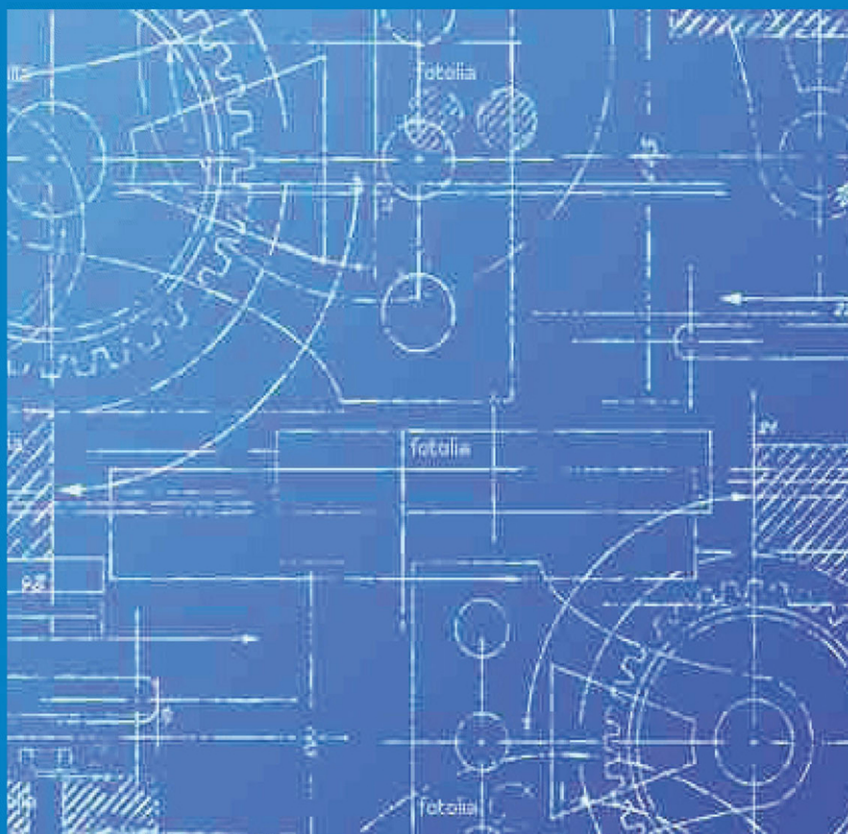


INNOVATION AND IT IN AN INTERNATIONAL CONTEXT

R&D Strategy and Operations



EDITED BY FRANTZ ROWE
AND DOV TE'ENI



Innovation and IT in an International Context

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R&D Strategy and Operations

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Abstracts

Chapter 1: International Open Innovation: Taking Stock and Moving Forward

Over the last decade the open innovation paradigm has been increasingly indicated as a panacea to firms' problems in the innovation process. Although it has increasingly been considered as *the paradigm* for organizing innovation, there still remain a few open issues related to the process and the extent to which external knowledge might enhance performance, particularly in internationally distributed contexts. The goal of this chapter is to present some controversial findings related to the use of external knowledge in the innovation process and to present relevant avenues for future research. While any claim of comprehensiveness would be foolhardy, we aim at highlighting a few topics we believe might constitute interesting avenues for future research at the intersection between the organization of R&D and international business.

Chapter 2: The Organization of the Knowledge Base and Inventive Performance

Beyond diversity and size, this chapter is interested in the impact of the organization of a firm's knowledge base on its knowledge-creation capacity. The organization as a knowledge base is evaluated by the level of coherence and cohesion depending on the complementary or similar nature of the relations among knowledge elements. Drawing on a statistical analysis of patent data from 1968 to 2002 in the semiconductor industry, the results suggest that coherence makes a positive contribution to inventive capabilities, while cohesion has the opposite impact. However, cohesion is found to be beneficial for knowledge creation when invention relies on the exploration of new combinations.

Chapter 3: Industrial Clustering and Innovative Output

The chapter examines the ways firms benefit from knowledge spillovers in industrial clusters. Clustered firms are eight times more innovative when located in clusters with strong specialization in their own technology. While the literature on organization agglomeration has highlighted a potential trade-off between the benefit and cost of co-location in terms of knowledge spillovers, our findings are that agglomerations are important to new innovative-driven ventures. However, our research also indicates that

although on average new ventures benefit from agglomeration, more work is needed to explore the mechanisms by which some organizations benefit from co-location and knowledge spillovers while others may not.

