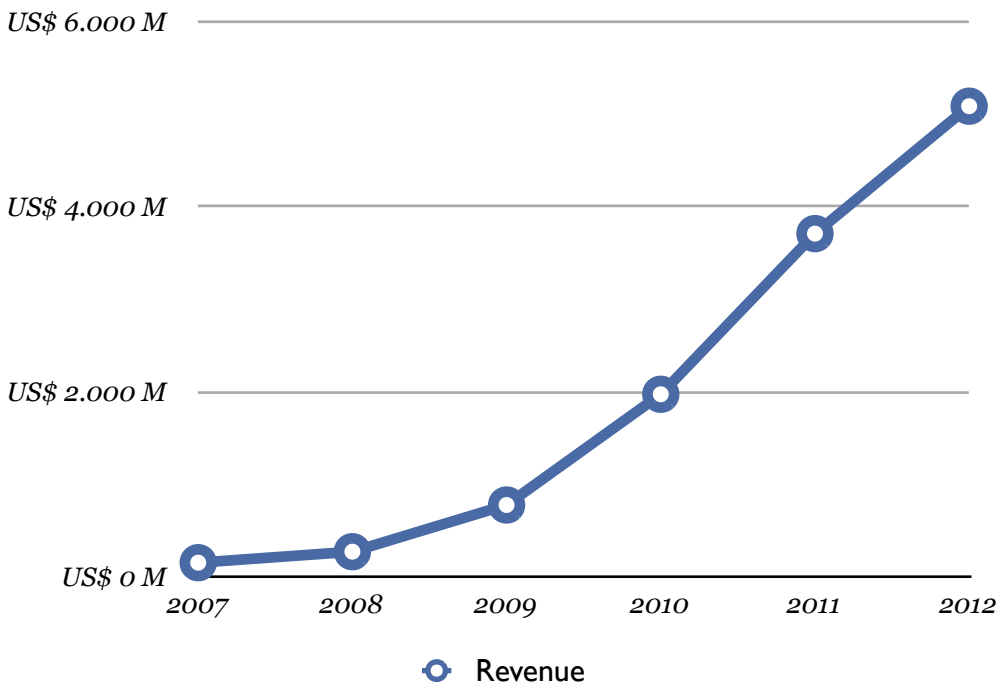
[1] *source: Internet World Stats.*



This impressive growth in users has been matched by an equally intense growth of the company's structures and resources. The company became public in March of 2012 and has reached at the end of the year a total workforce of over 4.600 employees. Just two years ago this number was less than half, but the company has been hiring aggressively to rapidly scale its business, growing by more than 50% in 2010 and by almost 45% in 2011, and expects to keep expanding significantly in 2012.

PROFITS

The company is just starting to monetize its huge user base and recorded its first profitable year in 2009. Revenue has been growing substantially, recording a CAGR of more than 100% since 2007, versus a market growth rate of 6,3%.
In 2012 the company recorded revenues of more than $5 billion, already a tenth of Google's $46 billion, but a tiny portion of an industry which is estimated to be worth $2.656 billion.



	2007	2008	2009	2010	2011	2012
Facebook revenue $M	153	272	777	1.974	3.711	5.089
Y/Y change	–	77,78%	185,66%	154,05%	87,99%	37,13%
Software & services market $B (source: Marketline)	1.943	2.149	2.158	2.313	2.483	2.656 (est.)
Y/Y change	–	10.6%	0.4%	7.2%	7.3%	7.0%

The company's margins have also been exceptionally high: above 40% in the last three years[2], in line with the most profitable software giants.

This profitability is remarkable when one considers the substantial increase in workforce the company has been undertaking, and the considerable costs associated with such exceptional growth.

[2] *considering the $1,57 billion of share-based compensation expenses the company recognized in 2012 following its IPO.*

	2007	2008	2009	2010	2011	2012
EBIT $M	-124	-55	262	1.032	1.756	538
EBIT growth	–	55,65%	576,36%	293,89%	70,16%	-69,36%
Operating profit margin	-81%	-20%	34%	52%	47%	11%
ARPU (Average Revenue Per User)	–	–	US$ 3,08	US$ 3,97	US$ 5,02	US$ 5,32
Y/Y change	–	–	–	28,90%	26,45%	5,98%

CORPORATE ASSETS

According to Alexa, Facebook is battling Google for first place as the most visited website on the web. The two giants are essentially tied in first position, alternating at the top quite often.

There are no doubts, however, that Facebook is the largest social network in the world, and by a wide margin.
It easily outmaneuvered its original competitors, such as Friendster and Myspace, leaving them dead or struggling for survival, and even when new competition has sprung up, Facebook has been able to rapidly adapt its product and stop their rise.

Today the company is in the position to crush emerging new social networks with the power of its huge network effect and product development prowess, or to absorb them by using its available cash and attractive stock.
An example of this has been Instagram, which at 27 million registered users on iOS alone, was increasingly positioning itself as more than just a photo-sharing app. When Facebook realized that some users were doing more of the daily sharing activities on Instagram rather than its own social network, it bough the company for $1 billion in cash and stock. Facebook maintained its spot as the most popular photo uploading service on the web, with more than 300 million photos uploaded each day.

When acquiring the competitor has failed, such as with Twitter, or was not possible, in the case of Google's own Google+, Facebook has been able to easily adapt to the new threats, while being protected by its strong network effect, which is 140 billion friend connections strong.
Twitter has today less than 300 million registered users in the world, and Google+, which has around 340 million registered users and is the second largest social network, is by most considered to be failing in terms of user engagement and actual use.
The average american user spends 6,7 hours a month on Facebook, compared to 20 minutes on Twitter and just 3 minutes on Google+.

Another strong competitive position has been obtained by Facebook's Platform, which by March of 2012 had been integrated in more than 9 million apps and websites, becoming a necessary requirement for any new product or service launched on the market.
The company has also recorded over 1,13 trillion likes since the launch of the feature in 2009; another indication of the fact that Facebook has transformed into a standard on the web.

E.4. Within-case analysis

		Design as Style	Design as Process	Design as Strategy
***What** is design*		Style	Product Development and Innovation at large	Meaning
***How** is design used*	*The role of design in the NPD process*	Function	Multifunctional Team Member	Process Leader
	The kind of NPD process	Structured Focus on Problem Solving Linear/Sequential No Exploration	⟺	Unstructured Focus on Problem Setting Non-Linear/Iterative Freedom and Exploration
***Who** designs*		No-one Designer	⟺	Everyone
***Where** design happens*	*Distance from top management*	Peripheral Activity	⟺	High level Activity
	Degree of connection to the "innovation network"	Limited	⟺	Active Participant
***When** design is used*		End of NPD process	During the NPD process	Always
***Why** is design used*		Product	⟺	Everything (Holistic)

	Facebook	Software Industry
Design Approach	Strategy	Process

Summary of Facebook's use of design.

Company		Major Radical	Minor Radical	Major Incre-mental	Total	Timeframe
Facebook Inc.	*N°*	4	1	4	9	8
	% of total	44%	11%	44%	100%	
	N°/year	0,500	0,125	0,500	1,125	

Competitive performance					
CAGR @[number of years considered since last]			*Profit*		
Facebook	*Market*	*Δ*	*Facebook*	*Market*	*Δ*
60,6% @3y >100% @7y	7,2% @3y 6,3% @7y (global software and services sector)*	742% @3y >1400% @7y	EBIT margin >40% average 3y (adjusting for share compensation in 2012)	EBIT margin 13.12% 2012 (internet sector)**	>205%

* source: Marketline

** source: NYU Stern School of Business.

Summary of Facebook's design innovation and competitive performance.

CONSTRUCT ANALYSIS

Facebook's approach to design is significantly more advanced than that of the rest of the software industry, which has an average design maturity halfway between the *design as style*, and *design as process* characterizations.

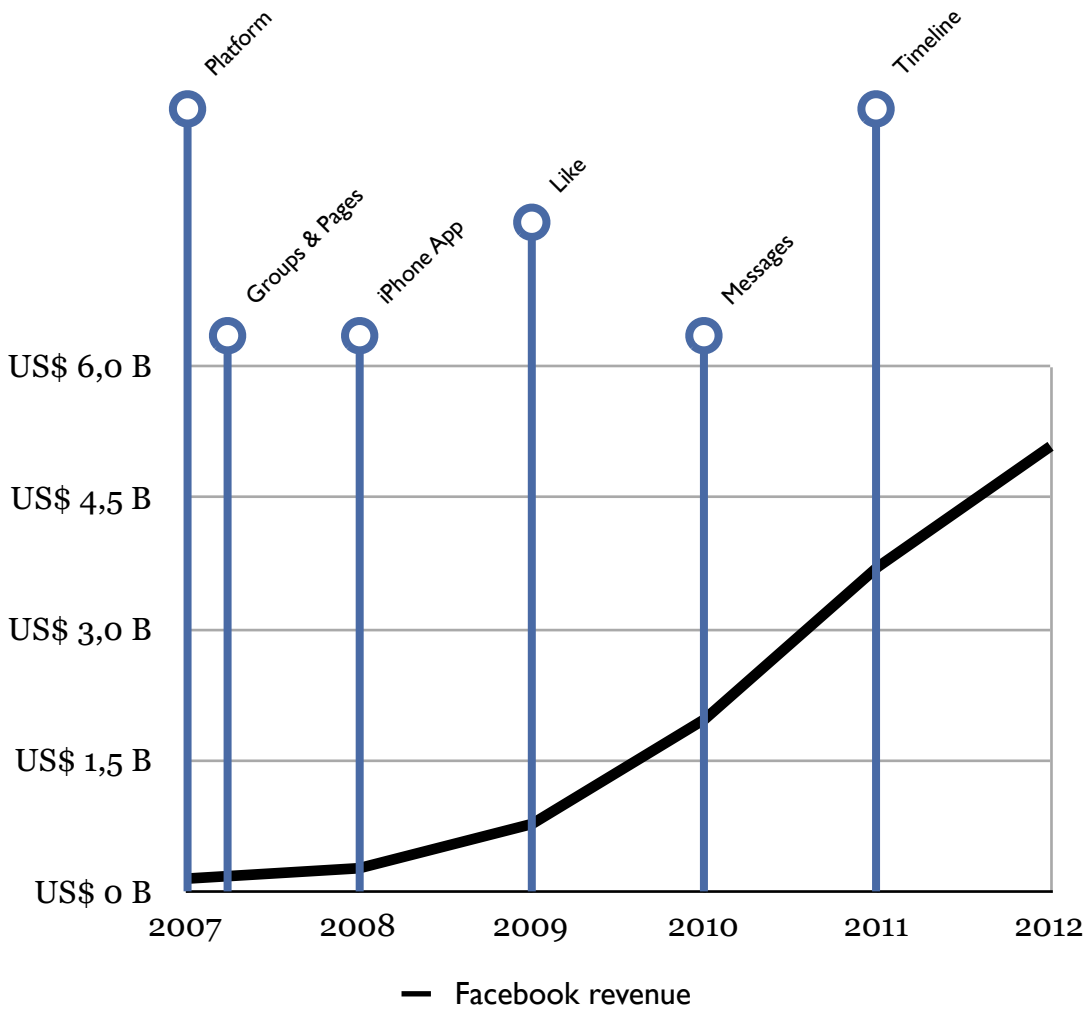
This sector is learning rapidly from the examples set by the various IT companies who have achieved success through the strategic use of design: both new startups, as well as established players, are approaching design and implementing it into their company cultures with a growing understanding of its value.

Facebook has been one of the leading companies in this process, adopting the *design as strategy* approach since the early days, and maintaining a steady investment in design as the company's resources grew.
The model describes Facebook's use of design particularly well, with the company

showing values consistent with the highest degree of design use maturity on all variables.

As a result of this investment, the company's design innovation performance has been very high over the years, with a steady stream of updates to existing products as well as new launches. Facebook has had an average of over one significant innovation every year, a remarkable rate of change, which has deeply modified the company's main product over the years. The frequent product developments reflect the dynamic nature of the entire internet sector, and appear appropriate given the turbulent market the company operates in.

In terms of competitive performance, the company has vastly outperformed the its market. Its CAGR over the last three years has been over eight times that of its competitor's average, with EBIT margins surpassing the exceptional value of 40%.

