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Microfoundations of innovative capabilities: The leverage of collaborative technologies on organizational learning and knowledge management in a multinational corporation

Dirk Schneckenberg, Yann Truong *, Hamid Mazloomi

ESC Rennes School of Business, 2 rue d'Arbrissel — CS 76522, 35000 Rennes Cedex, France

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ABSTRACT

Microfoundations of dynamic capabilities have become a central concept for strategy and innovation research. Yet, despite recent developments in information technologies which facilitate data flow and information management in firms, little is known about how organizational learning and knowledge management nurture microfoundations of innovative capabilities. Our case research addresses this gap by examining how the use of collaborative technologies in a globally leading industrial corporation leverages intra-firm processes of learning and knowledge sharing, fostering innovative capabilities. We combine top-down theorizing and evidence-based exploration to systematically trace microfoundations that undergird a firm's innovative capabilities. Drawing on multiple data sources, we categorize these microfoundations as organizational and managerial structures, systems, processes, and procedures. Our findings show that innovative capabilities result from specific interactions and interdependencies between microfoundations residing in the four categories. The complex and dynamic interplay of corporate knowledge sharing and organizational learning processes nurtures microfoundational sources of innovative capabilities and enables the firm to sustain a competitive advantage in rapidly changing environments. Our findings have important implications for the role of organizational learning and knowledge management in the dynamic capabilities framework.

1. Introduction

The nature of competition has changed rapidly during the last two decades as several driving forces transform the business world. These forces comprise the rise of the knowledge economy with its accentuation of scientifically grounded, high-level knowledge as a primary source for value creation (Kahin & Foray, 2006; Liu et al., 2007); the impact of globalization on diversification strategies of multinational corporations (Bartlett and Ghoshal, 1999; Dean and Kretschmer, 2007; Dunning, 2002; Grant, 1996b); the increasing speed of corporate innovation and accelerating product life-cycles (Ali et al., 2003; Huebner, 2005; Ittner and Larcker, 1997; Millson et al., 1992; Truong, 2013); and discontinuous customer preferences that drive technological transitions in industries (Akgün et al., 2005; Fredericks, 2005; Tripsas, 2008).

The combined impact of these driving forces is redefining innovation theory and practice. Innovation relies on the creation and combination of knowledge (Nonaka and Takeuchi, 1995). At the same time, the sources for corporate innovation have become more dependent on high-level scientific and technological knowledge, and these sources are geographically dispersed in globalized markets (Teece, 2000). Knowledge as a competitive asset is therefore particularly critical to sustaining firms' innovative performance (Grant, 1996a), as successful knowledge management and organizational learning practices result in more efficient corporate innovation performance and eventually leverage the success rate of new product and service offerings in markets.

Intra-firm knowledge transfer is essential for effective knowledge management, as it brings knowledge acquired by individuals, teams or business units to the level of the entire organization (Maurer et al., 2011; Tsai, 2001). Efficient knowledge sharing eventually reinforces the firm's absorptive capacity and drives organizational learning processes which allow the firm to adapt to changing competitive environments. As a consequence, firms should facilitate knowledge sharing among employees to improve their knowledge base. But transforming the top-management strategic vision of a knowledge-sharing culture to organization-wide reality in a large transnational firm is a challenging endeavor. Furthermore, the geographical dispersion of knowledge repertoires makes knowledge sharing and exchange within multinational firms even more difficult. The differentiation between knowledge management, organizational learning, and innovation processes at firm level is not clear-cut and presents many overlaps and interdependencies (Hedlund, 2007; Swan et al., 1999).

Even though recent advancements in information technologies and collaborative platforms have fostered organizational learning and corporate knowledge management practices, more research is needed to better understand how firm-level capabilities originate in lower-level

* Corresponding author.
E-mail addresses: dirk.schneckenberg@esc-rennes.fr (D. Schneckenberg), yann.truong@esc-rennes.fr (Y. Truong), hamid.mazloomi@esc-rennes.fr (H. Mazloomi).

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entities and processes (Argote et al., 2003; Lancioni and Chandran, 2009). This knowledge gap in the literature has led to an increasing interest in the microfoundations of organizational routines and dynamic capabilities. The microfoundations view aims to understand "… *specifically the origins, creation and development, reproduction and management of collective constructs such as routines and capabilities*" (Felin et al., 2012: 1351).