Chapter 4: Why Innovative Design Requires New Scientific Foundations for Manageable Identities of Systems

When can we state that things are identical or different? This is a key issue in structuring humans' representations and making plausible predictions with potentially major implications, as demonstrated in high-tech industries such as those studied here. The identity of things is not a natural and absolute relationship just waiting to be stated once and for all. Rather, it is an artificial and short-lived one, relative to available knowledge or experience, and should be memorized as such using well-suited semantics. Standard rationality enables designers to manage consistent identities according to a fixed state of understanding only. If that state is updated to reflect current changes of things or environments coupled with innovation, they must adopt a relevant non-standard rationality based on new scientific foundations.

Chapter 5: Configurational Thinking and Value Creation from Digital Innovation: The Case of Product Lifecycle Management Implementation

Product lifecycle management (PLM) platforms – which consolidate activities across the development lifecycle under a common application umbrella – promise to help companies to address many contemporary challenges in NPD. Yet, as with other enterprise-scale platforms, managers have difficulty deploying PLM. Based on observations from six case studies, we find managers can enhance PLM deployments by employing configurational thinking. This means treating PLM technology as just one part of a larger system of reinforcing elements related to the creation of new business capabilities. We identify two distinct layers of configurational thinking – the mindset layer and the toolset layer – and derive six principles spanning these layers that embody configurational thinking on PLM projects. We conclude by discussing implications of our configurational perspective for research on digital innovation.

Chapter 6: Coordination of R&D Activities and Communities of Practice in Multinational Companies

This chapter focuses on coordination mechanisms that multinational enterprises (MNEs) can use to efficiently manage innovation processes. The authors highlight recent trends concerning the location of R&D activities of MNEs, showing their increasing geographical dispersion. They analyze innovation processes developed by Groupe SEB, which is a world leader

in the small household equipment and cookware industry. The company is currently changing the organization of innovation processes, attempting to develop new tools and practices. It has recently created a community of practice whose objective is to promote interaction between actors involved in innovation. Interviews conducted with members of the new community allow the identification of major characteristics and benefits of this new tool.

Chapter 7: Effects of Product Lifecycle Management on the Reliability and Productivity of New Product Development: The Case of Co-development with China

Although much research is devoted to high-reliability contexts, relatively few works focus on the reliability of more conventional processes in industry or services. In these more traditional situations of performance improvement, the criterion of reliability is often coupled with that of productivity. This chapter describes the contribution of product lifecycle management (PLM) technology to the reliability and productivity of new product development. Through a longitudinal case study within a small appliance industrial group, we study the effects of PLM on productivity and reliability through explicit knowledge integration, routines and actors' mindfulness.

Chapter 8: Helping Global Software-Development Teams to Overcome the Challenges of Temporal Dispersion and National Diversity: The Importance of Leadership Roles

This chapter explores the challenges that temporal dispersion and cultural diversity create for global software-development teams and proposes that leaders have a critical role in mitigating those challenges by constantly coordinating and monitoring team activities. Data from 113 global software-development teams distributed across Europe and South America was collected to test these hypotheses. The results indicated that the negative effect of temporal dispersion on team performance was reduced when leaders constantly performed their monitoring and coordination roles. Interestingly, national diversity was negatively related to performance in teams when leaders did not frequently engage in their monitor and coordinator roles. However, the relationship between national diversity and team performance turned out to be positive in teams where leaders strongly engage with their monitor and coordinator roles.

Chapter 9: IT Use and Dispersed New Product Development Project Performance: The Mediating Role of Coordination

The spatial and temporal dispersion of innovative projects provides access to a broad base of knowledge all over the world. However, difficulties in communicating remotely in dispersed teams may jeopardize the success of

these projects. Although the use of IT in such projects has been the subject of several studies, the question of whether its use leads to improved performance remains unexplored. This study investigates the mediating role of coordination in the relationship between IT and the performance of dispersed new product development projects. The results highlight the mediating role of coordination for the use of IT that support product design and organization of tasks. Moreover, this research shows that the impact of IT on coordination differs according to the project dispersion level.