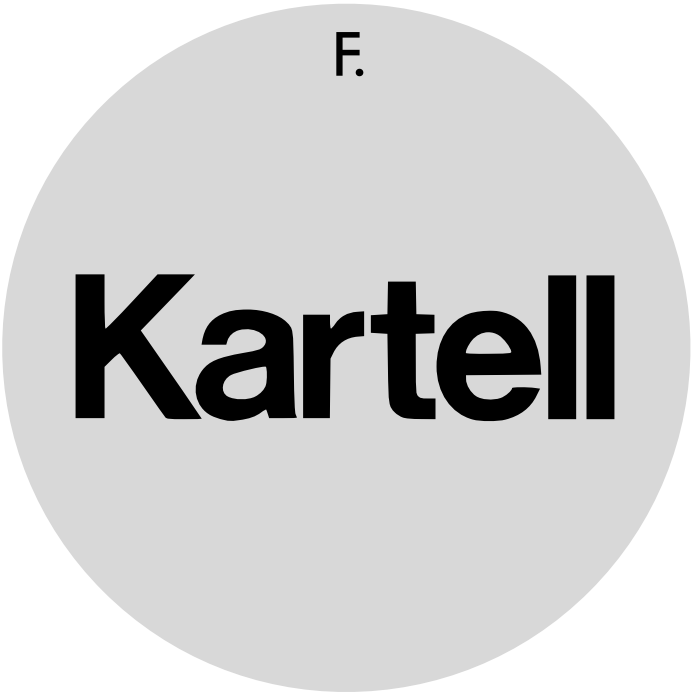


The company's output of innovative products has allowed it to continue to grow steadily over the years, overcoming numerous competitors and reaching the leadership position on the market.

In the last few years, the company's growth has started slow down (in relative terms). The company's global ARPU increases have diminished year over year, as the optimization of the current methods to monetize the user base becomes harder.

However, no particular inflections are noticeable in the company's rapid user base expansion, which is today the main driver of revenue growth. This is a sign of the effectiveness of Facebook's strategy of continuous product improvement, that is just starting to produce its financial results.

F.



F.1. Design innovation performance and context

I am a Japanese architect, an American set designer, a German industrial designer, a French artistic director and I am a designer of Italian furniture. Why am I a designer of Italian furniture? Because people worthy of this name are only to be found in Italy.

Philippe Starck

Kartell SpA was founded in 1949 by Giulio Castelli, a chemical engineer who had studied at Politecnico di Milano under Giulio Natta, winner of the Nobel Prize for chemistry. Castelli wanted to create something new with the new materials that the market was starting to offer, "attempting to generate, through [his] products, beauty, innovation, and most of all astonishment."[1]
The first opportunity came when, while skiing with some friends that worked as engineers at Pirelli, he heard of Nastrocord, a new material that the company had just introduced. Castelli had the idea of using it to produce a ski rack for the car and to market it as the Pirelli "Portasci". Kartell's first product was launched and met great success, being exported to France, Switzerland and Canada, and leading to the introduction of other car accessories made of plastic.

The car accessory business didn't last long however. The construction of high speed highways made the use of external racks less practical and Castelli started to look around for new opportunities. During the war a new material had been developed for use in radar equipment called Polyethylene and the first objects made in this new material had started to appear in the market. Castelli saw the potential of this new material and decided to create a new line of inexpensive objects for homes, where, since the war had just ended, almost everything was needed.

Through his wife Anna Ferrieri, an architecture graduate at the time, Castelli was introduced into a circle of brilliant friends such as Franco Albini, Marco Zanuso, Ignazio Gardella, Piero Bottoni, Ernesto Nathan Rogers and the Castiglioni brothers, future legends of italian design and architecture that injected into Castelli a strong passion for design. Among those friends was also a young Gino

[1] *G. Castelli, P. Antonelli, and F. Picchi, La Fabbrica Del Design: Conversazioni Con I Protagonisti Del Design Italiano (Milano: Skira, 2007), 26.*

Colombini, to whom Castiglioni proposed of working for Kartell on the new product line.

This was the start of Kartell as we know it: with the introduction of a slew of colorful and playful plastic products designed by Colombini. Nobody talked about design yet, but the new materials allowed Kartell to create products in a radical new way and to do so very inexpensively. After the first five years the company had already collected four of the recently (1954) instituted Compasso d'Oro Awards, along with many other international prizes, and had been featured prominently into the first industrial design exhibit of the Triennale of Milan, shifting permanently the company's focus to its new activity: cutting-edge design.

Through a process of continuous technological research the company kept working at the frontier of the plastic revolution, exploring new production techniques and pushing the boundaries of what could be made with this radical new material in terms of colours and shape.
With its slogan "Plastic as Science", Kartell opened a division to produce scientific equipment that could be created with plastic in place of traditional materials. This division, that still exists today and contributes up to a third of all revenues, has helped the company keep in touch with all major innovations in plastics along the years, functioning as training grounds for the main production lines.

The Sixties saw the beginning of the second phase for the company. This was the period in which Italian design grew and saw the quality and originality of its new direction recognized abroad. As Kartell's fame and experience with those new materials grew, the creative opportunities began attracting external designers that proposed new projects and opportunities. Kartell's approach to technical experimentation lead the company to develop a highly innovative production strategy, choosing to externalize the manufacturing process of each product to the most advanced producers on the market in order to keep exploring the possibilities made available by plastics. This revolutionary strategy would later inspire many of the great italian design companies, and create an incredibly vibrant and effective design district in northern Italy.

If, up until that moment, Kartell had been identified almost exclusively through Colombini's works and designs, from 1960 onwards the company began to

work with freelance designers as well, thus opening up to new or established talent, a common feature of its history. This period saw the rise to fame of products designed by some of the greatest italian designers of the time, including Ettore Sottsass, Gae Aulenti, Anna Ferrieri, Joe Colombo and Marco Zanuso, and the beginning of international exports to Switzerland, Japan and the United States.

The years between the end of the Eighties and beginning of the Nineties were marked by a new interpretation of the plastic product. The market had been flooded by a slew of cheap plastic products that ha shifted the perception of the public against this material. The furniture market saw the resurgence of handcrafted products, and of traditional materials such as aluminium, iron and wood. Designers and producers had to adapt, but Kartell's culture of plastic production was too eradicated to be shifted successfully, and the company suffered a sharp reduction in sales.

In 1988 Kartell started a new chapter in its history with the arrival at its helm of Claudio Luti, founder of Versace and son-in-law of Giulio Castelli. That year the company launched Dr. Glob, a chair designed by a young Philippe Starck, that used, for the first time in the company's history, different materials in conjunction with plastic.

Kartell had realized that, since a shift in core competences or market would be unfeasible, it would need to reinvent its current product offering in order to start growing again. The company had to dissociate itself from the widespread perception of plastic as a cheap material for low quality furniture. New meanings had to be injected into the material, and a new product language had to be developed.
This is the reason why Dr.Glob was designed to turn all of the traditional connotations associated with plastic products on their head: sharp edges instead of rounded corners, thick sections instead of the traditional three millimeters of width, and a radically new colour palette, that abandoned the usual glossy primary colours for sophisticated matte hues.

"I knew that modifying the catalog would have required years. The relaunch of our plastic production had to happen modifying completely the common perception about the material; we had to define the new plastic product especially from a visual point of view. This meant betting on innovation but in particular it meant insisting on quality to bring plastic back inside the houses of the whole world, regardless of their style."

Claudio Luti

The product catalog was revitalized with a series of innovative new products realized in conjunction with a new generation of designers such as Philippe Starck, Ron Arad, Vico Magistretti and Antonio Citterio, that, once given access to Kartell's unique competences, proved as prolific in terms of design icons as the designers of Castelli's era.
The Bookworm (1994) bookshelf and the FPE (1997) chair by Ron Arad, the Mobil (1994) storage system by Antonio Citterio, the Maui chair by Vico Magistretti (1996), are just a few of the most successful products of that period, who followed in the steps of Dr. Glob to redefine and elevate the meaning of plastics.

BOOKWORM: A NEW MEANING FOR PLASTIC

One of the products that stands out most of all from Kartell's early times under the new direction of Claudio Luti must be Bookworm, the famous bookshelf designed in 1993 by Ron Arad.

Arad arrived at Kartell with a history of working with steel. While moving out of his home he had been inspired by a coil of steel to create a continuous shelf that would unwind along the wall, held in place by some fake metal books. The idea for bookworm had been born.

The bookshelf could be as long as you wanted and shaped however you liked it. However this was not yet a product: it was a one off piece of art that Arad had created for his personal use, and which he had named "This Mortal Coil". The steel made it expensive, heavy, and impossible to install without specific equipment.

When Arad proposed the concept to Kartell, the company, that had just transitioned to its new owner and chairman, was initially taken aback.

The company had never worked on anything similar, could this strange, expensive and heavy sculpture proposed by Arad become a product?

"And to think that, if it had been up to me, we would never have made it. That time it was the obsession of my son-in-law Claudio Luti, who was formerly chairman of Kartell. He took the decision to make Bookworm."

"It was weird, in my opinion it would not have been successful at all. Our customer had been given too much freedom. He was not being sold an object but the freedom that hitherto he had never been granted. And then he had to fix it to the wall, not hang it and nobody likes fixing things to the wall, sooner or later they have to be taken down again."

Giulio Castelli

To Mr. Luti, however, this was exactly what the company needed. The company's skill with plastic would allow them to turn a work of art into a commonly used object. A work of art that would be inexpensive thanks to the efficient production process, but would carry an enormous value for its customer, going well beyond its basic functional value.

"At the time, the common image of plastic coincided basically with that of the white outdoors chair that had now invaded the world. Compared to the enthusiasm with whom the design objects made of plastic had been received during the sixties - with emotion for its innovative character and colours - in just two decades those qualities seemed lost, forgetting the versatility of this material."

Claudio Luti

Kartell started working on the project and soon realized that it would have to face some major challenges. To be able to reproduce the original concept of the product developed by Arad, a plastic material had to be used that had characteristics not unlike stainless steel: it had to be at once flexible, sinuous, elastic and coloured, but sturdy and resilient as well. The engineering department immediately sought assistance from its traditional suppliers to define the correct material and composition to be used for the production, finally settling with batch dyed polyvinyl chloride (P.V.C.), a semi-rigid plastic that is very widely used in various industrial sectors.