We address this gap and examine in our in-depth case analysis how collaborative technologies leverage organizational learning and knowledge sharing in the multinational corporation TechCorp[1] and contribute to the microfoundations of its innovative capabilities. The case of TechCorp is particularly compelling, as the firm needs to continuously nurture its innovative capabilities to provide competitive products and services in rapidly changing industry environments. TechCorp has around 350,000 employees and in 2014 earned more than €70 billion in revenues from operations in more than 190 regions, making it one of the largest industrial technology companies in the world. Knowledge management has been perceived at TechCorp as an integral innovation component for more than 15 years. Nevertheless, hierarchical structures and silo mentalities in business units and corporate divisions have constrained the firm's knowledge-sharing efforts. These barriers generate potential misfits between evolving business environments and more traditional innovation processes and threaten the firm's innovative capabilities. TechCorp's leadership has recently benchmarked its innovation processes and identified the weaknesses of its traditional knowledge-sharing practices. In consequence, TechCorp has decided to launch a technology-based knowledge management strategy that spurs organizational and managerial innovations and supports its corporate vision to become a company providing integrated technology solutions.

We combine top-down theorizing and evidence-based exploration in our case analysis. We interviewed managers from different business units and hierarchical positions and collected additional data to understand how TechCorp has implemented a technology-based strategy to foster corporate-wide knowledge sharing and learning processes. The technological solution of SharePlatform, with its community-based properties, has leveraged comprehensive knowledge management and organizational learning practices across corporate divisions and units, which in turn have nurtured TechCorp's innovative capabilities. This strategy has led to positive results for a number of key indicators of TechCorp's innovation performance. These indicators are more efficient identification of new product development opportunities, significant increase of innovation ideas that are brought to project status, faster decisions on new technology transfer and adoption, facilitation of cross-sector and cross-regional R&D processes, and faster time-to-market from ideas to product launches.

Our research contributes to a better understanding of the dynamic capabilities field by tracing, in a multinational firm, the microfoundations of innovative capabilities that originate in organizational learning processes and corporate knowledge management practices. We classify these microfoundations into four categories: organizational and managerial structures, systems, processes and procedures. Our study specifically advances understanding of lower-level components that constitute the sources of innovative firm capabilities, and we provide a fine-grained view of how these microfoundational sources influence higher-level firm behavior and performance.

The remainder of this paper is structured as follows. We first revisit the literature to identify elements in knowledge management and organizational learning that inform the emerging research agenda of microfoundations of dynamic capabilities. We then present the case study design and analyze the results along the aforementioned microfoundational categories. We search for patterns in the empirical data that fall into the areas of knowledge management and organizational learning, identify interdependencies that exist between them, and evaluate the extent to which they constitute microfoundations of TechCorp's innovative capabilities. We then integrate our main insights into a categorization system that specifies microfoundations originating in knowledge management and organizational learning activities, and we investigate interdependencies of these components when they converge into firm-level innovative capabilities. Finally, we specify theoretical and managerial implications of our study for its application in knowledge-based and high-tech industrial markets.

2. Theoretical framework

Managing knowledge in the organization is a main requirement for firms' innovative performance and resulting competitive advantage (Grant, 1996a; Teece, 2000). According to the knowledge-based view (Grant, 1996b, 1997), the main purpose of a firm is to coordinate and combine knowledge, and its capacity to perform these mechanisms determines organizational boundaries. Information technologies have evolved rapidly during the last decade and their collaborative properties have leveraged data exchange and knowledge sharing within and between organizations to unprecedented levels. The ways in which firms develop knowledge-management capabilities that they subsequently enact to use their knowledge assets represent a multifaceted research topic. Management scholars and practitioners state that the interdependency between knowledge management, organizational learning, and innovative firm performance remains a challenging issue that requires additional attention (Argote et al., 2003; Lancioni and Chandran, 2009).