Chapter 10: ‘Looking for Trouble’ in Global Information Systems Development and New Product Development Outsourcing Projects

Prior research on global information systems development (ISD) outsourcing projects and new product development identifies several management challenges, including the mitigation of cultural differences that can jeopardize project success. Despite the common mantra that greater distance makes ISD more critical, a growing body of literature on global virtual teams and internationally standardized codes of conduct suggests that they are becoming increasingly uniform. The concept of culture may thus increasingly refer to context-specific and dynamic professional cultures, rather than being solely embedded and statically rooted in national culture. In this chapter we show that with the globalization of IT project-management standards, alignment of professional practices and a maturing market for ISD offshoring, fewer culture-related conflicts appear to be emerging.

Chapter 11: Market, Technological and Process Management Knowledge in New Product Development Projects and the Value of New Products

The modern era provides an innovative environment that breeds creative processes, starting with an idea and maturing into a variety of new valuable products. Such processes thrive on the exchange of knowledge between professionals, individuals, teams and organizations. This chapter reviews the various types of knowledge created and transferred during a project lifecycle in the development of new products. It offers an in-depth investigation of the concept of knowledge exchange in new product development projects by evaluating the market, technological and process-management knowledge that exists prior to the project initiation, the knowledge created and exchanged by the various stakeholders throughout the project and the accumulated knowledge contribution to the value of the final deliverable product.

Introduction: A Systemic View of Innovation

*Dov Te'eni and Frantz Rowe*¹

Innovation is not an option for firms these days, especially those operating in an international context. It is essential for competing, indeed surviving, in today's rapidly changing and increasingly digital world. We believe that in order to understand how innovation in a digital world can be managed, supported and promoted, we must view it in an interdisciplinary way. This book takes a first step towards building such a view by first discussing perspectives from a number of different disciplines and then examining the ideas that arise from the interaction between them. This happens to be a well-known technique of innovation in general. In this introduction, we develop the rationale for a particular set of perspectives that, we believe, are essential for understanding innovation: strategic management, operations management economics, and information systems (IS). Moreover, as innovation is increasingly organized across national borders and organizational boundaries, we choose to pay special attention to innovation in the context of international business and open innovation.¹

As multiple disciplines bring with them multiple terminologies (again a common challenge faced by interdisciplinary innovation teams), the introduction also sorts out some of the terms used throughout the book.

Innovation can be managed and supported at two levels. The first of these is the 'strategic level' of organizing the structure of innovation, usually in the form of organized research and development (R&D) units and steering committees involving top management. The second is the 'operational level' of facilitating and managing the functions and operations of innovation – for example, information technology (IT)-enabled product development and teamwork. The term 'innovation' will be used in this book in its broadest sense, to encompass planned and unplanned innovation in both product and process. It can be defined as 'the development and implementation

¹Both authors contributed equally

of new ideas by people who, over time, engage in transactions with others within an institutional order' (Van de Ven, 1986).

R&D is planned innovation, defined as 'a creative activity which is undertaken with the aim of increasing knowledge and using such knowledge to create new applications, like technologically new or improved products and processes' (Ughetto, 2008). In this book, we discuss the strategic issues of organizing the R&D, and the operational issues of supporting R&D with resources such as workers, knowledge and IT.

Through their R&D and market intelligence, firms assess the prospects of the new products, and decide accordingly whether to invest in new product development (NPD). NPD involves R&D as applied to the development of new, incremental or radical, products, but is not confined solely to R&D. Its scope is defined as 'beginning with the perception of a market opportunity and ending in the production, sales, and delivery of a product' (Ulrich and Eppinger, 2000, p. 2). The management and operation of NPD projects involve multiple stakeholders, such as agents from marketing, design, styling, quality standards, manufacturing and operations, but also IT and finance specialists who must sponsor projects and support interactions with the necessary tools and infrastructure as projects unfold. In order to understand product innovation in practice, we therefore need both a strategic discourse (one that traditionally studies critical resources allocation; Bower, 1970) and an operational discourse (which clarifies how systems work; Alter, 2008; Orlikowski, 2002).

What has been studied?

Within the dimensions described above, and depicted in Figure I.1, we will now consider what has been studied and is discussed in this book. A broader view of the intersection between innovation and IT involving more dimensions and more disciplines can be found in the work of Nambisan (2003, 2013).