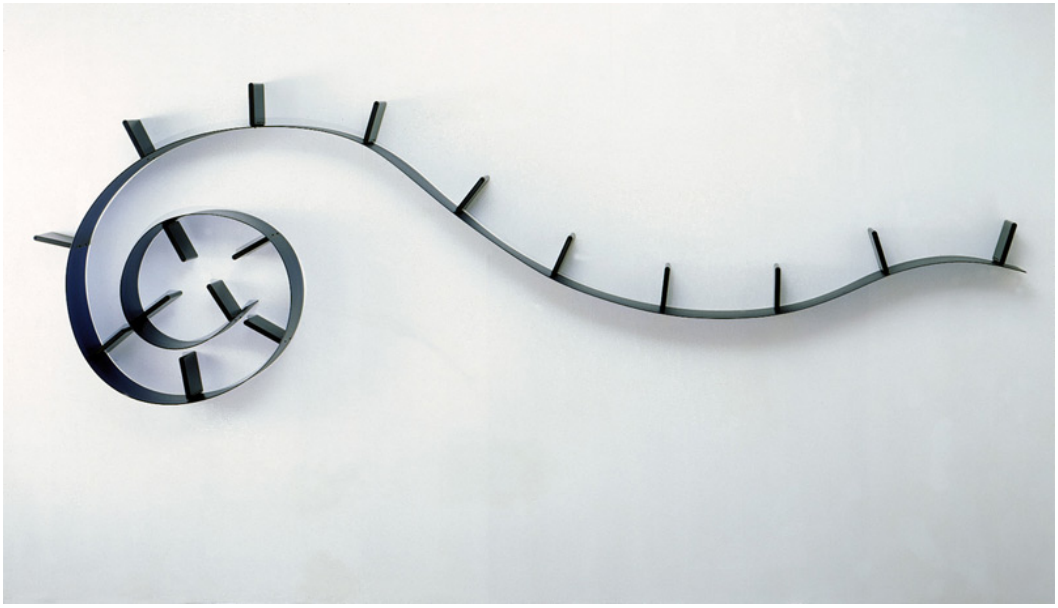
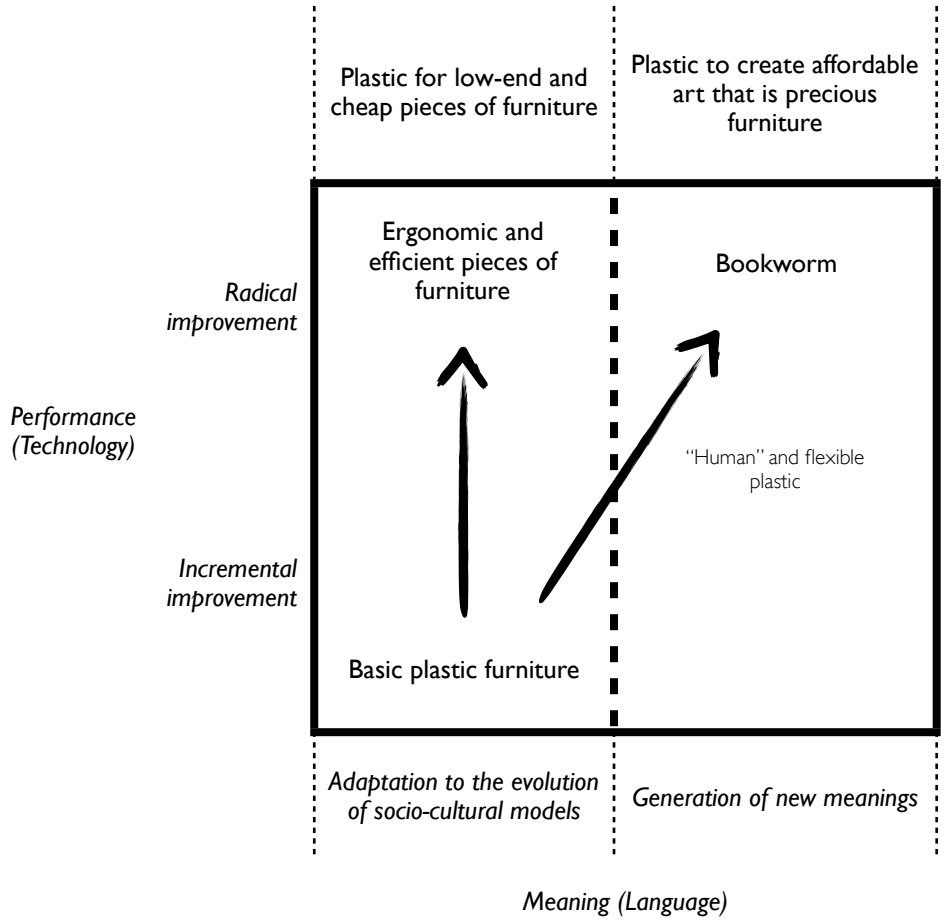


Fig. F.1 : the Bookworm library by Ron Arad.

The production process also presented its challenges. While the supports were made through injection molding, a common method for Kartell's products, the main part of Bookworm, the flexible band, was obtained through extrusion, a technology that had never been used in such a way by the company.

When being transposed to plastic, the product didn't just have to retain its functional abilities. While a lot of research and effort was punt into making sure that the rigidity and stiffness of the supports was sufficient to hold the required weight of books, and that attaching the product to the wall would be as simple as possible, the designer, in conjunction with the technological abilities of the company, was now free to project new meanings into the product. Colour, transparency and texture were now available at his disposal. The final product ended up being semi transparent, made in colorful but deep hues, and slightly textured.

> *"Claudio Luti still points out to me that the surface of Bookworm's band is not smooth but has little bubbles in it. Mind you, that is no defect but the pursuit of perfection. They wanted to give an impression of softness both to the eye and to the touch and that is the result. And it is not easy to achieve that because first of all the extruder had to be convinced... he is one of the best for this type of process and his extrusions are absolutely perfect and dry. But for this product this would not do, because his perfection, this time, seemed like a defect.*
>
> *Mrs. Romano, curator of the Kartell Museum*



Ron Arad created a real sculpture that could furnish a wall. The fascination that people have with it originates from the chance they are given to interpret the wall by designing a free shape. It was the perfect concept to realize the vision of Mr. Luti: to bring back plastic furniture into the home, as a quality product that could adapt to any style and be accompanied by any other furnishing, giving it the value of permanence and independence from passing styles and fashions. The product has been given value not through function, but through emotion, making this much more than a way of storing books.

"I do not really care if people use my creation or not, I have fun discovering procedures, what can be done with the material, what type of form can be achieved and function, in this case, is just an excuse. I am not interested in fighting for one side of the question or the other; saying: 'this is not sculpture! no, this is design', is not important at all. What counts is: is it interesting, is it boring, is it exciting, does it give you a sense of pleasure when you look at it or touch it or not?"

Ron Arad

Luti also revolutionized the distribution of the products. He opened the first flagship store in 1997 in Milan, and since then has opened more than 120 stores in almost as many countries. Instead of appealing to architects in need of furniture for their projects, the idea was to sell directly to the customer, with affordable prices that could lead to impulse purchases, and with colorful and always changing store windows that would invite onlookers.

In 1999 came La Marie, designed by Philippe Starck, reshaping once again the entire product portfolio.
Starck had been musing on the concept of "dematerializing" objects, and the opportunity to bring to life his ideas came while designing this new chair with Kartell. The company's know-how in the use of polycarbonate allowed him to push for the development of a previously unimaginable injection molding process that would create the chair from a single mold of perfectly transparent material. The result was a light and almost indestructible product, that seemed to disappear underneath the person sitting on it.

The goal was that of using the properties of plastic to create a universal object, that could adapt to all stiles and environments, and transcend passing trends and styles to become immortal.

"We wanted a chair that would stand out for its individuality and could stand on its own, but at the same time it had to be able to live in every context and next to any other piece of furniture. In fact La Marie lives indoors and outdoors, with hi-tech furniture as well as antiques, at home, in an office, and in public spaces.
La Marie contains all of the key values of our our brand: functionality, design, transversality, and, most of all, the value of permanence and independence from passing styles and trends. La Maria has been created to live an existence which is autonomous from the temporary shifts in taste, rising to the rank of cultural icon."

Claudio Luti

This would become the theme for Kartell's next decade. In 2001 "La Boheme" was introduced: a simple stool made of coloured transparent plastic shaped as an antique vase.
The idea was to juxtapose the modernity of the material, to the cultural history of the original object, to create something that could stand the passing of time.

The same concept was behind the following works by Starck, such as the "Louis Ghost" (2002, which is currently the company's best selling item ever), "Victoria Ghost" (2005), "Lou Lou Ghost" (2008) and "One More" (2012) chairs, as well as the "Ghost Buster" (2010) dresser and small table.

"We took their common memories, and turned them into an immaterial ghost."

Philippe Starck

Fig. F.2: La Marie (left), and Louis Ghost (right).

In 2002 the company made its return to the lighting business, which it had abandoned in the early 80s. It launched three new lamps, ("FL/Y", "Easy" and "Take") designed by Ferruccio Laviani, the company's art director, bringing Kartell's philosophy of colour and transparency to the sector. A year later came "Bourgie", another best-selling lamp penned by Laviani, which expanded the company's concept of reinterpreting classic shapes through the use of plastic.
The success, lead to the introduction of several other lamp models by Laviani, such as "Neutra" in 2008, and "Bloom", "Cindy" and Tatì" in 2009, resulting in the creation of a dedicated Kartell Lights division.
The latest addition to the Kartell Lights portfolio has been "Taj", in 2012, the company's first use of LEDs in its products.

The company also continued to experiment throughout the decade with new processes and materials. Pushing the limits of plastic through products such as "Bubble Club" (2000, Starck), a sofa awarded with the prestigious Compasso D'Oro award which was the first piece of furniture to be mass produced through rotational molding of polypropylene, or the chaise longue "LCP" (2002, van Severen), made of a single sheet of extruded plastic, or "Mr. Impossible" (2008,

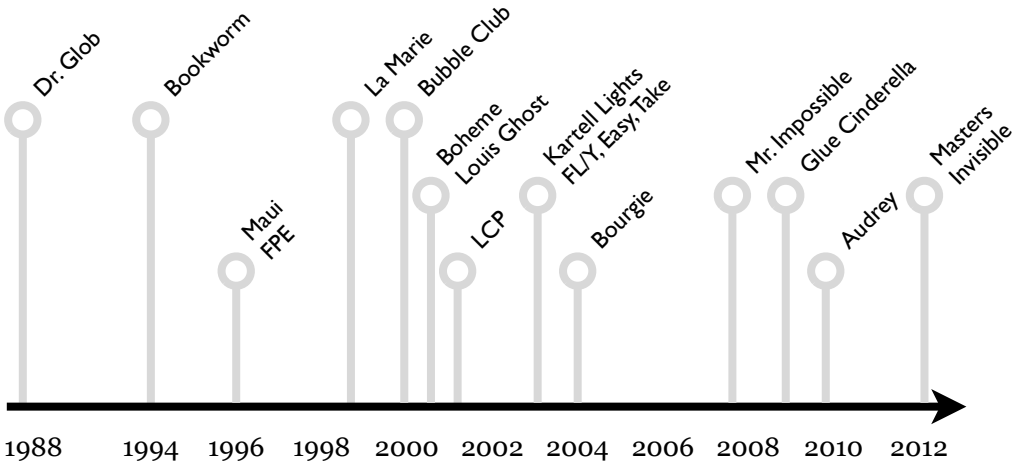
Starck), a seat with a layer of air between two laser-welded semi-transparent plastic molds.

In 2009 the company ventured once again into a sector, bringing plastics to the world of shoes with the launch of Glue Cinderella, by .normaluisa. This "experiment" by the company has evolved today into a small line of footwear, bringing together fashion and design, two of Milan's fields of excellence.

Fig. F.3: various recent Kartell products.

Today, the product portfolio continues to grow at an increasing pace, with new designers joining the company ranks and producing the design icons of the tomorrow.

Some of the latest successes have been the chair "Audrey" (2010) by Piero Lissoni, made with the minimum possible amount of plastic and aluminium; the "Invisible" series of tables and chairs (2012) by Tokujin Yoshioka, consisting of thick slabs of transparent plastic assembled together by hand; and finally the "Masters" chair by Starck (introduced in 2010 but brought to market only in late 2012, after two years of additional development to fine tune every detail and achieve the maximum possible quality), which continues Kartell's work on the union of old and new, by weaving together the back silhouettes of three design icons (Jacobsen's Series 7 Chair, the Eameses' Molded Plastic Chair and Saarinen's Tulip Armchair), to create a usable modern homage to history and culture.



Kartell's design innovation performance from Dr. Glob to today.

F.2. Investment in design strategy

WHAT DESIGN IS

From 1960, Kartell has made exclusive use of freelance designers. The company receives every year a high number of spontaneous submissions by aspiring and affirmed designers with project proposals, since the beginning however, and even more so today, under the guidance of Mr. Luti, Kartell has preferred to specifically select a designer first.

"Usually those projects that arrive spontaneously are not examined, because the project is the result of the collaboration between the company and the designer. As Magistretti always told me, 'design is made by a couple while architecture is made on your own'"

Claudio Luti

The long and expensive process of research and study that goes into the development of a new product could not be applied to a vast number of proposals, so a selection must be made upfront. This is a limitation especially relevant with plastics, where the huge investment required to build the production stamps means that everything in a product needs to be right at the first attempt. Test runs and corrections are impossible so everything must be studied and thought out in every detail before entering production. Even after this, since the results can never be guaranteed, the company must often accept very high levels of risk when starting a new production, something Kartell has traditionally never shied away from.

The first step in the creation of a new product is therefore the selection of the designers to work with. Kartell chooses among the top designers in the world and can count on many long-lasting relationships with some of the most prominent designers of our time. The company then allows this "club" of designers to propose their designs, without giving them precise instructions about what the company needs, but working together with them in the definition of the concept to determine and follow the strategic vision of the company for the future.

In this phase the sensibilities of Mr. Luti are essential. He is personally involved in the process and is responsible for the company's relationships with the designers as well as the final selection of the projects to bring forth. Luti believes the project is only defined by the union of the creative force brought to the table by the designer, and the forming force brought by the company, sitting together at a

single table: another reason why it is impossible for the company to select its future products based directly on project proposals.

Each Kartell product starts with a process of continuous research into the meaning of plastics, and into the significance of its products in society. The company doesn't just see plastic as a material, to be used to produce "beautiful" and "functional" objects, such as those that may emerge from external proposals; they see plastic as an enabler of certain values that are the essence of Kartell's culture, and that may only be expressed through the direct interaction of a designer with the company.
The incredible versatility of plastic has left almost complete freedom into the hands of the designers and employees of the company, who have therefore chosen as guiding principle for their work the creation of products that carry the company's values and message.