While previous inquiries have touched upon some salient connections between knowledge sharing, organizational learning, and dynamic capabilities, to date no empirical study has identified and delineated how microfoundational sources undergird firms' innovative capabilities. Hence, we aim to understand how organizational learning activities and knowledge management projects interact and nurture microfoundations of innovation capabilities of a multinational firm. Consistent with this investigative purpose, we mobilize literature on organizational learning, knowledge management, and microfoundations of dynamic capabilities as baseline fields informing this research topic. These three theoretical stances, which have developed as independent but interconnected research streams, include the majority of findings about knowledge-based advantages of the firm (Vera et al., 2011). In our background section, to develop a coherent theoretical framework for microfoundations of innovative capabilities, we refer to all three theoretical stances, enabling us to analyze and interpret the data collected in our case research.

2.1. The process dimension of knowledge creation

Research on organizational learning considers that the cognitive and behavioral bases for knowledge creation, retention, and transfer change continuously (Argote, 2012; Crossan et al., 1999; Fiol and Lyles, 1985). According to the organizational learning view, knowledge resulting from individual learning is embedded and stored in several repositories. As individuals represent the primary knowledge repository in organizations, the main challenge is to leverage their knowledge to the organizational level (*e.g.*, Argote and Ingram, 2000; Crossan et al., 1999). Learning leads to changes and modifications in knowledge. This new knowledge is subsequently embedded into the organizational culture of firms (Starbuck, 1992) and social networks (Dean and Kretschmer, 2007), and it is stored in organizational processes and technologies (Argote and Ingram, 2000). Competitive advantage of firms thus relies essentially on the effective and efficient transfer of knowledge from one repository to another. This line of argument results in the central tenet of organizational learning scholars: knowledge transfer processes within organizations – and specifically within large firms – improve firms' innovative performance (Tsai and Ghoshal, 1998) and diminish the risk of competence substitution (McEvily et al., 2000).

[1] For confidentiality reasons, we disguised the real identify of the firm and its collaborative platform with pseudonyms.

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Studies on organizational learning and knowledge transfer have nonetheless identified constraints threatening the strategic advantage which firms gain from knowledge. For instance, stickiness of knowledge in one organizational unit makes its transfer to other units costly and difficult (Szulanski, 1996). Furthermore, embeddedness of knowledge in organizational relationships can impede the effective transfer of content knowledge or constrain its replication in different contexts (Nahapiet and Ghoshal, 1998). Simonin (1999) demonstrates that complex and tacit knowledge creates states of causal ambiguity, which then limit firms' intentions to learn about and replicate successful strategic actions. Schein (1993) has shown that the effectiveness of knowledge transfer within and between organizations is reduced by lack of prior learning in receiver units, as well as by lack of motivation to transfer knowledge on the part of the source or to receive knowledge on the part of the receiver.

Recent organizational learning studies have paid more attention to knowledge retention and show that organizations risk forgetting knowledge (Devadas Rao and Argote, 2006; Holan and Phillips, 2004), leading to further research as to how transaction processes can upgrade and renew individual and team memory (*e.g.*, Brandon and Hollingshead, 2004; Lewis and Herndon, 2011; Peltokorpi, 2008). Whereas research on organizational learning inquires how knowledge evolution proceeds over time, it has limited explanatory power to unravel conditions and contexts for efficient knowledge creation, sharing, and application. For the discussion of the main tenets underlying our theoretical framework, we therefore complement the organizational learning literature with insights from knowledge management — the second important research stream dealing with knowledge-based advantages of firms.

2.2. The content dimension of knowledge application

While knowledge management research is closely connected to the research stream examining the evolution and application of information technologies, its principal interest is to uncover and understand mechanisms for storing, retrieving, diffusing, and exchanging knowledge assets in organizations. Knowledge management research perceives knowledge primarily as a corporate resource and inquires into conditions and contexts for its efficient application. In comparison to organizational learning research, which investigates how knowledge changes and evolves in organizations, knowledge management research considers knowledge to be a firm asset originating in previous corporate projects and decisions. This knowledge should be stored and used at the right time and place (Vera et al., 2011). In addition to being easy to retrieve, knowledge assets need to be able to be coordinated and combined when they are applied in corporate projects and processes (Grant, 1996a). Consequently, knowledge management research has developed in a technology-oriented way and considers how to use different types of technological systems for storing, exchanging, and retrieving information and knowledge that originates from past activities of the organization.