At the strategic level, research on innovation and strategic management has examined policy decisions that have long-term effects, including decisions on the structure of R&D units, the profile of R&D competencies and strategic focus, and the environments in which their R&D specialists operate. These problems have traditionally been treated in management and organization studies, but also in spatial economics and human geography, and they are a concern for governments at all levels.

As demonstrated in this book, IT affects strategic decisions about innovation and R&D because of the capabilities and flexibility that IT affords organizations, particularly through the growing use of Internet-based infrastructures for collaboration and knowledge transfer. In terms of a digital working environment, the issue of open innovation, including that of intellectual property and innovation exploitation, has also attracted attention in the last decade in economics, management and law.

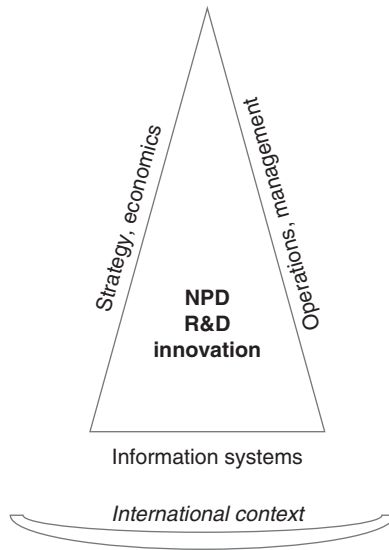


Figure 1.1 Perspectives of IT-enabled innovation

It is surprising, therefore, that IS researchers have not generally addressed strategic aspects of R&D and NPD. Moreover, IS development (ISD) has much in common with NPD. However, IS researchers who study systems development have generally overlooked research on NPD, and vice versa. Indeed, IS researchers have studied how ISD should be structured, where developers should be located and how they should be organized (dilemmas of onshore vs. offshore, of gender, of age, of competence, etc.). Despite the similarity between these ISD research topics and the parallel NPD research topics, there has been little referencing from one field to the other. One exception is the study of the impact of IT on the dynamic capabilities of NPD, which is placed in the broader context of the IT impact on products in general (Pavlou and El Sawy, 2006; Fichman, 2004). However, it may be time to revisit the substantial stream of IS literature on competitive advantage gained by IT-enabled products and services. This literature was developed in the 1980s and 1990s, over 25 years ago (Merali, 2012), but it may bring valuable insights into the evaluation of NPD (more on evaluation in Chapter 11).

At an operational level, innovation and IS researchers have studied collaboration and knowledge-sharing in R&D processes, as well as the management of R&D processes and NPD projects, IT support for R&D and the international aspects (Nambisan, 2003, 2013). Moreover, the IS perspective of innovation has produced discussions focusing on the IT support for NPD in the form of software such as product lifecycle management

(PLM) applications, for ISD and for teamwork in R&D. PLM is an enterprise software that helps to manage the development process (managed as a project) from initial idea to deliverable product. ISD is the process of developing an IT-based system from preliminary concept through analysis, design and implementation to a deliverable working system (again usually managed as a project). ISD resembles NPD in many ways (see, e.g., Nambisan and Wilemon, 2000). It is often supported directly by a family of software packages for computer-aided systems engineering (CASE). However, ISD is also supported indirectly by IT that enables powerful infrastructures under the general umbrella of open source (manifesting principles of open innovation), and productive practices such as programming with examples. Such indirect effects of IT trigger innovation through more efficient and effective processes but also through enhanced products (Nambisan, 2013). Finally, IT enables and supports the teamwork of R&D groups that are dispersed, temporally and geographically. In the international context, R&D groups are often diverse culturally too. When the team members collaborate from remote sites, we often use the term ‘virtual team’. IT-enabled collaboration directly supports innovative work but can also indirectly support innovation by enabling support functions such as crowd-funding for R&D.

Our interest in international business as the context of innovation responds to a growing trend of R&D that spans country borders. As firms expand, they strive to sell everywhere. But to accommodate and penetrate foreign markets, they need to comply with foreign governments’ demands, which may require not only local manufacturing and employment, but also co-design and development in order for the host country to be, in the long term, capable of capturing part of the value creation. Firms tend to comply while trying to retain their most complex and strategic NPD projects onshore. International management, in practice and in academia, has long identified that there are no unique solutions to the challenges of global innovation (von Zedwitz et al., 2004). Several major dilemmas that firms face when they distribute their activities globally capture the need to fit the management of innovation to the firm’s particular context (ibid.). Of these, four are particularly relevant to our focus on the intersection of innovation and IT: the locus of power (local vs. global) granted to R&D units, the level of process structuring dictated across locations, the tension between exploration and exploitation, and IT-enabled communication and collaboration vs. face to face. We will see all of these dilemmas appear in the ensuing chapters.