> *"If it's true that we weren't completely aware of doing design, doing design has always meant only one thing to me: producing objects that had innovative characteristics, either in terms of using new production technologies, aimed at materials economy and process efficiency, or in terms of product type, attempting to interpret the rapid transformation of social and cultural needs."*
>
> *Giulio Castelli*

This approach explains Kartell's shifts over its lifetime. The company has been continuously evolving its interpretation of what plastic products should mean to the market, identifying their role in society and reacting to deep cultural changes, rather than to passing fads and trends. Kartell products are designed to have a minimum life of at least 10 years, and must have a global appeal in order to be sold all over the world.
Given the peculiarities of plastic, which require high initial investments and thus long production runs to break even, this approach has come naturally to the company, and has been responsible for the company's survival, as much as for its suc-

cess.

> *"We injected into the material new qualities, transforming our industrial product into something which is almost richer than a handcrafted product, and under this innovative drive, that has never stopped, we brought back plastics into the homes of the bourgeoisie as an element of value, and into shops worldwide as an object of desire."*
>
> *Claudio Luti*

***What** design is*	Style	Product Development and Innovation at large	Meaning

HOW IS DESIGN USED – THE ROLE OF DESIGN IN THE NPD PROCESS

At Kartell design leads the process at all times. It initially gives life to the project and then guides the entire development, across all phases and activities.

Ideas for new products at Kartell are born through the interaction between designer and company. In certain cases the product originates from a concept or directly from a full design proposed by one of the company designers; while other times the company challenges its designers by suggesting the use of a particular new production technology or material, or a new direction to explore.

Regardless of its origin, every product development is deeply tied to the design of the product, which is the key driver of the process, and sets the goal towards which the project participants aim at all times.

***How** is design used: the role of design in the NPD process*	Function	Multifunctional Team Member	Process Leader

Once the preliminary discussions between company and designer are over, and new projects have emerged, a multidisciplinary team including Claudio Luti, the engineering director, the commercial director and the financial director select, among the high number of possible new product (Castelli described fondly how Ron Arad used to submit a new product proposal each week), the ones that should be developed further, aware that in the development phase up to 80% of those will be discarded, leaving an average of between four and six new products to be launched on the market every year.

Usually the company then takes the ideas to the prototype stage to then choose which of them are in line with Kartell's image and philosophy. This process usually takes up to a year, and the finished prototype needs another year of engineering to reach the market.

“The market doesn’t know what it wants. We are the ones who impose a product on the market. If the market wants something, it is already old.”

Claudio Luti

This is another reason why Kartell doesn’t rely on market research when developing its products: it would never be able to reach the market in a timely manner. The company therefore operates by anticipating the future needs and social trends with the help of its team and expert designers, that need to be capable, even after years of work, of killing a project when it doesn’t fully meet the company’s goals.

"The type of experimentation we engage in is always projected towards the future, which is our business. In addition, it is experimentation in design in the widest sense of the word, aimed at achieving that difficult synthesis of technology and the drawing board, economy and providing an answer to a social need."

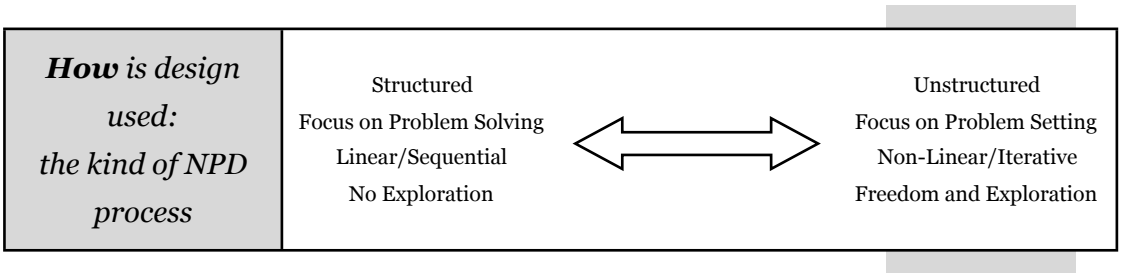
Giulio Castelli

In fact, the engineering process, which the company considers one of its core competences, is carried out in a manner which is much more akin to research, than traditional product development. Even at this stage, the product continues to evolve, as different production options are explored, reshaping the project, and opening up new opportunities. The designers are very involved even during this part of the product development process, as it is not uncommon for projects to change significantly during this phase, growing and at times becoming something completely different from the original idea.

The activities of the engineering office, from development to prototyping, are undertaken in close synergy with Kartell's circle of suppliers, generally mould manufacturers and chemical companies which contribute to the definition of the materials and the moulds that will be used in the production phases.
They represent an integral element in Kartell's innovation strategy, and are usually long-standing partners of the company, sharing the risk of new projects and even proposing new ideas and opportunities.

The capacity to process plastic, engineer products and engage in technological research, make up the historical heart of Kartell. The engineering departments, rooms where mixes, production techniques and final product specifications are decided, are what have set Kartell apart from many other companies in the industry. The ability to manage its image, the distribution skills, the way products are marketed and sold are determinant factors for Kartell, but none so much so as its traditional ability to work with plastic.

Ultimately, Kartell's product development is a flexible process, that is characterized by a profound sense of continued exploration and maniacal fine tuning. Plastic materials require extreme production precision and exact chemical formulas to achieve the desired effects, leading to long periods of work dedicated to the achievement of the best possible quality.
This means that no product is really done until it leaves the factory to be sent to the shops. The latest example is the Master's chair by Philippe Starck, which after being unveiled to the public in 2010 underwent two additional years of fine tuning before being finally shipped to the first customers.

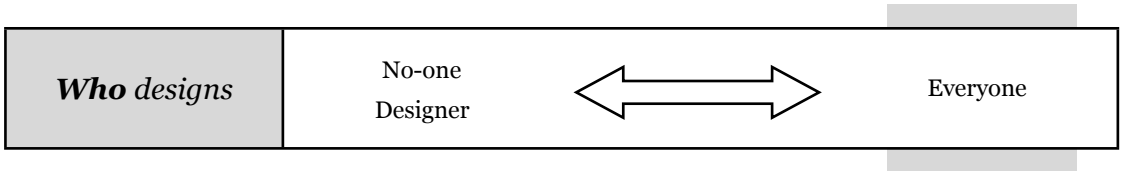


WHO DESIGNS

At any given time, the company collaborates with about ten external designers. Those designers aren't directly employed by the company, but are selected with the intent of embarking on a lasting relationship, and never with just one product in mind. Their work with the company usually lasts about a decade, and Kartell asks from them a daily contribution, both on existing products, as well as future proposals.

Mr. Luti is one of the key figures in managing and maintaining the company's exclusive "club" of designers. He participates in all product meetings, and shapes the company's future strategy together with the designers.

Engineers also participate in the design process by assisting the designer in bringing to life his ideas. They are a key element of Kartell's ability to bring to market its innovative products, and have significant impacts on the final outcome of each new project.

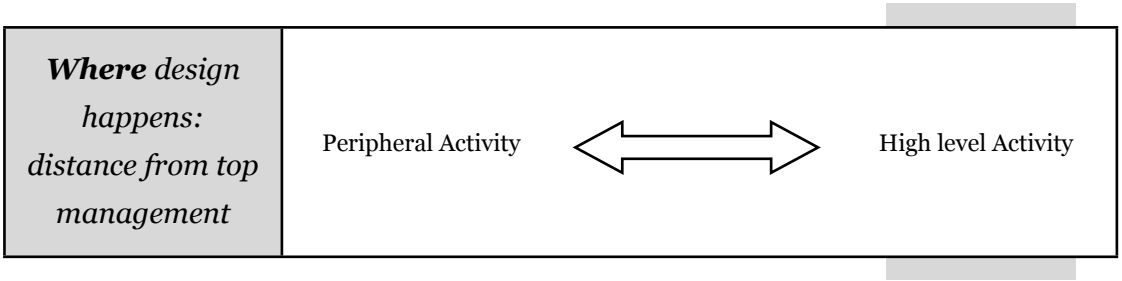


WHERE DESIGN HAPPENS – DISTANCE FROM TOP MANAGEMENT

One of the guiding principles of Kartell has always been the tight interaction between entrepreneur and designer. This principle has been one of the pillars of Castelli's era, and has been maintained and promoted by Luti, which is personally involved in the design of each new product.
The designers have personal direct relationships with the company's leadership, sitting at a table with Luti to discuss the company's future projects and ideas.

During the entire product development process, Kartell organizes weekly meetings between the managers from the engineering department, the designer and the chairman, who supervises this critical Kartell operation at all times.

Luti is the one who ultimately must take the final decision to send a product into production, and is responsible for the selection of the company's designers, making his personal sensibilities a key factor in the design innovation performance of the company.



WHERE DESIGN HAPPENS – DEGREE OF CONNECTION TO THE "INNOVATION NETWORK"

The activities of the engineering office, from development to prototyping, are undertaken in close synergy with Kartell's circle of suppliers, generally mould manufacturers and chemical companies which contribute to the definition of the materials and the moulds that will be used in the production phases.

Kartell has been one of the founding companies of the northern Italy design district, and is today deeply connected to this extensive network of unique competences. The company generally prefers to use suppliers that are located nearby, to simplify the intense co-operation that is often required when developing and producing the most innovative products.

"I believe that Italy, or more specifically Northern Italy, is still the centre of the design world, and I must say that it is not just because of the design that comes from Italy, but, above all, it is because of the manufacturing culture; there is no other place in the world where you can find such a vast array of craftsmen and manufacturers for all intents and purposes who know the value of design ..."

Ron Arad

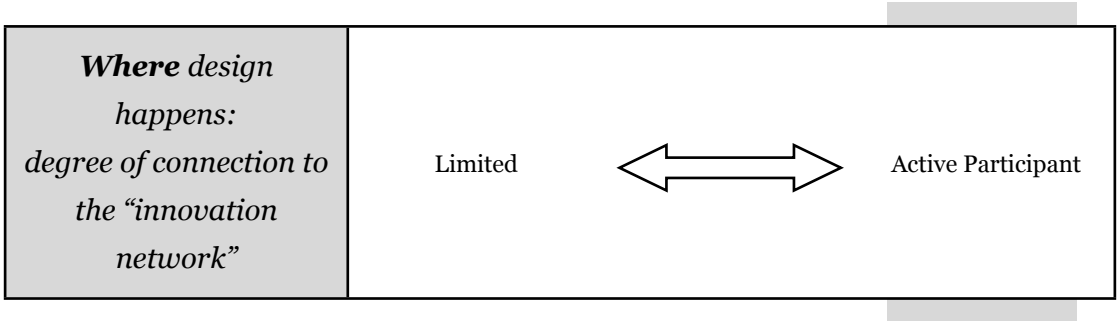
In this tight network of collaborations lies one of the greatest strengths of the company. Those suppliers have often been essential to the creation of new products, both in technical terms, by contributing know-how and technology, and in financial terms, contributing to the project with their own resources in order to promote or push their most innovative materials and processes into the market. Through the years those relationships have proved mutually beneficial developing

a set of skills and competences that can be found almost exclusively in this area of the world.

But the company also collaborates with leaders in plastics worldwide, who have come to trust Kartell over the year and often turn to them when launching new materials and mixtures.
A classic example of this was polycarbonate, which General Electric used for police shields and other security and defense applications, but was struggling to use in other sectors. Kartell noticed the opportunity that lied in the material's beautiful transparency and strength, so it worked with GE to create the first polycarbonate furniture product. At first even GE was skeptical, and guaranteed only an 85% chance that the strong material would work properly and without destroying the printing molds: Kartell took the risk and created La Marie, leading to the wide-spread adoption of polycarbonate around the world.

"The problem is always that of sensing opportunities and of finding ways to make the best out of new possibilities, because every day something new comes out, if we aren't the ones pursuing it: I look a lot at what is done with plastics in all the other sectors, particularly in those (such as automotive) which are naturally driven by innovation; we have very easy access to new technologies, because everybody knows we can make good use of them."

Claudio Luti



WHEN DESIGN IS USED

Kartell's use of design is a constant activity. From the beginning of new product development, to the manufacture, sale and marketing of the products.

It also has a main role in the formulation of the company's strategy, as Luti surrounds himself with designers to identify Kartell's vision for the future, and the direction its products should take.

