

Design and the Cultures of Enterprises

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Introduction

The relationship between design and the world of production has always fluctuated between two main views: the reductionist view of design—as one of the skills required in the product development process to enhance the appeal of the products; and the cultural view of design—as that unique system of competencies, knowledge, and skills, that (including the artifacts, practices, values, and beliefs that belong to the design culture) can envision innovative solutions that meet explicit or latent needs encompassing different constraints.

Even when the second perspective is assumed, the introduction of design culture within companies normally meets many obstacles—primarily the established culture and the natural resistance to change of organizations in which design culture seems to fight a daily war by being indissolubly bound to innovation.

That established organizations naturally develop a resistance to change is widely recognized,¹ and Treacy noticed that innovation, with the uncertainty that it brings and the alteration of the condition of efficiency linked to repetition,² can be described as a “last chance” that companies are forced to face in moments of trouble.

At the same time, we must also recognize that a prevailing line of thought on innovation underlines how companies must develop a sort of resilience—a capacity to “continuously anticipate and adjust to changes that threaten their core earning power, and change *before* the need becomes desperately obvious.”³ This line of thought nevertheless recognizes the difficulty of doing so.

As a function mainly involved in the development of new products, design challenges the natural organizational attitudes of preservation and resistance to change, generating a constant tension between the search for innovation and the necessity of relying on established ideas and solutions. In our opinion, this constant tension builds a significant link between design practice and culture and the problem of managing organizational change. Although change management can be described as a prescriptive and top-down practice, in which organizational

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- 1 Karl E. Weick, *Sensemaking in Organizations* (London: Sage, 1995); Edgar H. Schein, *The Corporate Culture Survival Guide* (San Francisco: Jossey-Bass, 1999); Gareth R. Jones, *Organizational Theory, Design, and Change*, 5th ed. (Upper Saddle River, NJ: Pearson Prentice Hall, 2007).
 - 2 Michael Treacy, “Innovation as a Last Resort,” *Harvard Business Review* 82, no. 7/8 (2004): 29–31.
 - 3 Gary Hamel and Liisa Välikangas, “The Quest for Resilience,” *Harvard Business Review* 81, no. 9 (2003): 52–63.

models and their sets of techniques and tools are normally abstracted from a context, operationalized, and transferred and applied to other contexts, we think that design practice and culture introduce a bottom-up perspective to organizational change that usually takes place in unexpected ways during the development of new products within companies.

How do design practice and culture relate to organizational change or even stimulate it?

The development of significant innovative products,⁴ services and solutions implies relevant changes in all the elements that compose the culture of an enterprise:⁵ processes, core competencies, knowledge, technologies, behaviors, values, and dogmas.⁶ As a consequence, the bottom-up perspective that is presented in this paper assumes that designing significantly new products might bring unexpected changes in the culture of an enterprise because contradictions might arise between the current culture and the one needed to implement the innovations. Thus, when design culture interacts with the culture of an enterprise, as can happen in the process of developing of a new product, the culture of the enterprise might change as an unexpected consequence of the interaction between the two types of culture. A significantly new product requires the implementation of a series of organizational changes that leads ultimately to changes in the enterprise culture. Conversely, if any culture externalizes and represents itself in the artifacts that it produces, then its products are expressions of the culture of the enterprise that produces them. Examining the products of an enterprise can provide an understanding of the culture that underpins them.

The adoption of a bottom-up perspective on organizational change is linked not just to the observation of real cases but also to the recognized situatedness of design practice and culture as a possible value; this perspective sits in opposition to the idea of models and techniques that can supposedly be applied indifferently in any context and situation.⁷ On the basis of this opposition, we not only generically criticize top-down change management approaches but also specifically demystify design thinking as a method and a set of connected tools that could lead managers to embrace the need for change and innovation.

The paper is structured as follows: First, we briefly introduce the main currents of thought in organizational change studies, further developing the connection between new product development and the need for change in the culture of the enterprise because of contradictions between the existing culture of the enterprise and the one needed to develop and exploit new products. Second, we examine how managerial practice is generally characterized by a type of reductionist thinking, in which methods, techniques, and tools are extracted from their original context and adopted along

4 Enter into the debate on radical vs. incremental innovation is not the aim of this study; thus, we introduce the idea of "significant innovation" in a relative way by connecting it to a specific context or enterprise. Note that something does not have to be significantly new to represent a radical innovation for the enterprise, as is the case for Sony Playstation and many other successful products.

5 "Enterprise" basically refers to a newly established organization that aims to generate an innovation to be exchanged on the market. This term is currently used similarly to "company," and the two are often used interchangeably, even if a company is a formal and well-established business organization that seeks profit by exchanging value in the market. Enterprises and companies are specific forms of organizations that aim to develop and maintain private business. Because the differences are not significant for the purposes of this paper, the two terms are adopted as synonyms. However, "organization" is a different matter. An organization is considered to be any human association that pursues a common goal, and the term is therefore more general. While an enterprise is an organization, an organization is not necessarily an enterprise. In the paper, the term will be adopted to discuss theories and tools to study and manage organizational change.

6 Alessandro Deserti and Francesca Rizzo, "Co-Designing with Companies," in *Proceedings of IASDR2011 4th World Conference on Design Research* (Delft: TU Delft, 2011), 1-12.

7 Donald A. Schon, *The Reflective Practitioner: How Professionals Think in Action* (London: Temple Smith, 1983); John S. Gero, "Towards a Model of Designing Which Includes Its Situatedness," in *Universal Design Theory*, H. Grabowski, S. Rude, and G. Grein, eds. (Aachen, Germany: Shaker Verlag, 1998), 47-56.

increasingly shorter lifecycles to manage organizational change. Such practice occurs even when the theories on organizational change are holistic and systematic. Next, we differentiate the notion of design culture from design thinking and discuss it in relation to enterprise culture. In this part, we express the idea that the products of an enterprise are not just the synthesis of the end user's needs, but essentially are the synthesis of its culture. From this assumption, we hypothesize that the development of new products often generates or requires changes in the culture of the enterprise as a kind of "side effect" related to the novelty of the products (at least for this particular enterprise). To verify this hypothesis, we consider three cases: the Sony Playstation, the LEGO Mindstorm, and the strategic design division in 3M. The cases are discussed in the last part of the article, in which evidence in favor of design culture as an implicit agent of change is provided alongside some lessons learned from the study.