A systemic view of innovation in this book

While each chapter generally stresses a certain disciplinary perspective, we may already identify important interactions between perspectives that arise implicitly, but also explicitly, in the chapters ahead. To see these interactions,

we now pause to take a holistic and multiperspective view of IT-enabled innovation.

IS brings the systems view (Churchman, 1971) to the management of innovation. To the organization engaged in innovation, R&D and NPD is seen as a system which has as its goal the production of value-laden products, and utilizes subsystems and resources designed and managed to achieve its goal in a coordinated and efficient fashion. The goal of producing an innovative outcome that can be sold is an external purpose but the system also has internal goals that concern the operations of the subsystems (von Bertalanffy, 1968). Furthermore, a system must have measures of performance for its goals and the goals of the subsystems, so as to be able to manage the operations of the system and adapt where necessary. The system's designer is concerned with optimizing the structure of the system, setting its goals and purposes, creating subsystems for information processing and coordination, and enabling learning through knowledge creation, sharing and utilization (Galbraith, 1974; Rowe et al., 2011). Thus the structure of the system constrains and affords the learning and behavior of its agents.

The learning perspective is, of course, essential in any treatment of innovation. IS has long taken a sociotechnical systems approach that is especially sensitive to multiple perspectives in the organization and to the issues related to organizational change (Pasmore, 1988), and it is more proactive in dealing with change (Senge, 1990). The behavioral, social and economic aspects of the processes and activities performed by the system's designers, managers and clients are therefore central to understanding innovation. For example, Boland, Tenkasi and Te'eni (1994) characterized a learning organization as agents (actors) learning and interacting with interpretations of the system and its environment. These interpretations constitute the organization's knowledge held by its agents. Successful organizations learn to combine organizational knowledge with industry knowledge in order to strategically structure and position their R&D activities (Aharonson, 2008).

To explain how the systems approach described above can frame the discussions in the ensuing chapters, we identify four themes of the systems approach outlined above that emerge or become important in the intersection of innovation and IT, especially in the international context. The themes are knowledge management, configurational design, distance matters, and diversity of agents and behaviors. These themes are not exclusive of each other. On the contrary, there are significant overlaps and interdependencies among them (see Conclusion), but each theme plays a role in underscoring certain issues that have academic and sometimes practical implications.

The first theme that links innovation and the IS perspective in a fundamental way is that of 'knowledge management'. Innovation is clearly about knowledge creation and knowledge transfer (Van de Ven, 1986). The IS perspective underscores the need for knowledge management that organizes

the knowledge needed as the input to the process of innovation. However, it also includes IT that supports agents in their activities, such as promoting individuals' creativity in design and enabling group co-design. Interaction between innovation and IS produces new ways of supporting and promoting innovation by looking at the processes of knowledge creation and knowledge-sharing at the level of the individual knowledge worker, and the team of knowledge workers. At the strategic level, we examine how the organization of knowledge in the system and its subsystems affect the processes of knowledge creation and knowledge-sharing, and how these processes affect innovative performance. At the operational level, we examine how knowledge management is used to support the work involved in R&D and NPD.