"When I talk about "industrial system" based on design I don't just refer to the idea of producing industrially an object that has a beautiful shape and is functional – certainly essential requirements for every good project; to me the idea of industrial design includes the entire process of industrial product development, that bridges between the creative and economic activities, and that brings the product from its conception to the hands of the costumers: from the choice of what to produce, to the technological and market research, to the project and the realization of the product, to its promotion and its sale."

Giulio Castelli

***When** design is used*	End of NPD process	During the NPD process	Always

WHY IS DESIGN USED

Apart from products, Kartell has always concentrated on the way its products are marketed and presented to the public.

From 1991, Ferruccio Laviani has been chosen to curate the artistic direction of the company, designing their stands at events such as the annual Salone del Mobile in Milan, and setting up other events and shows.

The Kartell stand at the Salone del Mobile is particularly important, as it is one of the major events worldwide for the furniture industry, and every new Kartell product is finally unveiled there. Kartell organizes a full sized exhibition at the Salone, giving space to most of its product portfolio and using this opportunity as one of its main communication channels, retelling the company's story, and displaying its character, its personality, and its vision.

Laviani is also responsible for the look of Kartell's many stores worldwide. Under the guidance of Luti, the company has set up a vast network of points of sale across the world, and each has been specifically designed for its location and architectural characteristics.
Window displays are meticulously curated, with coordinated themes across the entire store, and all display are updated regularly, to invite customers to keep looking and always be surprised. The stores present a dazzling appearance of colour and light, that looks like no other shop and captivates passers by.

Kartell's retail strategy has focused on appealing to impulse buyers, with items stocked at many price points and in different colours and variations, and has proven a success both in terms of sales and brand image.

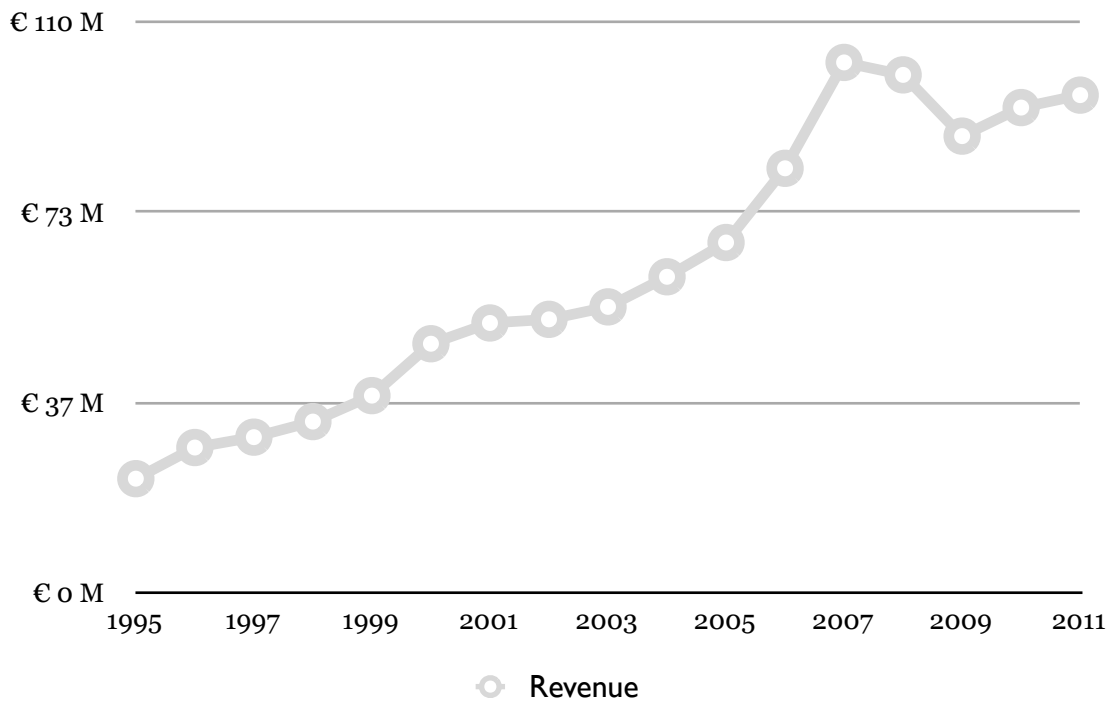
***Why** is design used*	Product ⟷ Everything (Holistic)

F.3. Competitive Performance

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Revenue €M	52,7	55,1	60,9	67,5	81,8	102,2	99,8	88,0	93,5	95,9
Y/Y change	–	4,45%	10,52%	10,88%	21,18%	24,90%	-2,33%	-11,78%	6,23%	2,54%
Global Furniture €B (source: Marketline)					495,5	514,8	526,3	522,7	526,6	553,2
Y/Y change	–	–	–	–	–	3,90%	2,23%	-0,68%	0,75%	5,05%
EBITDA	6,8	9,6	12,8	14,6	23,6	40,7	40,4	28,8	32,1	31,1
Y/Y change	–	40,09%	33,57%	14,05%	62,30%	72,17%	-0,69%	-28,67%	11,39%	-2,99%
EBITDA Margin	12,93%	17,35%	20,96%	21,56%	28,88%	39,81%	40,48%	32,73%	34,32%	32,47%

(Source:AIDA)

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Revenue €M				22,1	28,6	30,8	33,6	38,7	48,0	52,0
Y/Y change	–	–	–	–	28,93%	7,85%	9,12%	15,11%	23,99%	8,40%



Today, Kartell is still the market leader in plastic household furniture production, with a widespread presence worldwide, and one of the most renowned and respected brands in the industry.

The company has a broad international presence. It exports 75% of its annual turnover to 126 countries in the world, and has built a sophisticated global distribution network, consisting of more than 130 dedicated flagship stores, 200 single brand stores and over 4000 other points of sale worldwide.

GROWTH

The company has been able to grow at a tremendous pace.
In the decade between 1994 and 2003, Kartell's revenue has grown 175%, a staggering number when compared with the 28% growth of the italian furniture industry, and the european furniture average of 11%.

Between 2006 and 2007 the company saw a strong acceleration in growth (both years increasing revenues by well over 20% year over year), followed by a significant reduction in 2009 (-11,8%) as the recession hit hard some of Kartell's biggest markets, but apart from those variations, from 1995 to 2011 the company's revenue CAGR has remained a steady +9,56%.

The italian furniture sector has been particularly affected by the recent economic downturn[2], shrinking by 4,2% in 2011, after having slightly recovered in 2010 (+1,9%), the 18% loss of 2009. Kartell has outperformed the rest of the italian sector during the entire period and is now expected to resume growth at its usual rates.

Those numbers amaze even more if one considers that the company is now over 60 years old and has been considered among the best in its sector through most of its lifespan, and even through the delicate process of generational change.

I have been fortunate. Historically I have never seen an enterprise that has stayed at the same levels after power has been handed to the next generation. Take Zanotta for example, it was never the same after the "old man" died; the same thing happened to B&B... why did the Busnellis sell out to Opera? Because they realized the children were fighting and it would have been all over after they went. I have made my son-in-law chairman. He is very high-calibre as his results show. Anyway, you don't fund Versace out of nothing and he has brought with him a product sensibility that is typical of the fashion world.

Giulio Castelli

In the last decade the company has undergone an internationalization process which continues today, with the opening of many new points of sale around the world and growing sales in new markets.

In 2012 sales grew substantially in countries which had suffered during the 2009 crisis, such as the U.S. And Japan (both growing by 30%), and in new emerging markets such as South and Central America, with Brazil growing by as much as 40%.

The asian market remains relatively unexplored by Kartell, which will open its first five Chinese stores in 2013, and plans to have over one hundred within the next five years.

PROFITS

By externalizing everything it doesn't consider a core competence, and making use of external designers, it has maintained a tiny footprint, employing less than 100 employees (located at its Noviglio HQ, and not counting its retail personnel

[2] *according to reports by the Centro Studi Cosmit/FederlegnoArredo.*

around the world). This gives the company, that has had revenues of over 100 million euros, a remarkably high revenue per employee ratio.

The company's operating margins are also exceptionally high, with an average of more than 28% over the last decade, and increasing to an average of almost 35% over the last five years.

CORPORATE ASSETS

The company's product portfolio continues to grow, driven by a steady flow of new products, that join the ranks of timeless design icons that the company still produces many years after their introduction.

The list of awards that the company has received over the years reflects the impact that Kartell has had on the world of furniture and design. With 9 Compasso d'Oro Awards and many of its products featured in the permanent collections of Centre George Pompidou, Moma and the Victoria & Albert Museum, Kartell stands out as one of the most iconic furniture companies in the world.

With its steady stream of design icons Kartell assures a steady base of products that create a lasting source of revenue for the company. Some of Kartell's most iconic products remain in production despite being introduced decades ago, such as the set of storage units "Componibili", designed by Anna Castelli Ferrieri in 1967, and still available today.

F.4. Within-case analysis

		Design as Style	**Design as Process**	**Design as Strategy**
***What** is design*		Style	Product Development and Innovation at large	Meaning
***How** is design used*	*The role of design in the NPD process*	Function	Multifunctional Team Member	Process Leader
	The kind of NPD process	Structured Focus on Problem Solving Linear/Sequential No Exploration	⟺	Unstructured Focus on Problem Setting Non-Linear/Iterative Freedom and Exploration
***Who** designs*		No-one Designer	⟺	Everyone
***Where** design happens*	*Distance from top management*	Peripheral Activity	⟺	High level Activity
	Degree of connection to the "innovation network"	Limited	⟺	Active Participant
***When** design is used*		End of NPD process	During the NPD process	Always
***Why** is design used*		Product	⟺	Everything (Holistic)

	Kartell	**Furniture Industry**
Design Approach	Strategy	Style/Process

Summary of Kartell's approach to design.

Company		Major Radical	Minor Radical	Major Incre-mental	Total	Timeframe
Kartell S.p.A.	*N°*	4	5	4	13	21
	% of total	31%	38%	31%	100%	
	N°/year	0,190	0,238	0,190	0,619	

Competitive performance					
CAGR @[number of years considered since last]			*Profit*		
Kartell	*Market*	*Δ*	*Kartell*	*Market*	*Δ*
4,87% @3y 3,23% @5y 6,87% @10y	2,88% @3y 2,23% @5y (global furniture sector)*	69% @3y 45% @5y	EBITDA margin >35% average 5y	EBITDA margin 11.42% 2012 (furniture sector)**	>206%

* source: Marketline

** source: NYU Stern School of Business.

Summary of Kartell's design innovation and competitive performance.

CONSTRUCT ANALYSIS

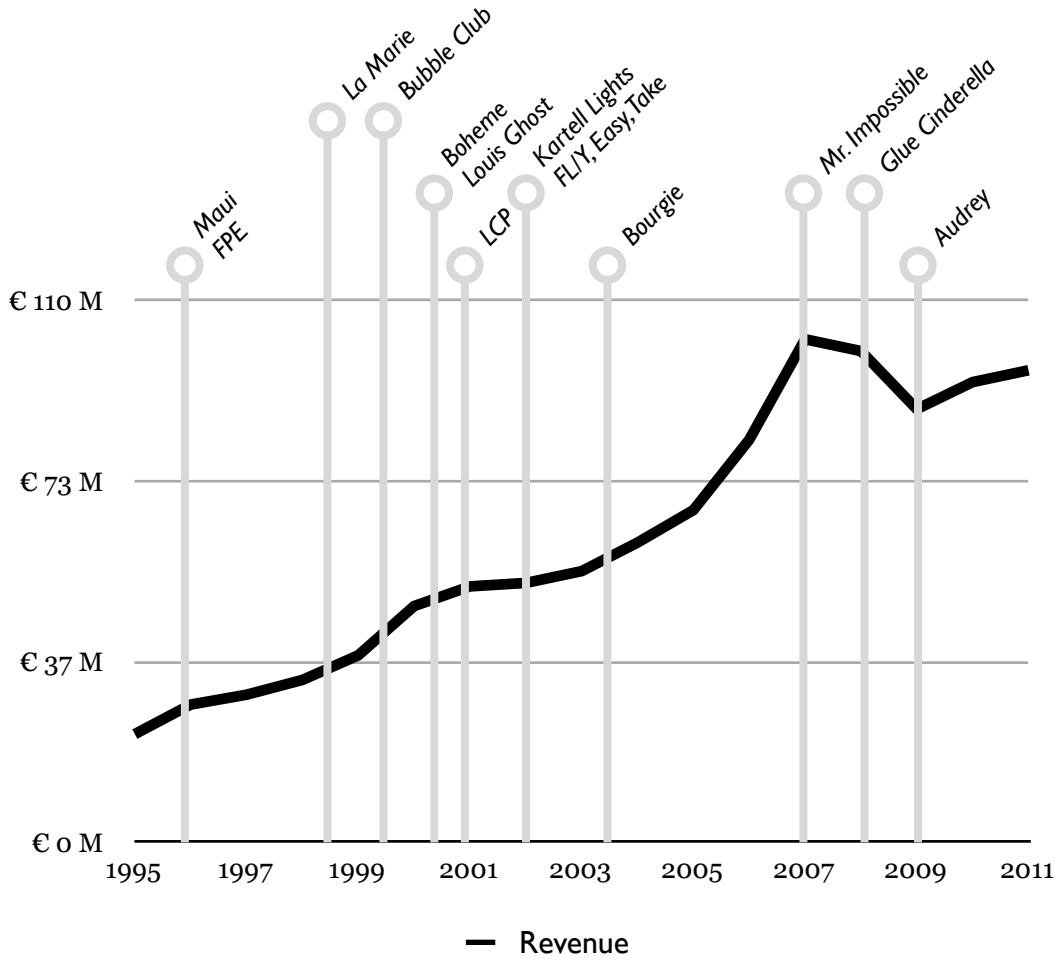
While the furniture sector is immediately associated with design by the general public, the vast majority of the industry, while investing a lot of resources in designers, implements design in a rather trivial way.
Certain localized groups of producers operating in particular geographical areas are an exception to this general trend however, with the Italian furniture sector, which includes Kartell, standing out as a prime example.