Design and Organizational Change

Research on organizational management and social studies has a long tradition of binding the competitiveness of an enterprise to its capability to continuously change its culture by overcoming organizational dogmas and by pursuing innovation.⁸

Many authors have provided definitions of organizational change. Moran and Brightman describe it as "the process of continually renewing an organization's direction, structure, and capabilities to serve the ever-changing needs of external and internal customers."⁹ Burnes noted that organizational change refers to understanding alterations in organizations at the broadest level among individuals and groups, and, at the collective level, across the entire organization.¹⁰ Regardless of the definition used, any significant change in an enterprise is seen as related to a shift in its culture: Organizational changes are symptoms of a change in the organization's culture.

Literature on organizational change differs in format and tone and encompasses several perspectives: descriptive accounts of change; theoretical models for analyzing change; prescriptive models that aim to guide the change process; typologies of different approaches to organizational change; and empirical studies of the success and failure of various initiatives, programs, and tools. For the sake of brevity, we cluster these contributions and distinguish between the main schools of thought.

The first set of studies considers change to be something emergent rather than planned.¹¹ According to this school of thought, managers make a number of decisions that are apparently unrelated to the change that emerges, and the change is therefore not planned. However, these decisions may be based on unspoken, perhaps unconscious assumptions about the organization, its environment, and its future and are therefore not as unrelated as they

8 Gary Hamel and C. K. Prahalad, *Competing for the Future* (Boston: Harvard Business School Press, 1994); Michael Polanyi, *Personal Knowledge: Towards a Post-Critical Philosophy* (London: Routledge, 1998); Peter F. Drucker, *Innovation and Entrepreneurship* (New York: Harper-Collins, 1995); Peter F. Drucker, *Managing in the Next Society* (New York: Truman Talley Books, 2002); Hamel and Välikangas, "The Quest for Resilience," 52-63.

9 John W. Moran and Baird K. Brightman, "Leading Organizational Change," *Career Development International* 6, no. 2 (2001): 111-18.

10 Bernard Burnes, "No Such Thing as a 'One Best Way' to Manage Organizational Change," *Management Decision* 34, no. 10 (1996): 11-18.

11 Henry Mintzberg, *Mintzberg on Management: Inside Our Strange World of Organizations* (Chicago: Free Press, 1989); Davis Nadler, *Discontinuous Change: Leading Organizational Transformation* (San Francisco: Jossey-Bass, 1995).

initially seem. Such implicit assumptions would dictate the direction of the unrelated decisions, thereby shaping the change process by serendipity and intuition rather than by planning. External factors (e.g., the economy, competitors' behavior, the political climate) or internal features (e.g., the relative power of different interest groups, the distribution of knowledge, uncertainty) influence the change in directions outside of managerial control. Even the most carefully planned and executed change program has some emergent effects and qualities. This reality highlights two important aspects of managing change: (1) the need to identify, explore, and, if necessary, challenge the assumptions that underlie managerial decisions, and (2) the possibility of facilitating (rather than precisely controlling) organizational change on the basis of perceptive and insightful analysis and planning, and of well-crafted, sensitive implementation phases. The reasoning is that organization-level change is not fixed or linear in nature but contains different emergent elements.¹²

A second set of studies distinguishes between episodic and continuous change. Episodic change is infrequent and not planned.¹³ Sometimes called "radical" or "second-order" change, episodic change often involves the replacement of one strategy or program with another. Continuous change, in contrast, is evolutionary and cumulative and is defined as "first-order" or "incremental" change.¹⁴ The distinction between episodic and continuous change helps clarify thinking about the future development and evolution of an organization relative to its long-term goals. Few organizations are in a position to unilaterally decide that they will adopt an exclusively continuous change approach. However, they can capitalize on many of the principles of continuous change by engendering the flexibility to accommodate and experiment with everyday contingencies, breakdowns, exceptions, opportunities, and unintended consequences that punctuate organizational life.¹⁵

A third set of studies addresses change relative to its extent and scope. Ackerman describes three types of change: developmental, transitional, and transformational.¹⁶ Developmental change enhances or corrects existing aspects of an organization, often focusing on the improvement of a skill, a process, or a procedure. Transitional change seeks to achieve a known desired state that is different from the existing one. The model of transitional change has its foundation in the work of Lewin,¹⁷ although Schein has more recently defined the theory conceptualizing change as a three-stage process that involves: (1) unfreezing the existing organizational equilibrium, (2) moving to a new position, and (3) refreezing in a new equilibrium position.¹⁸ Transformational change requires a shift in the assumptions made by the organization and its members, participants, or employees. Transformation can result in an organization that differs significantly in terms of

12 Sandra Dawson, *Analysing Organisations* (London: Macmillan, 1996).

13 Karl E. Weick and R. E. Quinn, "Organizational Change and Development," *Annual Review of Psychology* 50 (1999): 361–86.

14 Weick and Quinn, "Organizational Change and Development," 361–86.

15 Wanda Orlikowski, "Improvising Organizational Transformation over Time: A Situated Change Perspective," *Information Systems Research* 7, no. 1 (1996): 63–92.

16 Linda Ackerman, "Development, Transition or Transformation: The Question of Change in Organizations," in *Organization Development Classics*, Donald Van Eynde, Judith Hoy, and Dixie Van Eynde, eds. (San Francisco: Jossey-Bass, 1997).

17 Kurt Lewin, *Field Theory in Social Science* (New York: Harper Row, 1951).

18 Edgar H. Schein, *Process Consultation* (Wokingham: Addison-Wesley, 1987).

structure, processes, culture, and strategy. It might therefore result in the creation of an organization that operates in developmental mode, or one that continuously learns, adapts, and improves.

Change can be understood relative to the complex dynamic systems within which it takes place. Contrary to the scientific method (summarized by Karl Popper in 1972 as the three Rs: reduction, repeatability, and refutation), systems thinking explores the properties that exist once the parts have been combined into a whole. Applied to organizational change, systems thinking suggests that issues, events, forces, and incidents should not be viewed as isolated phenomena but as interconnected and interdependent components of a complex, socio-technical system. Accordingly, change is chaotic and often involves shifting goals, discontinuous activities, surprising events, and unexpected combinations of changes and outcomes.¹⁹

Even if the literature on organizational change is rich and heterogeneous, only a few contributions have discussed the idea that design culture and practice can be a vehicle, an agent of change in the culture of an enterprise. In design literature, which has recently devoted much time to its relationship with management, we also see little on this topic, unless we read between the lines and suggest further interpretations of contributions focused on other aspects.²⁰ As a major contribution, our study is inspired by a special issue of this journal, edited by Richard Buchanan, that specifically focused on design and organizational change.²¹ This work introduces new points of view on the relationship between design and management, arguing for “a new kind of design research, oriented directly toward the influence of design on organizational life.”²² It also reports on a few interesting case studies that focus on the process of developing new products and on the way these processes and products interact with the organization and culture of an enterprise. In particular, Junginger’s contribution, “Product Development as a Vehicle for Organizational Change,” investigates the possibility that product development might lead to organizational change in an enterprise when it is bound to the idea that the process of product development should be “human-centered,” or when the needs and the points of view of external actors, such as customers and suppliers, are brought into the organization and thus provoke “outside-in” change, as opposed to the normal “inside-out” view of the organization as a machine.