In line with prior research (Hansen et al., 1999; Hayes, 2011), we distinguish integrative technologies and interactive technologies as two categories of knowledge management systems. Integrative solutions constitute structured and unified databases for storing information and facilitating its retrieval. The main strength of integrative platforms is their capacity to support corporate knowledge management strategies by making best practices and lessons learned visible throughout the organization. These knowledge assets are instantly available for further application in any unit or division of organizations. In contrast, interactive applications enable users to interact and network in knowledge management platforms regardless of their geographical location. By providing technological platforms for knowledge exchange and collaboration, interactive solutions mobilize organizational knowledge for corporate knowledge management strategies and increase the efficiency of its application in project teams and units.

The puzzle of how firms acquire and retain knowledge-based advantages has led to an important evolution in knowledge management research. In contrast to the process-based approach used to inquire how firms create, retain, and transfer knowledge, the content-oriented approach to knowledge management seeks to understand in which ways organizations manage, store, protect, and retrieve existing knowledge. Recent developments in the knowledge management field reveal the social embeddedness of knowledge and focus on the concept of communities of practice. Communities of practice are self-organizing groups of collaborators within and across organizational boundaries that form on the basis of their common interest in solving particular problems in their fields of expertise (Brown and Duguid, 1991; Dermott, 1999; Wenger and Snyder, 2000). Related knowledge management studies show that the evolution of information technology solutions can transform communities of practice into networks of practice in which individuals interact with others in the network who share similar interests despite geographic dispersion (Brown and Duguid, 2001; Schneckenberg, 2009).

Knowledge management research has made many practical contributions to the design and implementation of systems that store knowledge efficiently for reuse and application in future corporate projects. The organization-wide scope of knowledge management enables firms to formulate new business practices and managerial initiatives. However, the knowledge management lens focuses primarily on the content and nature of knowledge assets and related questions regarding technical mechanisms of knowledge sharing and integration. Knowledge management investigates tools for managing knowledge regardless of firms' strategic and organizational capabilities that have developed according to the dynamics of their internal cultures and the needs of their external environments.

This emphasis on aspects of information technology generates only limited insights into how organizations create, apply, and renew knowledge to develop and sustain knowledge-based competitive advantage. Consequently, knowledge management research is not well suited to explain *why* organizations with similar knowledge management platforms and strategies differ in terms of their knowledge-based outcomes. To address this shortcoming and to pursue the principal objective of our study, which is to gain a more comprehensive understanding of the origins of firm-level capabilities and performance, we therefore discuss the relevant literature covering microfoundations of dynamic capabilities.

2.3. Integrating knowledge creation and application for innovative capabilities

The dynamic capabilities lens provides our study with an adequate theoretical framework that combines the tenets we have specified in the organizational learning and knowledge management streams (Vera et al., 2011). The integrative framework of dynamic capabilities aims to explain how firms develop strategic routines and capabilities that enable them to flexibly respond to industry changes without losing competitive advantage (Protogerou et al., 2012). Teece et al. (1997) argue that the value of corporate resources changes over time as firms adapt to changes in the external environment. In consequence, firms need to develop and maintain capabilities that allow them to continually create, integrate, and reconfigure existing and new resources. According to this view, organizational learning is one cornerstone for improving and updating dynamic capabilities of firms. Recent studies specify knowledge management as another important component for firms to develop and sustain dynamic capabilities. Hodgkinson and Healey (2011) see the efficient firm-level use of knowledge management systems as an important condition to help managers recognize new market opportunities. Villar et al. (2014) identify interdependencies between dynamic capabilities and knowledge management of firms that improved their export performance in mature industries.