Kartell was one of the first to adopt a more sophisticated approach to design, with practices that position the company perfectly into the category of *design as strategy*.

In the last two decades, the company produced four major radical innovations of meanings, and an average of 0,62 significant innovations a year. Kartell aims to create products with a minimum life of ten years, and appears to create radical innovations following a similar time frame. On average every decade, the company

proposes some new radical products, which are then followed in the next several years by a series of more incremental evolutions of the new concepts introduced.

The company's competitive performance has been very high, averaging in the last three years growth rates almost 70% higher than the furniture market. Kartell has also excelled in terms of margins, which are three times those of the competition, thanks to the combination of an extremely small corporate footprint, and high product margins.



TIME SERIES ANALYSIS

The company's design innovation performance has been particularly intense in the period of the early 2000's, as the company developed and launched products that brought to market a new vision of plastic products.

Sales have increased significantly over the last decade, with higher growth rates between 2005-2007, as the new product portfolio diffused on the market. In

2008-2009 however the recession halted the company's expansion, with 2009 recording the biggest decrease in sales in the last 20 years. Most of the company's portfolio is positioned at the market's high-end, so the impact on the company was stronger than that on the rest of the industry.
Already in 2010, Kartell had resumed its growth, with the launch of a new wave of products and the expansion of the lighting division (following the success of Kartell's 2002 lighting line).

6. Cross Case Analysis

This chapter will conduct a detailed analysis of the findings and results emerging from the case studies we have described in the previous chapter. Paragraph 6.1 will examine each of the model's constructs separately, while paragraph 6.2 will evaluate the model in its entirety, describing the relationships between each of the model's variables and constructs.

6.1. Construct analysis

INVESTMENT IN DESIGN STRATEGY

All of the selected companies appeared to regard design as a strategy, rather than as an asset. Most employed only a limited number of designers, or in some cases none at all, but demonstrated advanced levels of design use. In all cases the design management practices adopted were consistent with the *design as strategy* approach, as the majority of variables indicated scores corresponding to the highest level of design maturity.

The variables selected to identify a company's investment in design appeared to describe appropriately the processes and behaviors implemented by the selected sample of firms, which is summarized in table 6.1. The major design management practices are represented by the model, and there doesn't appear to be any characteristic which isn't intercepted by at least one indicator. In some cases, a number of variables were leaning towards some of the less advanced approaches to design, but the deviation was never[1] greater than one full level, and never in sufficient numbers to shift a company's overall use of design into a lower category.

The companies operating in more technologically intensive markets displayed a larger variance in results, and particularly a tendency to score lower on two key variables: the one measuring the *kind of NPD process*, and the one measuring *who is responsible for design*.
This pattern can be explained by those companies' need to cope with the more

1 with the exception of the variable "Degree of connection to the 'innovation network'", which will be discussed later.

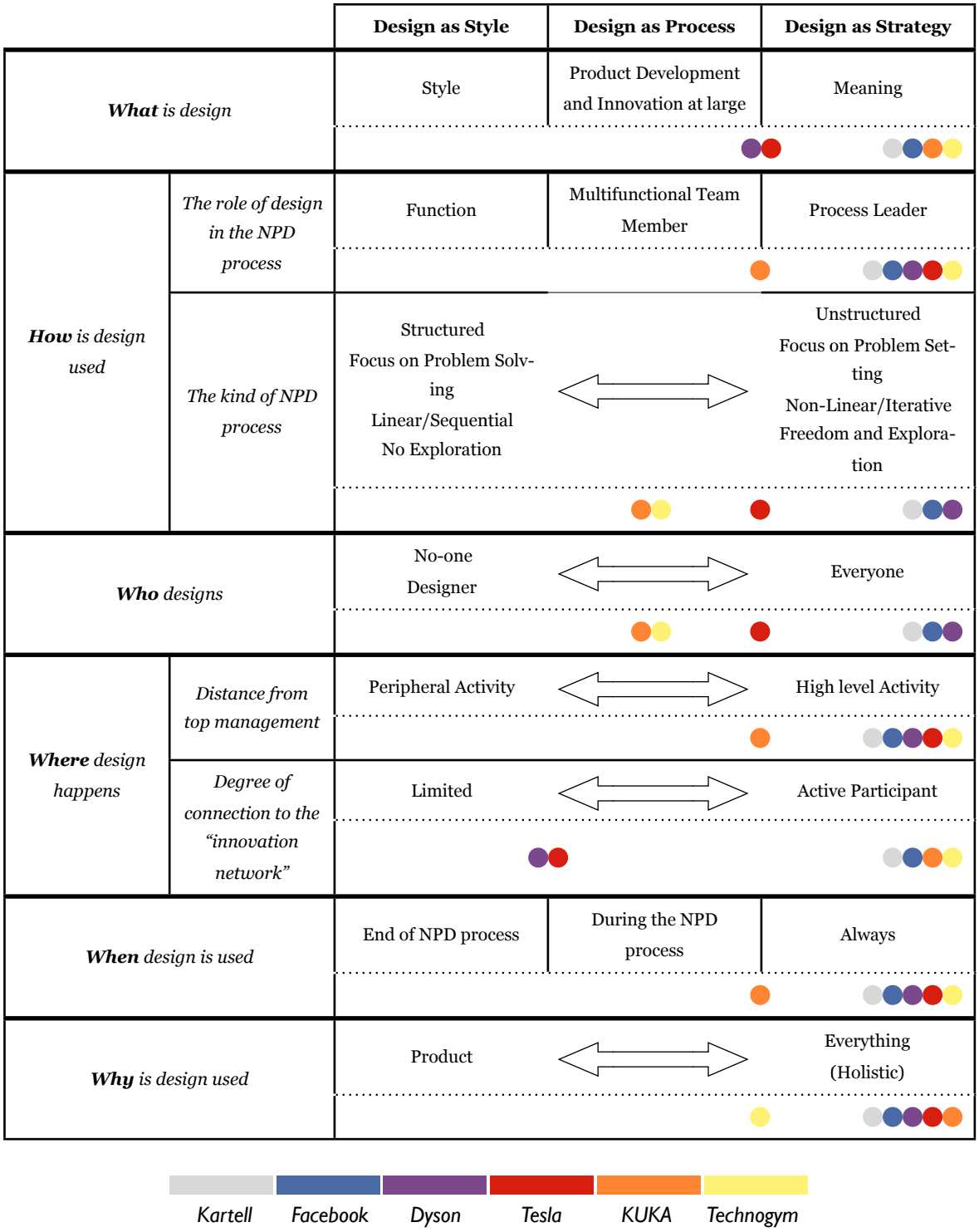


Table 6.1: the distribution of the scores of all companies on the variables measuring their approach to design.

complex technical characteristics of their products. Hi-tech products require a higher number of technical employees dedicated to the engineering of components which don't directly impact the customer's product experience; an engineering "back office" which is rarely involved in the design process.

At the same time, the intricacy of those products makes it impossible to adopt a

highly unstructured development process, as numerous iterations and frequent cycling between phases would result in unsustainable costs. While some kind of structure must be adopted, the fundamental elements of an NPD process consistent with the *design as strategy* approach are maintained in the initial phases of development, which in those companies rely on the iterative exploration of new solutions and on a strong focus on problem setting.

The only variable showing inconsistent results is the one measuring the *degree of connection to the "innovation network"*. Some companies have chosen to adopt an "isolated" attitude, almost exclusively relying on in-house resources, and incorporating new competences by hiring new employees into their R&D departments when necessary. Even in those companies some selected partnerships are at times created, but the coexistence within firms adopting the *design as strategy* approach of both the "isolated" and "open" orientations might indicate that the variable isn't particularly significant.
Nevertheless, the majority of companies in the sample does actively collaborate with the rest of the "innovative network," so while both configurations may be compatible with an advanced use of design, the "open" approach still appears to be preferred by innovative companies.

The case studies also underscored the fundamental role of management in implementing a successful design strategy. With the sole exception of KUKA, all companies examined had their CEOs or founders directly involved in the product development process, and supporting fervently the culture of design within the organization.
The most direct way for a company to incorporate design into its culture is certainly that of being conceived with design already injected into its corporate genes by the founding entrepreneur: this was the case in 5 out of 6 examined companies, with two cases in which the founders were actually industrial designers.
KUKA is the only exception among the sample, demonstrating that this is not a necessary requirement, and that high levels of design maturity can be achieved even in companies which are born with different corporate cultures. Even in this case however, the shift to a "design-driven" strategy was the consequence of a substantial shift in company leadership, which remains the principal and most effective determinant of a firm's culture.

DESIGN INNOVATION PERFORMANCE

As a good design innovation record was one of the selection criteria for the sample of companies, all cases displayed exceptional product performance, which is summarized in table 6.2.

During the study only significant innovations in meanings have been considered, by categorizing the sample's output into three categories of innovative intensity: major incremental (chosen as the minimum level for an innovation to be significantly superior than the average product improvement), minor radical, and major radical.

On average, the sample obtained 0,343 major radical, 0,196 minor radical and 0,267 major incremental innovations per year, a rather uniform distribution. The sum of all of those averages shows that the studied sample achieved a rate of 0,807 significant innovations a year.
This indicates a rather high frequency of innovations, and while no precise data is available to compare this number to that of the sample's competitors, in most cases the design-driven companies selected appeared to be contributing in a major way to the overall innovative output of their respective markets. This is further evidenced by the fact that the companies belonging to the test group were responsible for an ample portion of the recent radical changes in meanings of their markets.

Within the sample itself, certain companies appeared significantly above or below the average in terms of frequency of innovation. This appears to be the result of differences in context among the sample, rather than consequences of different uses of design. In particular the results appeared to be correlated to characteristics of the relative industry such as the duration of the sector's product life cycle, as well as its technological and capital intensity.

Kartell displayed to lowest number of innovations per year, almost 20% below the average. This is consistent with the long average life-cycle of products in the furniture market, which is brought to the extreme by the company's strategy.