In this paper, we begin from Buchanan’s insights and propose a shift in the unit of analysis of the relationship between design and organizational transformations. In particular, while Buchanan’s contribution focuses on the idea that organizations can be seen as products and can therefore be considered “objects of design,” our idea is that design culture and practice, when situated

19 Dawson, *Analysing Organisations*.

20 Peter Coughlan, Suri Jane Fulton, and Katherine Canales, “Prototypes as (Design) Tools for Behavioral and Organizational Change,” *The Journal of Applied Behavioral Science* 43, no. 1 (2007): 1–13; Colin Bruns et al., *Transformation Design, Red Paper 02* (London: Design Council, 2006).

21 Richard Buchanan, ed., “Design and Organizational Change” *Design Issues* 24, no. 1 (2008): 2–107.

22 Richard Buchanan, “Introduction,” *Ibid.*, 3.

within the culture of an enterprise and applied to achieve significant innovation in products and services, can lead to organizational change.

In developing our thesis, we would also like to step away from the idea of design thinking as it took shape in the discourse on the relationship between design and management. Although few years ago we could still use the term “design thinking” from a positive perspective by thinking about it as one of the ways to integrate design into managerial culture, today we think that its use is, in many cases, misleading, as we explain further.

Finally, even if we do not want to neglect or contradict the open and expanding nature of the design discipline, which seems to be constantly conquering new territories, we must underline a specific risk in continuously linking design to new potential areas of application by saying that they might be seen as “objects of design.” We observe that management has already undertaken a similar practice: Because the perspective is that almost all human activities or products can or must be managed, everything is seen as a possible object of managerial studies.

By assuming all of these critical points, our unit of analysis is much more focused on the “traditional” product development practice while seeking to investigate forms of “bottom-up” organizational change that take place during and throughout the process of product development, which ultimately brought us to the idea of design as an implicit agent of change.

Although theories of organizational change recognize the complexity of the phenomenon of change in organizations and therefore display a systematic and holistic attitude, organizational management is characterized by a wide number of models and techniques that seem to be derived from a reductionist way of thinking, thereby producing formulas that can be easily synthesized and turned into slogans, procedures and recipes that can be applied to a variety of situations with minimal adaptation. Despite harsh criticism of the fast turnover of these managerial models and techniques that led to the description of many of them as fads, the practice still seems to prosper.²³

From a certain point of view, design thinking can be seen as one of these fads: It could be associated with the growth of large design consultancies, just as many managerial models and techniques are bound to the growth of large managerial consultancies. Although it was initially meant to introduce research on design and new product development processes, it was subsequently turned into a managerial approach through the process of abstraction from its original context.

The three main faults of design thinking as it was extended to the management realm were: (1) the lack of contextualization and situatedness—a typical characteristic of new, quickly adopted-

23 Donny Miller and Jon Hartwick, “Spotting Management Fads,” *Harvard Business Review* 80, no. 10 (2002): 26–7; David Collins, “The Branding of Management Knowledge: Rethinking Management Fads,” *Journal of Organizational Change Management* 16, no. 2 (2003): 186–204.

and-dismissed managerial models; (2) the separation of the ideation and the development processes; and (3) the idea of a top-down practice that principally affects the management rather than the whole enterprise. To become effective in enterprises, design must become part of the culture, and companies must develop their unique design culture by integrating design through bottom-up processes that require negotiation and alignment and are continually performed in the never-ending activity of innovation.

We next introduce the notion of design culture as the system of knowledge, competences, and skills that operates in a situated context that designers adopt to develop new solutions, in relation and opposition to the notion of design thinking as a context-independent process. We seek to demonstrate that design culture can often provoke changes in the whole culture of an enterprise (in an implicit way) during the process of development of new products. The following paragraphs argue this hypothesis by discussing three cases of cultural change in enterprises as an unexpected consequence of innovation projects and by drawing some theoretical conclusions.

A Different Perspective: Design as an Implicit Agent of Organizational Change

The analysis of design from the perspective of organizational change throws new light on the relationship between design culture and enterprise culture: Design challenges the natural organizational attitudes of preservation and resistance to change, generating a constant tension between the search for innovation and the necessity of relying on established ideas and solutions. This constant tension builds a significant link between design practice and culture and the problem of managing organizational change.

The hypothesis that we discuss is that every project leading to a significant innovation can trigger, like a domino effect, changes at different levels of the culture of an enterprise as a consequence of the contradictions that it generates within the enterprise. We define these contradictions as tensions between the degree of change in the culture of an enterprise required to develop a new product (trigger for change), and the current culture of the enterprise (constraint to change). Contradictions are the sources of change in all situations in which innovation overcomes the constraints to its own development by generating new artifacts, knowledge, beliefs, processes, structures and technologies that become part of the culture of the enterprise by modifying it.

Design and Culture: The Dialectic Between the Context of Destination and the Original Context of New Products

The discourse on the relation between design and culture is usually based on the idea that we should link design to the cultural context in which it occurs/operates to better understand or guide

it. The cultural context is then interpreted as a recipient for the design of products, which will be better conceived (if we look at the process from a professional perspective) or better understood (if we look at the process from a historical perspective) by linking them with the cultural context. Therefore, culture is a reference to the end-user at an individual or at a social level: The design of the product can be interpreted as the result of the context of its destination in its multifaceted dimensions, including the cultural one.

Some scholars introduced the idea of “culture-oriented product design,” or the idea that culture can be seen as a catalyst for designing innovative products if and when designers are able to incorporate a specific culture into the product design, thereby giving space to the interpretation of local characteristics, in contrast to the globalization of solutions.²⁴ This line of thinking can be associated with the vast literature on the reasons and modes of making design interact with the context of destination, primarily but not only represented by the end-user, thus leading to solutions that properly fit a specific context.²⁵ If we assume that designers should focus not just on the needs but also on the culture of the end-user, we get to the idea of “culture-oriented product design.”