At the higher level of a firm, knowledge management is concerned with knowledge transfer, knowledge translation and knowledge transformation within and between organizations. Transfer occurs when differences and dependencies between agents are known. In this case, a common lexicon is sufficient to share and assess knowledge at the boundary. Translation occurs when differences and dependencies between agents are unclear, in which case common meanings must be developed. Transforming knowledge requires the development of common interests to create new knowledge, and validating it within each function and collectively across functions (Carlile 2004, p. 560). In one of the most insightful works on the management of R&D, Tom Allen (1986) specified the role that IT would play in transforming the R&D function. In fact he believed that IT would tend to redesign the structure of R&D because new IT support, like PLM, would help to manage innovation projects more efficiently throughout the firm and its larger ecosystem. At the same time, in terms of knowledge creation, he rightly argued that knowledge-translation requirements across different disciplines would hinder the potential benefits and would favor face-to-face or at least oral exchanges. Nowadays, we can advance his thinking by positing that the Internet and all scientific databases serve chiefly to reinforce developments within disciplines rather than across disciplines. This is reflected in the very few studies on the effect of IT use on R&D work within firms (Whelan et al., 2010; 2013). We may only assume, from a human resource viewpoint, that interdisciplinary experts within firms and across specialties are most needed for interdisciplinary dialog on innovation because current IT will not provide the translation across specialties. Evidently, when innovation is distributed around the globe, IT inevitably becomes the main communication means. However, until members have formed a common contextual representation through the sharing of experiences, implicit knowledge and know-how exchange requires human boundary-spanning and mediation (Boland et al., 1994). This becomes particularly salient in an international context (Merminod and Rowe, 2012). The need for translation is underscored in our discussion of the next few constructs. First, however, we touch

briefly on the chapters in this book that address the issue of knowledge integration and knowledge transfer.

Several chapters expand on the concept of knowledge and its management. At a strategic level, an important issue is the organization of R&D centers so as to promote innovation. Ludovic Dibiaggio, Maryam Nasiriyar and Lionel Nesta in 'The Organization of the Knowledge Base and Inventive Performance' (Chapter 2) talk about the organization of knowledge, its synergies and integration (Dibiaggio, 2012). They use the concepts of knowledge coherence and cohesion that respectively affect exploitative searches (the refinement of existing technological knowledge) and explorative searches (the invention of new knowledge combinations by experimenting with untested combinations) (March, 1991). They test the likelihood of successfully producing explorative knowledge or exploitative knowledge, depending on the specific patterns of the firm's knowledge organization. Similarly, Barak S. Aharonson, Joel A.C. Baum and Maryann P. Feldman in 'Industrial Clustering and Innovative Output' (Chapter 3) use an extensive longitudinal dataset of firms in the Canadian biotechnology industry to examine how a firm's innovative performance (measured by the patent application rate) is affected by the utilization of R&D resources (capital, employees and research alliances). Finally, Bruno Cirillo and Giovanni Valentini present a different view in 'International Open Innovation: Taking Stock and Moving Forward' (Chapter 1). Rather than looking at the location of R&D activities, they consider looking at organizing R&D in an environment of open innovation. They present some controversial empirical findings related to the use of external knowledge in the innovation process. They further claim that, while the benefits of knowledge transfers have been extensively reported, the boundary conditions of the efficacy of an open innovation strategy for firm performance have yet to be determined.

Closely allied to the issue of knowledge generation and transfer (as demonstrated by Chapter 1) is a second theme of 'configurational design', which is applied to knowledge and more generally to the innovation system (Fichman, 2004). In the configurational approach, the structure of the system is designed to ensure that goal achievement is effective, and that resource utilization is efficient, by providing the right configuration of subsystems and resources in relation to the environment (Von Bertalanffy, 1968).

Gilbert Giacomoni and Jean-Claude Sardas in 'Why Innovative Design Requires New Scientific Foundations for Manageable Identities of Systems' (Chapter 4) theorize about the fundamental question of how to configure and label systems to ensure effective innovation. When a new product involves new components (subsystems), to what extent do the properties of the product change when operating in a new environment? Even when the environment is stable, this issue is complex and is seen as a knowledge-integration problem (Dibiaggio, 2012). However, often such innovations are

not designed for new environments, and they become risky when, unbeknown to the designers, the environment changes in a way that alters the properties of the new product. For instance, components of products may not be interchangeable in different environments. Knowledge of the consequences of the integration of a new component is often limited to the current environments in which current products operate. This explains the importance of labeling products correctly so as to inform product designers and users of possible incompatibilities. The simple question of which family the product with a modified component belongs to has practical implications for designing, for manufacturing operations and for marketing. To answer this question, the authors use a mathematical analysis of collections and sets, highlighting the link between design and bounded rationality. The resulting instability of the systems' behavior leads to 'bounded identities', depending on the changing environments. This is an insightful demonstration of the more recent systemic approach, comprehensively described by Senge (1990), in which systems thinking must also be seen from the perspectives of the rationally bounded designers and users (the system's clients). In this approach, the complexity of understanding and designing a system is mainly a function of the interrelationships among subsystems and between subsystems and the environment, especially changing environments.