In this view, knowledge acquisition and transfer and profiting from external knowledge and innovation can be considered as activities

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supporting managerial decision making to sustain competitive advantage in rapidly changing external markets. For example, Zahra and George (2002) conceptualize absorptive capacity as a dynamic capability. One element that differentiates absorptive capacity from previous knowledge management and organizational learning concepts is the identification and evaluation of the potential value of external knowledge. The recent development of open innovation requires firms to have a better understanding of absorptive capacity (Lichtenthaler and Lichtenthaler, 2009). Teece (2007) refers to open innovation as a process that exposes firms not only to external knowledge and innovation but also to drivers of change. The dynamic capabilities approach thus integrates the process and content views as key sources for competitive advantage. The managerial and knowledge-based routines required for developing absorptive capacity have been discussed as a process element of this capability. Another example of the process elements of absorptive capacity is intra-firm knowledge transfer, which relates subunit-level to firm-level absorptive capacity (Tsai, 2001). While absorptive capacity is concerned with acquisition, assimilation, and application of external knowledge, existing organizational knowledge and its relation to external knowledge are important to the content element of dynamic capabilities (Cohen et al., 1997).

Closely following the social and behavioral research streams, Teece (2007) has developed a comprehensive framework for dynamic capabilities of firms. He theorizes sensing opportunities, seizing opportunities, and reconfiguring and combining competitive assets as three firm-level capacities that combine to form the dynamic capabilities of firms and enable them to sustain superior corporate performance in contexts of rapid innovation. The microfoundations of dynamic capabilities, which undergird the sensing, seizing, and reconfiguring capacities of firms, reside in organizational and managerial structures, systems, processes, and procedures. To result in a sustainable competitive advantage, the firm-level microfoundations of dynamic capabilities need to be difficult to develop and deploy, so that competitors cannot easily acquire and copy them. For this differentiating aspect of the firm's competitiveness, Teece (2007) specifies the essential role of organizational learning and knowledge management processes to continuously nurture and advance the microfoundations of dynamic capabilities at all corporate levels.

Sensing strategic opportunities involves numerous learning processes for decision makers to be able to discover, analyze, and evaluate new technological and environmental developments (Helfat and Peteraf, 2014). Seizing strategic opportunities requires important managerial decisions on resource allocation and business model configurations that need to be informed by learning and knowledge-sharing efforts of the involved business units. Once firms decide to seize market opportunities, dynamic changes in the external environment require reconfiguring and transforming managerial procedures by which strategic assets have been organized. Knowledge management systems facilitate reconfiguration of firms' capacities by providing decision makers with coherent information for corporate knowledge assets. Organizational learning processes and knowledge management strategies thus constitute important input factors for developing and sustaining the microfoundations of dynamic capabilities, which undergird firms' sensing, seizing, and reconfiguring capacities.

Summing up, from the main tenets in the literature we assume that firms using the dynamic capabilities approach have to integrate organizational learning (as the process dimension of knowledge) and knowledge management (as the content dimension of knowledge) as key resources for their innovative capabilities and subsequent creation of competitive advantage. Previous work on dynamic capabilities has studied the influence of organizational knowledge as existing resource to explain competitive advantage in stable or moderately dynamic markets (Amit and Schoemaker, 1993; Helfat and Lieberman, 2002; Prahalad and Hamel, 1990). But innovative capabilities of firms in fast-moving markets rely more on creating and sharing higher-level contextual knowledge than on reusing existing knowledge. This focus on contextual knowledge is essential for innovative performance, as firms at fast-moving markets require a continuous evolution of dynamic capabilities (Eisenhardt and Graebner, 2007). Our work follows this perspective and aims to clarify how a multinational industrial firm relies on organizational learning processes and corporate knowledge management projects to systematically nurture and deploy the microfoundations of its innovative capabilities in highly dynamic environments.

3. Methodology

Drawing on the dynamic capabilities framework, we combined top-down theorizing (Lee et al., 1999; Shepherd and Sutcliffe, 2011) and inductive theory building and elaboration (Eisenhardt, 1989; Ridder et al., 2014) from rich data in our analysis. This combination enabled us to rely on the dynamic capabilities literature to establish the categorization scheme, which we then applied to analyze the case evidence for the relevant theoretical concepts. To delineate how organizational learning and knowledge management nurture microfoundations of innovative capabilities, our analysis included categories and relationships among categories of organizational structures, systems, processes, and procedures. We additionally investigated the deployment of collaborative technologies by which TechCorp leveraged its innovative capabilities.