Although we do not want to neglect the importance of the cultural context of destination, we note a gap in that a product can be interpreted not just as the result of its context of destination, but also and in some cases, primarily as the result of its original context. In this case, a new product must also be seen as the result of the culture of the company that produced it. If we look at the context of destination as the main force that influences the design process, then we are primarily driven to consider the culture of the end-user; but if we look at the original context as the main force that influences the design process, then we are primarily driven to consider the culture of the company, or else “the way things get done around here,” which is one of the most famous definitions of corporate culture.

Many cases illustrate how entrepreneurial ideas can be bound to specific contexts and how single products are necessarily consequences of the environment in which they are born. We might explain the adoption of closed software solutions in Apple as an intentional choice bound to the company’s culture; or we might describe the whole philosophy and offering of the Italian company Technogym, market leader in the fitness and biomedical rehabilitation equipment field, as bound to the culture of the geographical area where it is located—one of the most important leisure districts in Europe.

Design Culture as a Process

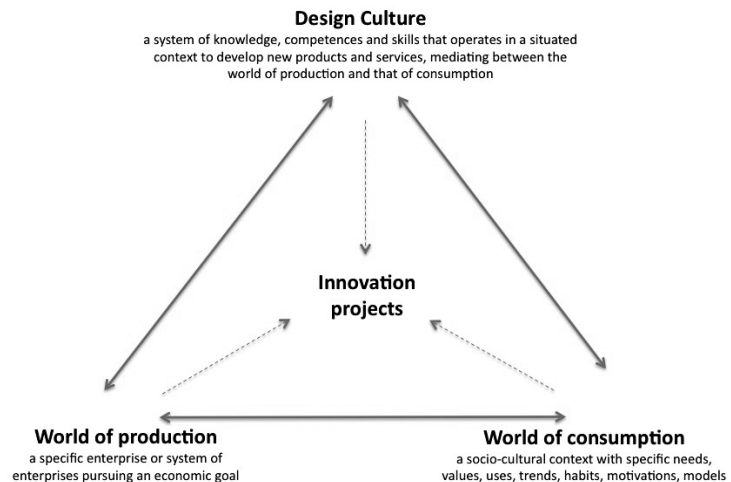
If we look at products as material evidence or results of the culture of an enterprise, we must at the same time observe that new products produce a shift in this culture, or else that the cause–effect

24 Richie Moalosi, Vesna Popovic, and Anne Hickling-Hudson, “Culture-Orientated Product Design,” *International Journal of Technology and Design Education* 20, no. 2 (2010): 175–90.

25 Donald A. Norman, *The Psychology of Everyday Things* (New York: Basic Books, 1988); Liam J. Bannon, “From Human Factors to Human Actors,” in *Design at Work: Cooperative Design of Computer Systems*, Joan Greenbaum and Morten Kyng (Hillsdale, NJ: Lawrence Erlbaum Associates, 1991), 25–44; Patrick W. Jordan and William S. Green, *Human Factors in Product Design: Current Practice and Future Trends* (London: Taylor & Francis, 1999); and Jorge Frascara, *Design for Effective Communications: Creating Contexts for Clarity and Meaning* (New York: Allworth Press, 2006).

Figure 1

The picture shows the role of design culture as a complex process of mediation between the world of production and that of consumption, performed during innovation projects. Design culture, as a situated feature, assumes different characters depending on the specific culture of the enterprise that, by starting a specific innovation project, aims to satisfy the needs of a specific consumption culture. Projects of innovation are led by the capability of design culture to situate its action through the activation of a process of trial and error, leading to the development of solutions that can encompass resistance and constraints posed by the culture of the enterprise to meet needs and expectation posed by the world of consumption.



connection can be easily inverted. This view suggests that implementing successful and lasting innovation requires strong organizational changes and a shift in the design culture, and that the introduction of a (new) design culture in an enterprise often should be coupled with organizational change management. In opposition to the idea that design thinking is independent from design practice, we see design culture as a specific *system* of knowledge, competences, and skills that operates in a specific context to develop new products and services; that mediates between the world of production and consumption; and that coordinates multiple factors related to technology, market, and society (see Figure 1). Design culture encompasses the actual practice of designers rather than reflecting only the formalization and learning of non-situated formulas for innovation. Design culture includes those competences and knowledges (the sets of distinctive knowledge, processes, and tools) used for solving complex problems and for “conceiving and planning what does not yet exist.”²⁶ Design culture can be generated and acquired by enterprises as they develop artifacts and attribute meaning to them in the social contexts where they operate and meet their customers.

Julier’s contribution emphasizes the interpretation of design culture as a process which:

is, perhaps, the most established usage, and stems from architectural and design criticism. In particular, it describes the immediate contextual influences and contextually informed actions within the development of a design. A close term that throws light on this is the Italian...“cultura di progetto.” The word “progetto” implies something broader than simply the form-giving within design, but extends to the totality of carrying out design; for example, from conceiving and negotiating artifacts with

26 Richard Buchanan, “Wicked Problems in Design Thinking,” *Design Issues* 8, no. 2 (1992): 18.

clients, to studio organization, to the output of the design and to its realization. Within all these... is an implied interest in the systems of negotiation—often verbal—that conspire to define and frame design artifacts. [...] Thus, the project process is understood to be produced within and by a network of everyday knowledge and practices that surround the designer.²⁷

The notion of design culture emphasizes a “way of doing things” in a context-dependent manner.²⁸ It involves the origination of new products and product forms but also their value augmentation, or “the structuring of a systematic approach to understanding the dynamics and effects of material and immaterial relationships that are articulated by and through the multiple [artifacts] of design culture.”²⁹

From this perspective of design culture, innovation in an enterprise might affect its established structure and culture and might challenge the way in which people interact, the existing capabilities, and how things are accomplished in daily activities. Note that, to understand both the reasons behind the development of new products and the concept of design culture, we must consider both an “outside-in” perspective (i.e., products as a result of quests from different external stakeholders, primarily customers) and an “inside-out” perspective (i.e., products as results of the company’s culture). In new product development literature, we note a general overestimation of the second perspective, while in many situations, the first seems to prevail; we should, in any case, apply an integrated vision.

In the following paragraphs, we introduce three cases: The first two describe processes of new product development; the third describes the process of acquiring and diffusing design culture in a science and engineering-based enterprise through the development of new products. The three cases are examples of how design culture and practice, in interaction with the established culture of an enterprise, can change the culture in different ways. These cases illustrate the vision of design culture as having the capability to perform a complex and dynamic process of mediation also influenced by the technological developments, the socio-economic constraints of the manufacturing process, and the cultural context that gives rise to the need for new products, the effect of which may result in the change of the culture of the company.