KUKA was also below average by almost 6%. The company belongs to the sample's most capital intensive industry, with complex R&D requirements that

Company		Major Radical	Minor Radical	Major Incremental	Total	Years
Technogym S.p.A.	*N°*	4	2	4	10	11
	% of total	40%	20%	40%	100%	
	N°/year	0,364	0,182	0,364	0,909	
	Δ from average	2,0%	-1,4%	*9,7%*	*10,3%*	
KUKA AG	*N°*	4	3	2	9	12
	% of total	44%	33%	22%	100%	
	N°/year	0,333	0,250	0,167	0,750	
	Δ from average	-1,0%	*5,4%*	*-10,0%*	*-5,7%*	
Tesla Motors Inc.	*N°*	2	1	1	4	5
	% of total	50%	25%	25%	100%	
	N°/year	0,400	0,200	0,200	0,800	
	Δ from average	*5,7%*	0,4%	*-6,7%*	-0,7%	
Dyson Ltd.	*N°*	3	2	2	7	11
	% of total	43%	29%	29%	100%	
	N°/year	0,273	0,182	0,182	0,636	
	Δ from average	*-7,1%*	-1,4%	*-8,5%*	*-17,0%*	
Facebook Inc.	*N°*	4	1	4	9	8
	% of total	44%	11%	44%	100%	
	N°/year	0,500	0,125	0,500	1,125	
	Δ from average	*15,7%*	*-7,1%*	*23,3%*	*31,8%*	
Kartell S.p.A.	*N°*	4	5	4	13	21
	% of total	31%	38%	31%	100%	
	N°/year	0,190	0,238	0,190	0,619	
	Δ from average	*-15,3%*	4,2%	*-7,7%*	*-18,8%*	
Average	*N°/years*	0,343	0,196	0,267	0,807	
		42,1%	26,1%	31,8%		

Table 6.2: summary of the design innovation performance of the entire sample.The number of significant innovations of meaning during the period is reported according to their intensity.The number of innovations per year is calculated for each category, with variances of more than 5% of average evidenced.

lead to long product development cycles, and therefore long product life cycles. Tesla operates in a similar context, and obtains a similar result to the robot maker. In both cases however, the design innovation performance was among the highest in their sectors, and in particular, their product development times were significantly lower than average.

It should be noted that while the second lowest value belongs to Dyson, this result is in some way an inaccurate value. The company suffered a major product failure with one of its new products during the initial part of the studied timeframe[2]: having invested significant resources into the new project, it spent the first half of the years examined recovering and limiting new product launches. But if this period is ignored for the calculation of Dyson's design innovation performance, its innovation rate would be 0,857, among the highest in the sample and significantly above average.

Dyson's adjusted performance is comparable to Technogym, which operates in similar market conditions and has registered a frequency of innovation 10% above average. This result should be expected, given the medium technological intensity of their sectors, and the average length of their product's life-cycles.
Unsurprisingly, Facebook was the fastest innovator in the group, with a rate of design innovation almost 32% above average.

COMPETITIVE PERFORMANCE

Most of the sample demonstrated very high competitive performances, significantly outperforming their markets in either growth rate, or profit margins, and often in both. The results for all of the companies are summarized in table 6.3.

The sample showed very high differential results across most of the measures recorded, increasing confidence in the findings despite the limited size of the sample. Five out of six cases performed at least 50% better than the rest of its industry on all indicators, and often significantly more, with an average gap between company and market of over 200%.
The superior performance by the sample was consistent both across growth meas-

[2] *the Contrarotator laundry machine launched in 2000. Interestingly, it the only major product failure within the entire sample*

Company	Competitive performance					
	CAGR @[number of years considered since last]			*Profit*		
	Company	*Market*	*Δ*	*Company*	*Market*	*Δ*
Technogym S.p.A.	12,9% @3y 8,1% @11y	3% @3y (global sports equipment market)*	330% @3y	EBITDA margin 14% average 3y 15,6% average 11y	EBITDA margin 6,23% 2010 (average among top 3 companies in global sports equipment market)*	125%
KUKA AG	12,7% @3y* 6,6% @5y*	11,9% @3y* 9,7@5y*	6,7% @3y -32% @5y	EBIT margin 10,8% 2012 robotics division 6,3 % 2012 entire group	EBIT margin 14,69% 2012 robotics division market leader 6,8% 2012 entire group market leader	-26% robotics division -7% entire group
Tesla Motors Inc.	54,5% @4y	13,41% @4y (U.S. automotive manufacturing sector)*	306,4% @4y	Gross margin 25% end of 2013 target	Gross margin 23,37% 2012 (automotive sector sector)**	–
Dyson Ltd.	14,5% @5y	3,5% @5y (global household appliances sector)*	314,3% @5y	EBIT margin 25,6% average 3y	EBIT margin 16.56% 2012 (household products sector)**	55%
Facebook Inc.	60,6% @3y >100% @7y	7,2% @3y 6,3% @7y (global software and services sector)*	742% @3y >1400% @7y	EBIT margin >40% average 3y (adjusting for share compensation in 2012)	EBIT margin 13.12% 2012 (internet sector)**	>205%
Kartell S.p.A.	4,87% @3y 3,23% @5y 6,87% @10y	2,88% @3y 2,23% @5y (global furniture sector)*	69% @3y 45% @5y	EBITDA margin >35% average 5y	EBITDA margin 11.42% 2012 (furniture sector)**	>206%

* source: Marketline

** source: NYU Stern School of Business.

Table 6.3: summary of the sample's competitive performance.

ures, as well as profit indicators, with the first category showing more higher separation.

KUKA is the only case not showing a substantial gap, and in most measures underperforming. Its evaluation is based on a slightly different frame of reference: no data was available for the overall robotics market, so its performance was compared to the market leader. Even so, given the market leader's inferior use of design, KUKA's performance should have been superior. KUKA's history may reveal the reason behind this discrepancy, as the company is just starting to recover from a tumultuous period of corporate instability. The company's adoption of design is also rather recent, if one takes into account the sector's long development cycles, and the company has been showing its highest levels of design innovation performance in the last few years. In fact, several indicators show that the company is just starting to reap the benefits of its investment in design: the strongest piece of evidence are the positive trends in KUKA's performance measures, compared to its competitor's declining trends.

6.2. Evaluation of the complete model

ANALYSIS OF THE RELATIONSHIPS BETWEEN THE MODEL'S CONSTRUCTS

Overall, the model appeared to describe appropriately the use of design by the selected sample, and to propose relationships between its constructs which are consistent with the behaviors observed in the sample's performances.
Table 6.4 is a synopsis of the main indicators in each construct for all of the sample's cases.

The difference between the approach to design of the studied companies and that of the rest of its industry was always large: while the sample adopted the most sophisticated implementation of design strategy, most of the overall markets involved displayed the average characteristics of using *design as style*.
The only exception was the software industry, probably aided by the immateriality of their products which requires every pixel on the screen to be designed from scratch, and therefore presents a clearer need for the use of design.

In most cases, the sample's competition was forced to follow in the wake of the design-driven companies' innovative leadership. All of the examined firms have earned the reputation of being among the top, if not the best, innovators within their industry, and have been responsible for the majority of the radical changes in their market thanks to a superior and sustained rate of innovation.
The correlation between a higher design innovation performance, and the use of the *design as strategy* approach to design is supported by the sample examined.

Company	Investment in design strategy		Design innovation performance	Competitive performance		Context	
	Company	*Market*	*Rate of innovation (significant innovations/ year)*	*ΔCAGR @[number of years considered since last]*	*ΔProfit*	*Size*	*Tech. Intensity*
Technogym S.p.A.	Strategy	Style	0,91	+330% @3y	+125%	Medium	M
KUKA AG	Strategy	Style	0,75	+6,7% @3y -32% @5y	-7%	Large	H
Tesla Motors Inc.	Strategy	Style	0,80	+306,4% @4y	–	Medium	H
Dyson Ltd.	Strategy	Style	0,64	+314,3% @5y	+55%	Large	M
Facebook Inc.	Strategy	Process	1,13	+742% @3y >1400% @7y	>205%	Large	L
Kartell S.p.A.	Strategy	Style – Process	0,62	+69% @3y +45% @5y	>206%	Small	L

Table 6.4: summary of the main constructs for each case.

The disparity in design innovation performance has also clearly benefited the companies belonging to the sample in terms of competitiveness, allowing them to control some of the strongest positions in their markets. The link of causality between the model's constructs explains accurately the dynamics observed during the case study, and receives therefore support.

Interestingly, even within the sample of design-driven companies, a higher rate of innovation was associated with an increased growth differential between the company and the market (as described by figure 6.1). On the other hand, higher margins did not seem to be related to higher rates of innovation, suggesting that the two measures are not connected.

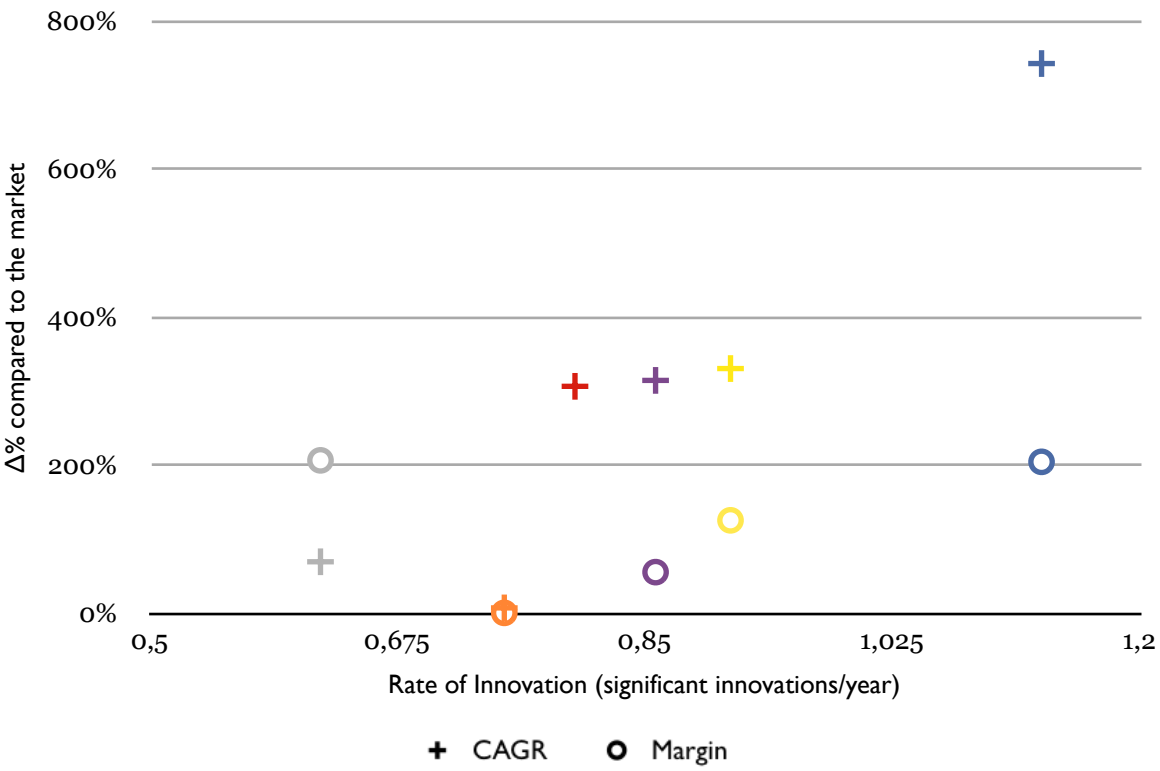


Figure 6.1: the relationship between rate of innovation and the variation in performance compared to the market in terms of growth and profits.

The view that the strategic use of design should be considered a long-term process also receives support. In all cases the effects of design on the product portfolio were accumulated over time, with long periods of increased design innovation performance rather than the sporadic creation of individual radical innovations. This is consistent with the hypothesis that product performance is mostly affected by the company's overall design culture, rather than the product development process of a specific project. The systematic characteristics required by advanced design approaches allow companies to generate steady innovative streaks, as the new organizational values and structures impact the overall product development activities of the company.

This behavior is reflected in the firm's financial performance, which grows gradually as the company's design innovation performance increases, and the effects of new products benefit the entire portfolio. In fact, company performance was only rarely influenced in a significant way by a single new product launch, and growth in sales seems to be mostly driven by the steady stream of innovative products.

In most cases, sales seem to grow at a rather constant rate (which is generally much higher than the rest of the market), with new innovations maintaining the company's continued expansion and with only substantial market changes or other large shifts within the company (such as KUKA's corporate turmoil in the early 2000's) modifying this trend.
Only one case presented a major failed product, and its effects on the company's financial indicators were certainly felt. However, the company's other highly successful product lines compensated for the loss, and while the launch of new products (and therefore the design innovation performance) was restricted during the years in which the product was failing, once the problematic product was abandoned all of the company indicators quickly returned to normal.