3.1. Case selection and data sources

We selected TechCorp as the single firm for the case for two reasons. First, TechCorp is one of the world's largest industrial firms. Outstanding innovation performance makes TechCorp an exemplar multinational firm that has been particularly successful for several decades in sustaining its leadership position in dynamic industry environments. While TechCorp is usually not accessible to external researchers, senior management provided us with this opportunity to carry out our research on its innovative capabilities. Second, TechCorp needs to continuously develop and nurture its innovative capabilities to sustain its performance and leadership position. TechCorp has taken a great variety of actions to undergird its innovative capabilities with organizational learning processes and knowledge management projects, which make it a unique and rich case for elaborating the emergent microfoundations theory (Eisenhardt and Graebner, 2007; Yin, 2003).

We drew on multiple data sources for this case study. Starting in September 2009, we conducted a total of 28 semi-structured interviews with middle and senior managers. The interviews took place face-to-face and *via* VoIP and lasted between 45 and 90 min. We asked open-ended questions that focused on the role of organizational learning processes and knowledge-sharing interactions in the daily work of respondents and their respective teams and units. We recorded and transcribed all interviews and asked the interviewees to provide us with additional material documenting innovation projects and processes in their units. Our respondent sample contained employees working in corporate innovation projects. By verifying respondents' work responsibilities and competences before the interviews, we ensured that respondents had the necessary knowledge and experience to answer questions related to our study. To capture diverse views on the phenomenon under study, we included a range of respondents from different hierarchical and functional levels of the firm. Our sample therefore contained respondents who work in a variety of functions, such as research and development, technology portfolio management, mechanical engineering, quality control, open innovation management, business services, key account management, information technology solutions and services, usability design, and business development. The variety of respondent backgrounds and perspectives helped to reduce bias and ensure that the interview sample contained a representative social distribution of perceptions on microfoundations of innovative capabilities (Eisenhardt and Graebner, 2007; Myers and Newman, 2007).

We were able to add a rich collection of complementary case evidence to the interview data. Additional data sources included reports

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and position papers describing organizational learning and knowledge management projects of TechCorp, internal research investigating the creation and roll-out of new innovation projects, and conference presentations as well as project documentation related to the innovation activities of the central R&D department at TechCorp headquarters. We particularly profited from extensive access to the project documentation and the knowledge repositories of SharePlatform, TechCorp's collaborative platform that was launched in 2009 and principally serves to facilitate innovative project work. We were able to access stored documentation for learning processes and knowledge-sharing practices of SharePlatform users for this study. Table 1 summarizes the sources of evidence used for our analysis.

To increase the scope, depth, and consistency of the findings regarding microfoundations of innovative capabilities, we carried out a triangulation of data sources in our analysis (Denzin, 1989). Data triangulation serves as a corroborative strategy to collect and analyze information from multiple sources to more strongly support interpretations of a specific phenomenon (Yin, 2003). The analysis of multiple sources helps create a convergence of evidence to establish a common and more reliable ground for a concise understanding of the observed phenomenon. Data triangulation also strengthens the reliability and validity of case study findings (Patton, 2001). The triangulation of the collected data helps to determine how strategic objectives of the innovation strategy and the deployment of SharePlatform have started to bring workforce behaviors and corporate realities at TechCorp closer to the desired knowledge networking practices.

3.2. Data analysis

Since we were interested in tracing and sorting microfoundations in the case data, we present the results with reference to Teece's (2007) categorization of microfoundations of dynamic capabilities. As noted previously, organizational and managerial structures, systems, processes, and procedures are four essential categories that separate the microfoundations of dynamic capabilities from the capability itself. We adopted this categorization scheme because it remains to date the most comprehensive approach in the literature for gaining evidence-based insights into microfoundations of dynamic capabilities.

We used the four categories in our content analysis to identify microfoundations of TechCorp's innovative capabilities, which originate in and relate to organizational learning processes and knowledge management projects. The '*structures*' category contained microfoundations of innovative capabilities that are parts of organizational entities, such as strategic frameworks for innovation, the role of R&D units, and the impact of formal management structures on knowledge sharing. The '*systems*' category captured microfoundations that connect knowledge sources and make them accessible to larger entities. In this category we focused particularly on SharePlatform as an IT-based system for knowledge sharing. The '*processes*' category contained microfoundations that embody a series of actions or steps to achieve innovative capabilities, such as formal and informal learning and knowledge sharing in teams and networks. Finally, the '*procedures*' category encompassed microfoundations that represent formal ways of enacting knowledge-sharing behaviors, such as incentive systems for and benchmarking of innovation, ideation contests, and explicit management decision routines to staff vacant team positions with the most knowledgeable employees available.