The LEGO Mindstorm Case

The Danish toy company, LEGO Group, provides an interesting example of how the development of a new product (the LEGO Mindstorm) can reshape the culture of the enterprise and reinforce its competitive strategies and market position. Since 2009, LEGO

27 Guy Julier, “From Visual Culture to Design Culture,” *Design Issues* 22, no. 1 (2006): 70.

28 Buchanan and Margolin, *Discovering Design*; Silvia Pizzocaro, “Research, Theory, and Design Culture: A Knowledge Growing Within Complexity,” in *Proceedings of the Politecnico Di Milano Conference*, Silvia Pizzocaro, Amilton Arruda, and Dijon De Moraes, eds. (Milano: Design Plus Research, 2000), 90-95; Flaviano Celaschi, *Il Design della Forma Merce [The design of the Form Goods]* (Milano: Isole24ore, 2000); Paola Bertola and Carlos Teixeira, “Design as a Knowledge Agent: How Design as a Knowledge Process Is Embedded into Organizations to Foster Innovation,” *Design Studies* 24, no. 2 (2003): 181–94; and Flaviano Celaschi, and Alessandro Deserti, *Design e Innovazione: Strumenti e Pratiche per la Ricerca Applicata [Design and Innovation: Tools and Practices for the Applied Research]* (Roma: Carocci, 2007).

29 Julier, “From Visual Culture to Design Culture,” 73.

products have continued their global success, resulting in a significant increase in global sales. LEGO's growth was realized in a stagnant global toy market. The highest growth rates occurred in English-speaking markets, but almost all markets achieved double-digit growth rates. However, results have not always been so flattering for LEGO Company management. In recent years, the emerging videogame market has been a constant and real menace to its existence.

Like many organizations, LEGO built its business model on intellectual property. Thus, the process of product innovation was managed internally: LEGO conducted market research to understand what customers thought about its products, developed new products based on the derived information, and created marketing communication campaigns to build the brand around customer expectations. However, as computer games grew in popularity, the company feverishly tried to adapt to new trends and opportunities in the marketplace. LEGO ultimately decided to enter this market with the development of LEGO Mindstorm. The product basically used robotics along with LEGO bricks and supports, but the core of the product was its software.

By using the LEGO Mindstorm software, customers should have been able to program their own robot of bricks. But when the product entered the market it did not have the expected success because the programmable functionalities were limited, and the kids wanted something more. At that time, LEGO was a company with significant expertise in brick toys but with virtually no knowledge about electronic games and their potential users.

Within two weeks after the product's launch in 1998, adult hackers reverse-engineered the firmware and developed a number of additional software programs that could be used to program the robots, and a small market of sensors and peripherals that could be added to these robots also emerged.

The Mindstorm line was LEGO's attempt to achieve substantial revenue growth by broadening its customer base to include older children and adults. Although LEGO's initial attempt was a market failure, it ultimately found a new strategy for attracting older age groups into its market base. What resulted from the development of LEGO Mindstorm was that LEGO learned it did not need to add bells and whistles to LEGO bricks but just needed to exploit the literacy of the customers by involving them in the process, so that they could be engaged in play that is sophisticated, constructive, and fun.

The search for innovative and new functionalities of Mindstorm, achieved by hacking the original software, demonstrated to the company the potential of crowd-sourcing as an innovation tool. The potential of the product skyrocketed with this "open software" approach, and it generated dramatic engagement among

customers along all of the LEGO product lines. The company realized that the many customers who were using and adapting—and in some cases violating, as with Mindstorm—the LEGO Group’s intellectual property were not threatening the culture, core competences, and intellectual assets of the company; instead, they were actually redefining them and thus introducing the company to new, intriguing, and innovative territories.

Accepting this new relationship with the customer base meant that LEGO needed to change its philosophy and approach to innovation processes, moving from a model in which innovation is created by internal functions (e.g., R&D and Marketing) to a model of open innovation strongly based on interactions with a community of hackers, developers, and designers who were literate in LEGO products and technically competent. This community gave LEGO the opportunity to develop important concepts, such as Lego Technic³⁰—a line of products built together with customers who were Lego-literate enough to design complex models on their own.

By opening itself up to an active involvement with these enthusiasts, the company was able to tap into a rich vein of innovative thinking and was able, once again, to make the brand relevant.³¹ Although the development of the original Mindstorm product went badly, the case perfectly shows the potential effect of a new product development process on the culture of a company: In this case, a dramatic shift occurred, from the traditional protection of copyright and intellectual property toward open innovation and co-creation practices.

The value of co-creation at LEGO cannot be related to the traditional concept of customization. Instead, it has much more to do with a series of changes at the company: in the mentality and mind set of its management from a product-centered to a customer-centered vision; in the core competences of its R&D from closed and internal teams to peer-to-peer teams (customers and people from LEGO); and in the products portfolio from a set of bricks of different sizes and colors to a line of products designed as thematic collections (e.g., Technic, City, LEGO Factory, LEGO Farm, LEGO Harry Potter, and LEGO Creator).

The Sony Playstation Case

Sony’s capability to make advanced technological products characterized it throughout its history, from the first small transistor radio to the Walkman, and from the CD player to digital cameras. Despite this strong capability, Sony faced a dramatic crisis in the 1990s that brought the company to the brink of economic disaster.³² Profits fell from \$1.3 billion in 1993 to a loss of \$3.3 billion in 1995. The investment in Hollywood resulted in a huge failure, with a single loss of \$3 billion in 1995. Even more worrying was that, in those years, Sony had lost three major business opportunities in

30 <http://technic.lego.com/it-it/default.aspx?icmp=COITFR15Technic> (accessed July 27, 2012).

31 Nicolas Ind and Majken Schultz, “Brand Building, Beyond Marketing,” *Strategy+Business*, July 26, 2010, 23.

32 This case is an elaboration of the “Ken Kutaragi: Sony’s Digital Bandit” case study, discussed in Gary Hamel, *Leading the Revolution*, (Boston: Harvard Business School, 2002): 27-28, 64, 84.

consumer electronics: PCs, mobile phones, and video games. The PC market at the time was split between large players (HP, Compaq, Dell, Toshiba) and small producers (including Apple), all of which defeated Sony. Nokia, Motorola, and Ericsson dominated the mobile phone market, while video games were in the hands of Sega and Nintendo.

All of these new markets were based on digital technologies. Meanwhile, Sony's success had always been based on analogic technologies, such as VCRs and televisions. With the exception of a few scattered designers in the company, very few employees were acquainted with these new technologies, which were revolutionizing the consumer electronics market. One of the few designers conscious of this radical change was Ken Kutaragi, who worked at that time in the Sony R&D lab and was on the research team that developed the "Mavica," the first digital camera.