Robert G. Fichman, Satish Nambisan and Marc Halpern in 'Configurational Thinking and Value Creation from Digital Innovation: The Case of Product Lifecycle Management Implementation' (Chapter 5) explore the role of digital innovation configurations in promoting the generation of value. They define a digital innovation configuration as 'some novel arrangement of technological and organizational elements in which some focal digital technology is necessary to achieve some focal outcome'. In their study, the focal digital technology is a PLM platform, and the focal outcome is significant business value creation. On the basis of six case studies in large multinational firms, the authors present evidence of configurational thinking among managers in the most successful implementations. Moreover, they are able to prescribe a set of general implementation principles, which are consistent with the configurational view of value creation through PLM. Interestingly, Chapter 5 addresses both levels of analysis – the strategic and the operational – in what the authors call two layers of configurational thinking – the 'mindset layer' and the 'toolset layer'. This idea of explaining configurations at multiple levels is important and consistent with the systems approach (Senge, 1990). It can be extended to the other themes too.

Configurational design, in its broadest sense, should include not only structural configurations but also the dynamic configuration of processes and projects. In particular, portfolio management, which is about selecting R&D and NPD projects on the basis of strategic, technological and economic considerations, has emerged as critical to the management of the resources

needed for innovation (Cebon and Newton, 1999) with implications for competitive advantage (Bard et al., 1988). However, IS has looked to portfolio management since the 1970s to manage costs and risks of ISD (Ein-Dor and Segev, 1978). This is another potential area for IS researchers to contribute but is unfortunately missing from this book.

The third theme that emerges is the idea that 'distance matters'. This links innovation and IS perspectives. It matters in terms of the structure of the system and the structure and location of its subsystems, and it matters in terms of the efficient operation of subsystems in the given structure. The distance between collaborators, within the company or within the multinational company located in different countries, has an impact on the innovative performance of a firm. However, also at the level of a team, the process and outcome of teamwork depend on the distance between team members, where distance can be physical in time and space, or mental (Ngwenyama et al., 2009). Distance between perspectives is needed in order to generate the conflict that results in creative thinking, but distance builds barriers to communication, which is inherent in today's collaborative innovation. IT enables teams to work beyond time and space, but it introduces difficulties that may reduce productivity. This is because new IT systems implementation tends to induce resistance to learning new tools (Van Offenbeck et al., 2013), and also because extant tools and systems are embedded into organizational routines and organizational inertia, which are essential for operational excellence (Besson and Rowe, 2012). A better understanding of these interactions, taking an interdisciplinary approach, is adopted here, and this can lead to better designs of IT to avoid such problems.

The chapters in this book that address distance do so mainly at the operational level, and deal in particular with mechanisms for communication and coordination among agents and units working at a distance. Working at a geographical distance is typical of multinational enterprises and, indeed, these particular chapters describe studies conducted in the international context. Lusine Arzumanyan, Ulrike Mayrhofer and Christopher Melin entitled their chapter 'Coordination of R&D Activities and Communities of Practice in Multinational Companies' (Chapter 6). Here the authors analyze new tools and practices that are used by multinational enterprises to efficiently manage their innovation processes. They further examine different coordination mechanisms that can be used to coordinate R&D activities, with a focus on 'communities of practice'.

Two other chapters discuss the role of IT in distributed organizations, looking at the need for coordination and the impact on measures of performance. Céline Péréa and Sebastien Brion in 'IT Use and Dispersed NPD Project Performance: The Mediating Role of Coordination' (Chapter 9) emphasize the key role of IT in dispersed NPD project coordination. They substantiate empirically previous research on the role of coordination as a key performance lever. Furthermore, they demonstrate how the impact of IT is

determined by its role in supporting coordination; although the impact on performance is not direct, which is in line with Hoegl et al. (2007) and Salomo et al. (2010). In 'Effects of Product Lifecycle Management on the Reliability and Productivity of NPD: The Case of Co-development with China' (Chapter 7), Caroline Mothe, Valéry Merminod and Frantz Rowe show how PLM can improve both the productivity and the reliability of product co-development across continents. This double improvement is an original result that complements previous well-known research on high reliability. Despite its limitations, PLM can effectively structure the development process and centralize project data. This reinforces transparency in the sharing and reuse of explicit knowledge and coordination.