Interestingly, while some cases appeared immune to the economic downturn of 2009, others suffered more than the rest of the market. This may be partially explained by the fact that often companies who choose a design-driven strategy take advantage of their superior product performance to position themselves at the high end of their respective sectors. This renders them more vulnerable during a recessive conjuncture, when the market reduces its consumption and becomes more sensible to price. However, the companies examined seemed to recover faster than the rest of the industry, suggesting only a temporary effect, resulting perhaps just from a delay in purchasing decisions by their customers, rather than a complete substitution with cheaper products.

MODEL APPLICABILITY

The model described appropriately the varied set of companies selected. The dynamics of the core sample, composed of global companies producing primarily physical products for use by end-users, were accurately represented by the model.

Of the two companies selected to extend generalizability, KUKA and Facebook, only the latter, which was the only service company within the sample, offered conclusive results. Therefore, the hypothesis that the model may be applied to product and service companies alike receives support, while, given the partial inconclusiveness of KUKA's evidence, the applicability of the model to industrial companies is only partially supported. KUKA's case evidenced several advantages

obtained by the company over the years as a result of its use of design, and a substantial upward trend in recent years, but more time will be needed to definitely prove that the company's adoption of design was ultimately successful.

The model was also effective across the other contextual variables selected. Company size did not have any impact on the efficacy of investments in design, and, when dealing with global companies, appeared irrelevant. Technological intensity had only mild effects on the rate of innovation resulting from the use of design, but ultimately poses no particular limits on the applicability of the model.

7. Conclusions

I've started this research with the goal of identifying the value of design and the way it may be captured successfully by companies. The objective was to describe the way an investment in design may generate positive returns for a company, and how it may allow a firm to better succeed in the market. I also wanted to identify the most effective methods for a company to implement and manage design, and how those approaches would be affected by the organization's characteristics and context.

By relying mainly on the latest research regarding *design-driven innovations* and *design management*, I have proposed a model describing how design should be managed, and the relationships between an investment in design and the company's innovative and competitive performance. The definition of design as the *meanings* of a product is central to the model, since Roberto Verganti's identification of design as an additional dimension of innovation has constituted the main theoretical backbone of this thesis.

To assist in the development of the emerging model, a best-in class exploratory case study was also conducted, focusing on six companies displaying an advanced use of design. Their current approach to design was analyzed, and the insights gained were combined with the theory and findings emerging from the existing literature. The union between those two elements allowed me to identify the key variables involved in the use of design by a company and the relationships which connected them to a firm's performance. Once the model had been defined,

the research on the six initial case studies was expanded, to verify the validity of the proposed constructs and to offer initial support to the model's hypotheses.

AN ACCURATE MODEL OF A COMPANY'S INVESTMENT IN DESIGN

The model introduces a new way of studying a company's investment in design, which is based on the notion of design as a strategy, rather than as an asset. Previous studies in the use of design have usually measured a company's investment in design by measuring financial expenses and other economic indicators. The model I have proposed evaluates a company's investment in design by considering what role is given to design within the organization's structure and culture, which is the result of investments that are for the most part not financial in nature. The way a company chooses to approach and manage design requires a much more significant expenditure in terms of processes, methods, time and commitment, rather than in terms of monetary resources.

Three different approaches to investing in design are presented, with a set of variables describing and identifying the way the company adopts design. Each approach is associated with a growing level of maturity in the use of design and has the potential of generating a gradually higher design innovation performance as the company moves from one to the other. Those three configurations are called (in order of increasing design maturity): *Design as Style*, *Design as Process*, and *Design as Strategy*.

Each approach to design is defined by a particular configuration of organizational and cultural variables. Six categories of variables were selected, relating to:

- *what design is*: measured by observing what definition of design a company adopts;
- *how design is used*: recognized by studying the role that design has within the new product development process, and what kind of NPD process the company employs;
- *who designs*: identifying who is involved in the company's design activities;

- *where design happens*: evaluated by examining how far away from top management design is performed, and how connected the company is to the "innovation network";

- *when design is used*: measuring when the design activity takes place relative to the main product development process;

- *why is design used*: determined by the kinds of activities in which the company employs design, and the design outputs generated.

A complete summary of the value the variables assume for each of the three approaches to design is presented in table 2.1.
The studied sample of companies, which were selected for their high performance in terms of innovation of meanings, scored high values in all of those variables, and were therefore categorized as belonging to the *Design as Strategy* configuration, while their respective markets were found to be generally employing the *Design as Style* approach.

The major design management practices employed by the studied companies appear to be correctly represented by the model, as there didn't seem to be any characteristic in the sample's implementations of design which wasn't intercepted by at least one indicator. In some cases, a number of variables were leaning towards some of the less advanced approaches to design, but the deviation was usually limited to less than one full level, leaving no doubts over a company's classification.

Overall, the variables selected appeared to describe appropriately the processes and behaviors implemented by the selected sample of firms (the complete results are summarized in table 6.1).
The companies operating in more technologically intensive markets displayed a larger variance in results, and particularly a tendency to score lower on the variable measuring the *kind of NPD process*, and on the one measuring *who is responsible for design*, which can be explained by the peculiarities of highly technical sectors.
The only variable showing inconsistent results is the one measuring the *degree of connection to the "innovation network"*, as some companies have chosen to adopt

an “isolated” attitude, almost exclusively relying on in-house resources. The coexistence, within firms adopting the *design as strategy* approach, of both the “isolated” and “open” orientations might indicate that the variable, while preferred by the majority of the sample, isn’t particularly effective at identifying a company’s approach to design, and might not be significant.

The study sample concentrated on companies displaying very high design performance, which were all found to be adopting highly mature approaches to design, and operating in sectors implementing on average the least sophisticated design strategies. This appears to validate the model’s ability to describe accurately the configurations of design use at the edges of the available spectrum, but further research will be necessary to confirm the applicability and reliability of the model’s representation of the intermediate levels of design maturity.

MATURE DESIGN STRATEGIES GENERATE HIGHER COMPETITIVE PERFORMANCE

The large difference in the way the sample’s companies approached design compared to the rest of the market, lead to significant divergence in the resulting competitive and innovative performances.

The design-driven companies selected were characterized by a much higher design innovation activity than the rest of the market, with frequent introductions of products displaying innovative meanings. In most cases, the sample’s companies contributed in a major way to the overall innovative output of their respective sectors, being responsible for an ample portion of their market’s recent radical changes in meanings.

Most of the sample demonstrated very high competitive performances, vastly outperforming their markets in either growth rate, or profit margins, and often in both. The results for all of the companies are summarized in table 6.3. The very high differential results observed across most of the measures recorded, offer support with high levels of confidence to the hypothesis of a causal relationship connecting the implementation of a *design as strategy* approach to high competitive performances.

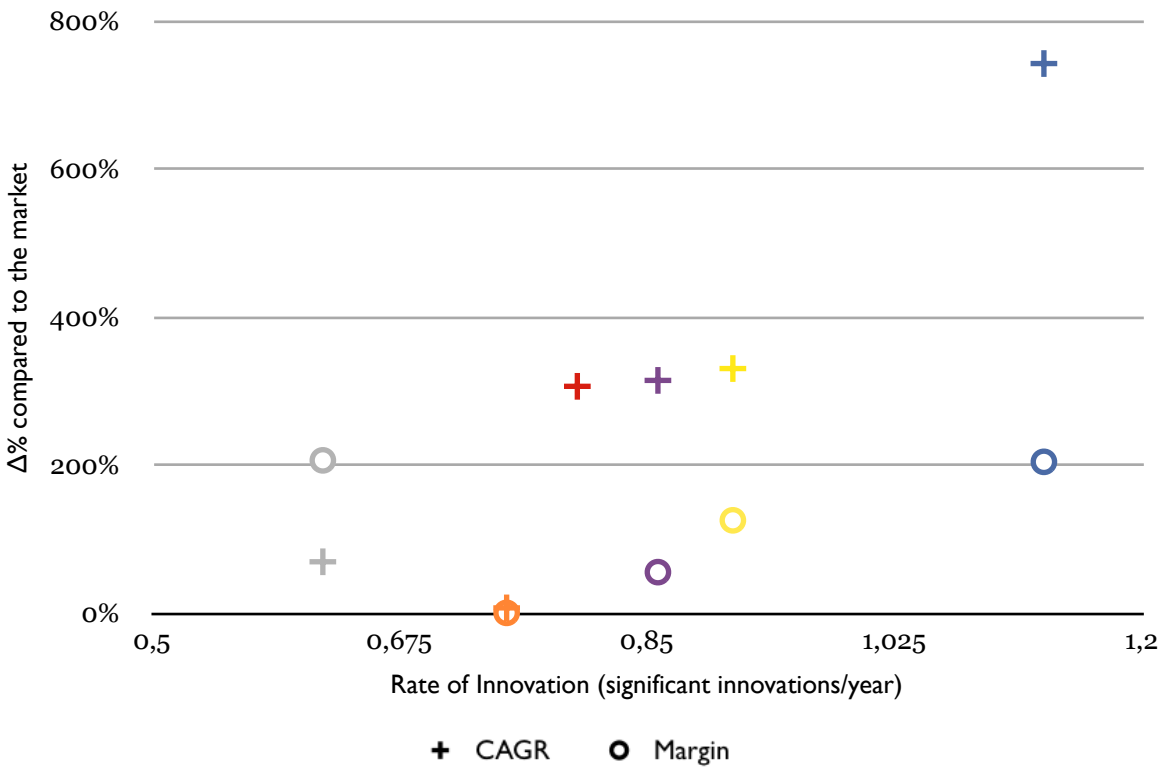


Figure 7.1: the relationship between rate of innovation and the variation in performance compared to the market in terms of growth and profits.

Contextual variables were found to have only mild effects on the sample's use of design, and consequently had no particular impacts on the results obtained by the companies compared to their sectors. The model seems to be applicable across a wide range of markets and sectors, and both for companies producing physical goods, as well as services. Evidence was found that the model may be used also in industrial and B2B sectors, but, given the partial inconclusiveness of the results in the case used to extend the model's applicability in this direction, this hypothesis is only partially supported and will require further investigation.

MANAGERIAL IMPLICATIONS

The findings of this research confirm the crucial role of management in the successful adoption of design by large companies. Top management was found to impact on many of the model's variables describing an organization's approach to design: in five out of six examined companies, the CEO or founder was directly involved in the product development process, and was among the main proponents and supporters of the organization's culture of design. Since design should be

treated as a strategy, the company's management is in the best position to affect the firm's future vision and direct it towards an advanced use of design.

In most sectors and industries (possibly even all), after implementing a sophisticated design strategy, companies can expect to significantly improve their product performances, leading to substantially superior competitive results on the market. Advanced approaches to design are associated with higher growth rates, higher product margins and accumulation of corporate assets. However, managers should keep in mind that, for a design strategy to be successfully embraced by an organization, substantial changes in the company's processes, structures, and overall mindset will be necessary. The company's culture will need to be modified deeply, usually requiring a rather long and gradual process of change. The firm's leadership should be the first to overcome the obsolete conception that investing in design consists of a spot investment in a product's appearance, and embrace the new long-term and continuous conception of design as a strategy.

Depending on the industry's characteristics, design strategies require several years to produce their first returns, as the effects of design are accumulated over time. The resulting product performance will also be distributed over a long period, as mature design approaches generate innovative streaks across many years rather than sporadic individual radical innovations.
Managers looking to incorporate design into their companies should therefore do so by assuming a long-term perspective, and focusing the company's efforts first of all on their product portfolio, the most effective source of competitive advantage.

LIMITS AND FUTURE RESEARCH

This study's sample, while presenting strong evidence in support of the initial hypothesis, is limited, in terms of the definitiveness of the conclusions it might lead to, by its small size. The results presented in this thesis provide an initial confirmation of the emerging theory, but they should not be considered conclusive.

Future research involving larger samples will need to be conducted. In particular, it might be useful to select samples including companies employing different approaches to design, but operating within the same sectors, in order to provide a precise measurement of the relationship between a company's maturity in

the use of design, and it's performances. The sample used in this thesis was limited to companies adopting the *design as strategy* approach, but future studies would do well to also include companies making use of intermediate stages of design maturity.

Overall, the variables selected to describe a company's approach to design appeared to appropriately intercept the various processes and behaviors implemented by the studied sample of firms. However, by employing larger samples of data, more rigorous testing methods such as factor analysis may be applied on the proposed set of variables, to better determine the efficacy of those indicators, and their eventual interdependencies and overlapping measurements.

Further research will also be needed to determine the model's applicability in industrial and B2B sectors. Additional case studies may be useful to verify the use of design in this sector, before resorting to more statistically significant testing.

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