Without a formal mandate, Kutaragi began work on a new electronic product in the late 1980s that would eventually lead to the creation of the Computer Entertainment Division in 1993 and to the launch of the PlayStation in 1994. After less than five years, PlayStation represented 12% of the whole revenue of Sony (\$57 billion), and the company became a leader in the electronic entertainment market.

The project to develop the new device started when Nintendo launched its 8-bit product for video games, the GameBoy. Kuratagi decided to develop a 16-bit device that would improve the horrible sound of the Gameboy and that would make game storage easier, avoiding magnetic tapes by exploiting the CD player technology that Sony had already mastered. The project began because of Kuratagi's "curiosity" for videogames (he had bought a GameBoy for his daughter but was very disappointed with its performance) and because of the expertise of the employees who had participated in the Mavica project. When the design team informed top management about this new 16-bit system, management would not support its development because it was perceived as inconsistent with the existing activities and interests of the company. The decision revealed management's perception that the videogame market was somehow "frivolous" and that it did not match Sony's image, which was based on sophisticated technological products. Company culture was centered solely on producing small and reliable products based on tough core competences in analogical technologies. Despite the rejection, some senior managers were struck by the project and by the design team's approach, which they saw as offering new possibilities. In 1986, these senior managers arranged a meeting to discuss the project with the designers. The group and its leader, Kuratagi, strongly believed that after the crisis of the preceding years and the failure of a series of "traditional" products, Sony should enter the digital entertainment market and develop a new "digital" culture. The

process had already begun, although in an unstructured way: Sony was selling millions of CD players and other products, including new digital components, without having developed a vision for the digital market and its role in the competitive arena. To Sony, for example, the CD was considered a replacement of the vinyl record, rather than a product of the digital revolution.

The vision of the design team inspired one senior manager who decided to support the project as a personal venture, but its development was kept a secret from the rest of the company. The failure of the MSX project (the home computer architecture that never became the expected international standard), the lack of consistent internal expertise in consumer electronics, and a lack of visionary leadership prevented the company from initiating real organizational change to address the potential new market.

In this context, the new 16-bit system developed by Kuratagi still could not become a Sony product, but it served as a bridgehead to the world of digital entertainment. Lacking experience in the sector, the senior manager decided to allow Kuratagi to establish a research collaboration with Nintendo to develop a new chip that would better handle the audio of the GameBoy. However, the design and development of this new chip remained secret because it would have generated internal conflicts. Most of management would not understand why the R&D division was helping a competitor develop a better solution for its products.

In 1991, Nintendo renegotiated the agreement with Sony: The company was concerned that the CD player technology, on which Sony was continuously working, would weaken its dominant position in the videogames market. In fact, the CD technology had huge potential as a support for videogames, but it conflicted with magnetic cassettes, which were then the standard.

Development of the new chip almost came to a halt; but something had changed in the vision of the management, and the design team was able to convince senior management that the chip's design, as a new platform, would give Sony the chance to successfully enter the digital entertainment market. The company began to see the potential of this new product. The work carried on by the design team realigned the company's vision in a completely innovative and effective way. A series of events—Nintendo's fear of losing its strong market position, the failure of the deal with Nintendo, and the pride and vision underlying the Sony designers working on the project—gave way to the birth of the Sony Computer Entertainment Division. After two years of work, the Sony Playstation was introduced. The transistor under its plastic shield was one of the first to incorporate a 32-bit processor, a graphics chip, and a data decompression system on a single piece of silicon—the "system-on-a-chip." The PlayStation was launched in Japan in December 1994. Nintendo's launch of a similar product, the Nintendo 64, came a full 18 months later, delay was critical:

Sony gained supremacy in a key market. Exponentially growing sales reflected the value of the Sony brand and its technical superiority. The PlayStation quickly became the best-selling console, and in subsequent years, Sony went through a series of organizational and market changes that turned it into one of the world's leading companies in consumer electronics.³³

The 3M Global Strategic Design Case

In 2011, 3M generated more than \$29 billion in annual revenue and managed an extensive portfolio of more than 55,000 products.³⁴ With more than 40,000 global patents and patent applications, the company had mastered the traditional R&D process, becoming renowned for the 15% rule—the time given to its researchers to work on their own personal interests and introduced by William McKnight in 1948. The strategy has much more recently been adopted by companies such as Google.³⁵

But from 2001 to 2005, 3M faced significant financial troubles. Attention turned from innovation to applying the Six Sigma management strategy, imported by James McNerney from GE and based on the idea of improving the quality of process outputs by identifying and removing the causes of defects and minimizing variability in manufacturing and business processes. The company's efficiency increased as it focused on execution, but meanwhile, the core character of the company—innovation—registered a lower performance. In 2006, the typical one-third of sales represented by products introduced in the past five years dropped to one-quarter: "The impact of the Six Sigma regime... was that more predictable, incremental work took precedence over blue-sky research."³⁶

The need for change and for the return to a focus on innovation was strong and clear: "[T]he onus shifts to growth and innovation, especially in today's idea-based, design-obsessed economy. While process excellence demands precision, consistency, and repetition, innovation calls for variation, failure, and serendipity."³⁷ Design was introduced in 3M in the following years as a new culture to be combined with the traditional R&D and engineering background of the company, and the environment was a constant struggle between efficiency and creativity.³⁸ The existing design function was engineering, dominated by the Design for Six Sigma (DFSS), in which the main goal of the new product development process was to introduce Six Sigma quality from the very beginning. According to Mauro Porcini, head of global strategic design in the consumer and office unit at 3M, "[w]hen 3M hired me they didn't know how to use me—they just knew that they wanted to have more of a presence and focus on design. At 3M designers existed, but they were often not involved until the end of solution development."³⁹ "My biggest roadblock," he notes, "was the lab

33 In late 1999, Sony sold 55 million consoles and 430 million PlayStation games and made more than 3,000 videogame titles available, with a \$6.5 billion turnover and a 17% margin (compared to Sony's 5% average).

34 3M, *2011 Annual Report: Inspired innovation*, http://media.corporate-ir.net/media_files/irol/80/80574/Annual_Report_2011.pdf (accessed August 2, 2012), 4.

35 Kaomi Goetz, "How 3M Gave Everyone Days Off and Created an Innovation Dynamo," *Co Design*, www.fastcodesign.com/1663137/how-3m-gave-everyone-days-off-and-created-an-innovation-dynamo (accessed July 30, 2012).

36 Brian Hinds, "At 3M, a Struggle Between Efficiency and Creativity," *BusinessWeek*, June 11, 2007, www.businessweek.com/stories/2007-06-10/at-3m-a-struggle-between-efficiency-and-creativity (accessed August 2, 2012).