Table 1
Sources of evidence.

Source of evidence	Description of source
Interviews	Semi-structured interviews with 28 senior managers from different hierarchical levels of the firm. Respondents work in a variety of functions ranging from research and development to IT solutions and services.
Strategy records	Documents covering strategic and operational aspects for TechCorp's organizational-learning processes, knowledge-management projects and corporate innovation strategy.
Project documentation	A wide range of evidence documenting the development, piloting, and roll-out of the SharePlatform project, as well as minutes of use-case workshops.
SharePlatform archives	Evidence for learning processes, knowledge-sharing practices and complementary interaction patterns of SharePlatform users.

At the same time, the very nature of the microfoundations creates challenges when this categorization scheme is applied for analysis. The basis for sorting the microfoundations into the four categories remains ambiguous, as otherwise the sustainable competitive advantage of firms could be easily identified and copied and would hence rapidly vanish (Teece, 2007: 1321). For example, for particular aspects of the innovation strategy it is difficult to decide whether they belong more to the *structure* or to the *process* category of microfoundations. In a similar way, certain properties of SharePlatform lie somewhere between the (knowledge sharing) *system* and (organizational learning) *process* categories. To counter this potential analytic bias and ensure a dependable level of inter-coder reliability and consistency in the categorization of the data, in our content analysis we coded samples of the material in parallel. We then compared and discussed the respective differences and consistencies for the categorization results in our team. The multiple coding clarified the initial vagueness during the analysis and iteratively comparing our sorting in the coding process helped to ensure that we had sorted the evidence to the appropriate microfoundation categories.

As in our top-down theorizing process we deduced the categorization scheme for microfoundations of innovative capabilities from the framework of dynamic capabilities, and we subsequently applied a thematic analysis to the case data (Flick, 2014). In a first step, we applied open coding to independently analyze and interpret each collected piece of evidence. We coded the interview transcripts for the main topics falling into the thematic domain of microfoundations. The following interview statement illustrates the process:

> The collaborative properties and open communication channels of SharePlatform foster the creation of communities of interest, in which initial innovation ideas and reflections can be developed collectively. [Senior Manager Information Technology Solutions and Services, October 2010]

In the open coding procedure, we applied the terms 'collaborative properties,' 'open communication,' 'communities of practice,' and 'collective innovation development' to this specific interview statement. We likewise coded the archival records to identify organizational learning and knowledge management topics that we could meaningfully relate to microfoundations of innovative capabilities of the firm. In a second step, we sorted the identified themes into the categorization scheme. For example, we categorized the above interview excerpt as a microfoundation residing in organizational *systems*, as the respondent perceives SharePlatform as the main source for leveraging community-based communication and innovation development in the firm.

Our detailed inquiry resulted in a fine-grained elaboration and a clearer delineation of complex, interdependent entities and practices undergirding microfoundations of innovative capabilities. By exploring particular nuances of microfoundations in the case data, we enrich the general understanding of what these theoretical concepts represent in the reality of large firms competing in dynamic industry contexts. This analytic logic of case research that engages in a deep investigation of social entities and practices is called heuristic generalization (Tsoukas, 2009). Research pursuing heuristic generalization addresses the question of 'what is happening here?' by exploring particular nuances of concepts as they manifest in organizational reality (Greenhalgh et al., 2011). In this sense, our case findings sharpen the theoretical

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view of microfoundations by disentangling the concept's inherent complexities and by providing a reference point for further research and application in corporate practice.

4. Results and discussion

Our findings show that organizational learning and knowledge management influenced the microfoundations of innovative capabilities, but in a more complex and dynamic interplay than previous research has described. We present below the microfoundations residing in each category and subsequently discuss the relevance of our study for theory relating to microfoundations of dynamic capabilities.