In addition to these three chapters that address distance, a few of the aforementioned chapters touch on the issue of distance too. Aharonson, Baum and Feldman (working at the strategic level in Chapter 3) identify geographic clusters empirically based on the relative geographic locations of individual firms, permitting them to examine clustering effects over compact geographic areas. They were able to examine the impact of smaller distances than previous studies constrained by data available only for pre-defined administrative or statistical units, such as states or metropolitan areas, in order to re-examine evidence that spillovers and other agglomeration externalities are stronger in smaller geographic areas (Jaffe et al., 1993). Moreover, they claim that the impact of distance must be seen in light of how far the cluster shows specialization. This leads back to the idea of the configurational approach.

A fourth theme, related to the previous theme of distance, is the 'diversity of agents and behaviors' within the system. As with the case of distance, IT enables teams to be composed of members from different cultures and countries. Diversity fosters creativity but at the same time it may generate cultural clashes and miscommunication. This tension may be addressed, and IT has a role to play in moderating the impact of cultural diversity. As noted above, this is particularly relevant to the international context. Moreover, IT has a role in enabling the generativity needed for diverse and contingent behaviors (as in the configurational approach). Yoo et al. (2010), for example, show how new and generative IT-enabled architectures can promote innovation. The idea of diverse agents and behaviors leads back to the basic systemic law of requisite variety, which states that in order to control each possible state, one must have a corresponding variety of possible response states (Ashby, 1956). Diversity is thus a source of adaptability and flexibility, two qualities that are at the core of innovation. Our book deals mainly with cultural diversity and innovation. Furthermore, it does not examine the idea of divergent behaviors, although the discussion of configurational design alludes to it; there is more on this issue in the Conclusion.

Two specific chapters deal with the impact of diversity in ISD. Iván Alfaro in 'Helping Global Software Development Teams Overcome the Challenges

of Temporal Dispersion and National Diversity: The Importance of Leadership Roles' (Chapter 8) adds to distance the theme of cultural diversity. Working at an operational level in the international context, he introduces the need for leadership to overcome the challenges related to cultural and temporal distance by monitoring and coordinating global teamwork. He assesses the impact of temporal dispersion and national diversity on performance in global software-development teams. This work on ISD reaches similar conclusions to those of Péréa and Brion in their study of NPD (Chapter 9). Here they conclude that IT-enabled coordination is necessary to overcome distance, in order to achieve innovative performance.

Roman Beck in 'Looking for Trouble in Global ISD and NPD Outsourcing Projects' (Chapter 10) describes what happens when the organization outsources projects. Although many prior studies have dealt with culture, cultural differences and culture-related conflict on multiple levels (Beck et al., 2008; David et al., 2008), few have questioned the role of cultural differences in global IS sourcing businesses (e.g., Lings et al., 2006). Beck offers a more nuanced view, which challenges the sole focus on national cultural differences and the frequent occurrence of culture-induced conflict in global ISD. He claims that a globalized workforce is associated with a harmonization of professions and cultures that mitigates national cultural difference. For example, a programmer from India, the USA or Germany goes through the same training, standardization and certification processes. This creates common ground between professional and cultural perspectives, and it aligns behaviors.

Both chapters, by Alfaro and Beck (chapters 8 and 10), again are in favor of a configurational design (without using the word), and go beyond this to call attention to the dynamics of developing and using resources. Again, this is a lesson that could be expanded to other themes too, in line with the current applications of the systems approach that deal with the need for complex systems operating in dynamic environments to adapt and innovate. As noted above, in connection with configurational design, Senge (1990) in particular claims that the real leverage in most management situations lies in understanding the dynamic complexity, not so much the detailed complexity.

The final chapter of work in progress highlights the need to tie the operational-level outcomes of the various subsystems at different stages of NPD to the value that the system seeks to maximize. Vered Holzmann in 'Market, Technological and Process Management Knowledge in NPD Projects and the Value of New Products' (Chapter 11) offers a new conceptual framework for knowledge management in R&D and NPD projects. It is based on the assumption that the value of the new product is shaped by accumulated layers of knowledge that were created and supplemented throughout the development processes. Thus the chapter cuts across the themes of knowledge management and configurational design, and returns to the basic