37 Ibid.

38 Ibid.

39 Braden Kelley, "Optimizing Innovation - Mauro Porcini of 3M," *Blogging Innovation*, October 27, 2009, www.business-strategy-innovation.com/2009/10/optimizing-innovation-mauro-porcini-of.html (accessed August 2, 2012).

directors who were in charge of creating new products. 'Here arrives this young guy from Italy, from the periphery of the 3M empire, and he's telling us how to do innovation?'"⁴⁰

Coming from his experience in the Italian office, Porcini understood that introducing a new design approach was not the concern solely of the design department; instead, it should affect the whole company, thereby challenging its culture and its resistance to change. As one of the technical directors reported, "At first we thought 'What is this guy talking about?' Mauro [asks] 'what does that mop on the shelf say to the customer when she shops?' I'm thinking 'It's a mop; how much water comes out?'"⁴¹

Porcini introduced design culture into 3M by involving the different labs and external consultants and stakeholders from the very beginning, performing a concurrent design process and aligning everyone in the new vision using a participatory approach. The incorporation of design culture, as described by Porcini, was based not on the top-down introduction of theoretical issues, methods, or techniques but on a bottom-up approach in which the process of developing new products could act as an agent for cultural change in the company. The design of new products was an occasion for aligning everyone with the new approach and vision. Porcini's early failures in the introduction of a design-driven view of innovation helped to show the correct path, and the commercial success of a few products designed or redesigned according to the new "designerly" approach served as a turning point in changing preconceived ideas about what product development looks like.⁴²

Discussion of Case Studies

Although the idea of design thinking is based on the belief that anyone can be creative and contribute to the generation of ideas, its application in companies has mainly resulted in the commitment of top-level managers to using designers as consultants to apply design thinking processes and techniques to the creation of innovative ideas that the companies should develop to innovate and exploit the market. The aim of these types of processes is to force outside-the-box thinking, and within this framework design thinking is primarily seen as a way to introduce or stimulate creativity for the envisioning of new solutions.

The three cases presented above show how organizational change is much more complex than simply leading people to think outside the boundaries of their daily context. The literature on organizational change identifies many other issues that strongly affect innovation in organizations, including cross-divisional work, cross-disciplinary work, resistance to change, overcoming dogmatic thinking, the need for new competences and technologies, and inefficiency of production and business processes.⁴³

40 Chuck Salter, "The Nine Passions of 3M's Mauro Porcini," *Fast Company* 159; www.fastcompany.com/design/2011/3m-mauro-porcini (accessed July 30, 2012).

41 Ibid.

42 Ibid.

43 Hamel and Prahalad, *Competing for the Future*.

While the role and the effectiveness of design thinking as a soft approach for directing organizational change toward innovation must still be demonstrated, these three cases show how the design culture applied to the development of a new product (LEGO Mindstorm and Sony Playstation) and the introduction of design competences (3M) led to dynamic and emergent changes in the culture of the companies. In particular, they show the following:

- The innovation projects described can be considered examples of design culture in action.
- Design culture in action can be seen as a process that generates innovation mainly by prototyping, by using a trial-and-error approach, and only subsequently by adopting a convergent way of thinking, based on the satisfaction of the product requirements.⁴⁴
- When design culture addresses innovation in an enterprise, it can affect the firm's established structure and culture, challenging the ways in which people interact with one another, its existing capabilities, and how daily activities are accomplished.
- Organizational changes can occur as unplanned effects of innovation development projects.

Design culture in action, as a process that can generate significant innovation through trial and error, accepts that constraints can be overcome by continuously discovering new micro-solutions and by embracing a process of continuous mediation among the actors and the competences involved, rather than adopting a predefined platform for development.

The three cases show the larger role that design culture can play in a company, making clear that, more than leading processes of creativity, design culture makes clear the contradictions between the current culture of a company and the system of competences, knowledge, and artifacts needed to innovate. The need to resolve these contradictions triggers the organizational and cultural changes needed to develop the innovations.

The "positive" role of contradictions in triggering change and facilitating innovation, and the development of new products as a continuous agent of generation of these contradictions was recognized in the literature. Takeuchi and his colleagues explicitly acknowledge that sparking innovation means continuously managing tensions and contradictions, and making their creation and recognition part of the enterprise culture:

Quite simply, [Toyota Production System] is a 'hard' innovation that allows the company to keep improving the way it manufactures vehicles; in addition, Toyota has mastered a 'soft' innovation that relates to corporate culture. The company succeeds, we believe, because it creates contradictions and paradoxes in many aspects of

44 Note that designers adopt a mix of divergent and convergent thinking and that both the capability to generate creative ideas by exploring solutions and the capability to follow logical steps to refine solutions are necessary in design activity. Both must be structured in a variable mix, depending on the purpose and phase of the project.

organizational life... People often ask us, 'Tell me one thing I should learn from Toyota.' That misses the point. Emulating Toyota isn't about copying any one practice; it's about creating a culture. That takes time. It requires resources. And it isn't easy.⁴⁵

Note that Takeuchi's thinking evolved from the idea of the transferability of best practices to the idea that to develop continuous innovation, companies need to contextualize forms of knowledge creation and practices of management, new product development, and production.

In the LEGO Mindstorm case, the failure to develop a new product became the unexpected occasion for radically changing the dogmas and values of the company. It was able to move from a model in which innovation is created by internal functions (e.g., R&D) and defended by a complex system of copyrights, to a model of open innovation strongly based on interaction with external communities of hackers, developers, and designers. The cultural change in this case was linked with the introduction of new competences, a new internal design center, new production processes, new distribution chains, and new products, all based on a new business model that exploited a partnership with external communities.

In the Playstation case, the adoption of a design-led approach in the development of the new product, and its success on the market, happened in a climate of distrust and resistance to change—one that threatened failure for the Playstation project long before it could gain momentum and become the biggest Sony success in the past 17 years. Relevant to Sony's case is what Schein says about culture and resistance to change:

[A]s companies age, elements of the corporate culture or the misalignment of subcultures can become serious survival problems for the organization, especially if the technology, market conditions, and financial situation have changed. Key elements of the corporate culture can become a serious constraint on learning and change. The organization clings to whatever made it a success. The very culture that created the success makes it difficult for members of the organization to perceive changes in the environment that require new responses. Culture becomes a constraint on strategy.⁴⁶

The 3M case supports our ideas that cultural change in an enterprise might result from the introduction of bottom-up design processes, and that the change can be emergent, as the literature has already recognized, rather than planned and based on the top-down introduction of new methods and processes.⁴⁷ The case also shows that when design culture is inserted into companies that

45 Hiroataka Takeuchi, Emi Osono, and Shimizu Norihiko, "The Contradictions That Drive Toyota's Success," *Harvard Business Review* 86, no. 6 (2008): 96-104.

46 Edgar H. Schein, *The Corporate Culture Survival Guide* (San Francisco: Jossey-Bass, 1999), 17-18.

47 Mintzberg, *Mintzberg on Management*, and Nadler, *Discontinuous Change*.

already exhibit a strong culture, as at 3M, this introduction necessarily generates inter-functional and cultural conflicts that can best be solved by designers who are capable of mediating and negotiating the processes of inclusion and participation. The way in which 3M decided to invest in design, although still characterized by a certain naiveté, shows that companies and sectors that are traditionally far from design can start to understand design's strategic role and how its introduction is a matter of culture, which takes time to develop.

Porcini's recent shift to PepsiCo in the newly created role of chief design officer was officially introduced as a matter of creating a design culture in a company that does not have it. The shift confirms a general trend, as well as our suggestion, that companies have started looking at design as a particular internal culture with a pervasive presence, rather than as a set of services that can be externalized and applied only in particular situations. As Brad Jakeman, president of PepsiCo's global beverage group, declared in an interview with *Ad Age*: We firmly believe design and design thinking is a significant vector of innovation and therefore growth. I was looking for somebody who could not only orchestrate amazing design but also... build a design culture within an organization. Mauro, through all of his accomplishments doing that at 3M, rose to the top as the perfect candidate.⁴⁸

In the case of 3M, we documented a structural intervention—something that might interfere by its very nature with the culture of the company—but in all three cases we also showed that the development of new products might open unexpected possibilities of change for the culture of the enterprise. In particular, the new product development processes studied did the following:

- forced the employees to overcome their limits and dogmas;
- aligned the employees with the potential of a new vision;
- encouraged the companies to transform the processes of production, distribution, and communication; and
- helped the companies to revise their strategies and to develop their own design culture.

The three reported cases clearly show that design culture approaches innovation in a way that differs from the traditional managerial approach. In particular, we emphasize the following distinctive aspects:

1. *Generation of fresh insights.* Watching for and identifying emerging needs in a very direct but naive way—without the filters and dogmas bound to established procedures

48 Natalie Zmuda, "Pepsico Creates Chief Design Officer Role," *Advertising Age*, <http://adage.com/article/global-news/pepsico-adds-chief-design-officer-role-taps-3m-s-porcini/235264/> (accessed August 3, 2012).

and ways of doing—is a key element of the design approach to innovation. The innovation is sought as an intuitive recognition of and response to a need, thereby forcing the company to change along the way. The whole Playstation development process was generated and driven by Kutaragi's search for a better gaming experience.

2. *Perception of failure as a working tool.* The managerial approach to innovation often lives by the mantra, "failure is not an option." A design culture, meanwhile, sees that learning through prototyping, accepting modifications—even radical ones, and assuming failure as part of the process can free designers from the fear of organizational punishment. This fear limits managers in the way they deal with change and innovation because they believe that the best way to avoid such punishment is by trying to please all functions and key roles inside the company and adopting conservative solutions that maintain the status quo. The cases of both LEGO and Sony depict the conception of failure in design culture as part of the game of innovation and not as something that must be avoided at all costs. In many cases, it is documented how early failures lead to success. The April 2011 issue of the *Harvard Business Review* is, in fact, entirely dedicated to failure.
3. *Integrated vision over functional vision.* For innovation projects, design culture adopts a systematic, holistic approach that defines the entire platform of stakeholders needed for the project. The managerial approach, meanwhile, often is structured to achieve efficiency through a functional subdivision of the tasks. To increase efficiency and to avoid failure, managers tend to rely on pre-existing knowledge and resources and on separate functions in the process of developing new products, thus dramatically reducing the chances of creating breakthroughs or facing unexpected changes during the process.

Conclusion

In recent years, design thinking has received much attention as a driver for change and innovation in enterprises. This attention resulted in the adoption of a set of techniques and tools in the field of idea generation that managers are supposed to learn and easily replicate in different contexts because thinking in a designerly way could be the key to creating and fostering innovation. Such tools and techniques reflect a serious misunderstanding: Design does not contribute to innovation simply by generating new ideas; it does so by actually constructing new, viable solutions. This construction can occur only in environments characterized by a real

design culture, as we defined it, through new product development processes that are likely to introduce or require concurrent organizational changes. Thus, the real innovation booster that could radically change companies, competencies and processes, and even transform people in organizations lies in managing innovation projects using a situated design culture.

Disconnecting design thinking from “design doing” is the wrong way to express the potential of design with respect to the management of innovation and organizations. The results of the most advanced studies on organizational culture and on practice-oriented culture demonstrated the need to avoid separating the tacit from the explicit dimension of knowledge.⁴⁹

The three cases discussed demonstrate that more than design thinking per se, new product development, and new internal processes produced the occasion for the change. Projects of significant innovation drove the three companies to cope with the unexpected need for change based on the implicit action of design culture.

In this framework, the idea of design culture is far from being a shortcut to the introduction of design in companies; it is based on the necessity of rooting design deeply within the enterprise, which takes both a long time and the ability to adapt it to the specificity of the situation. We believe that innovation can be fully developed and exploited only “inside the box”—in a situated way—by considering the organizational context (company), the technological and productive context (technology and production), and the context of use (society and market).

We see great opportunities for the expansion of knowledge about how design practice and organizational change can be carried out simultaneously. Intriguing opportunities are arising to discuss from a new perspective the relationship between design culture—as one of the relevant domains of competence and knowledge that addresses innovation—and the phenomenon of organizational change.

Organizational change emerged in unexpected ways in the cases described, but if we assume that significant innovations necessarily bring with them organizational changes, we could anticipate the need for change, accepting and expecting it as a natural consequence of the development of new products. As a promising object of future studies, to what degree can the actions of organizational change be planned and intentionally carried out simultaneously with the development of new products? Great potential arises for the cooperation of design research and managerial research in the development of a common framework of action, with which firms could carry out a change in their offerings (product and service innovations) as they carry out a change in the ways they develop, produce, and deliver them to the market (organizational change).

49 Michael Polanyi, *The Tacit Dimension* (Cambridge, MA: Blackwell, 1966); Nonaka and Takeuchi, *The Knowledge Creating Company*; and John Seely Brown and Paul Duguid, “Knowledge and Organization: A Social Practice Perspective,” *Organization Science* 12, no. 2 (2001): 198–213.