4.1. Microfoundations originating in organizational and managerial structures

> Cross-departmental collaboration with colleagues is of paramount importance for the firm. We need to have the opportunity to see in all business units which kind of knowledge and know-how is available, in the very sense of the well-known aphorism: If this firm only knew what it really knows. [Project Leader IT Solutions and Services, June 2011]

This interview quote illustrates the importance of knowledge as a resource and competitive asset for TechCorp's innovation strategy. The firm aspires to become an integrated technology company, and its strategy focuses on innovation-driven growth markets, using and developing expert knowledge of people within the firm, and getting closer to customers. These three strategic objectives require TechCorp to be able to continuously innovate by fostering organizational learning and creating technology-based synergies among its four main industry sectors. For example, the portfolio policy of TechCorp asks all business units to be pioneers and hold the first or second competitive position in their respective industries. In 2014, TechCorp invested more than €4 billion in its combined R&D, and the corporate R&D department disposed of almost €1 billion of company-owned venture capital. In terms of innovative performance indicators, TechCorp filed more than 4200 patents in 2014 and specifically aims to increase patent creation in trendsetting technologies. Since 2011, TechCorp's total output placed the firm in the first position in the EU patent ranking.

The main mission of the central R&D department is to leverage knowledge about technological solutions and to spread process know-how across TechCorp's sectors. Although the firm's headquarters are located in Europe, the network structure comprises 30,000 employees who work in more than 160 R&D locations worldwide. The network structure and geographic dispersion of the central R&D ensure a high diversity of its workforce and constitute important structural microfoundations of TechCorp's innovation capabilities. The central R&D department manages a portfolio of around 50 technology fields and develops collaborations with external research institutions worldwide, adding up to more than 1000 R&D partnerships with universities, research centers, and industrial partners. The following interview quote describes this collaborative function of the central R&D department:

> We are located in the unit of technological strategies, and our main task is to coordinate the research collaboration of internal innovation projects with universities and research centers. If employees envisage collaborating with external university researchers, they should directly contact our unit to profit from our coordination expertise. [Research Project Manager, September 2010]

The central R&D department also creates and manages interdisciplinary research clusters, which pool the expertise of top researchers for key innovation projects of TechCorp. Finally, the central R&D department handles the registration and exploitation of intellectual property rights and innovation value chains. Through the combination of these tasks, the central R&D department adopts the role of a knowledge broker inside the firm. The abstraction of complex technology-based knowledge and its transfer and recombination across innovation projects is at the core of work routines in the unit.

One example from the industry sector illustrates the complexity of product innovation and the importance of the central R&D department to transfer and recombine knowledge across scientific domains and organizational boundaries. TechCorp offers the leading solution for gas-turbine engineering to provide energy in industry and infrastructure plants. This leading position is grounded in the systematic creation, recombination, and exploitation of scientific knowledge spanning areas as diverse as aerodynamics, coating, combustion, probabilistic design, and sensor technologies. The knowledge and expertise reside in a complex network of more than 50 university research centers connected to this project. In addition, TechCorp's innovation managers leverage knowledge from its network of suppliers and customers. The complexity of these processes requires a high level of knowledge-brokering capability to make efficient use of knowledge as resource in innovation clusters.

Most innovation projects at TechCorp depend on cross-sectional and cross-divisional knowledge transfer processes. Organizational learning and knowledge sharing across divisional boundaries leverage the impact of corporate technologies for innovation and business model development. The structural configuration of innovation projects reflects this cross-divisional learning and knowledge transfer by establishing cross-functional R&D units and networked modes of work organization. Modular team configurations in R&D projects serve as breeding grounds for innovation and encompass such diverse partners as universities, research institutes, key customers, competitors, start-ups and venture capitalists, privately and publicly funded think tanks, and governmental partners. Modular team structures in the central R&D department recombine heterogeneous expertise, facilitate the use of integrative technologies, and facilitate R&D inventions in innovation projects. In this way, TechCorp adapts the structure of work organization to the function of complex learning and knowledge transfer processes to ensure continuous innovative capabilities in its key sectors.

The establishment of technology transfer units to generate knowledge inflows and outflows is another structural feature underlying TechCorp's innovative capabilities. As part of its open innovation strategy, TechCorp has created two technology transfer units to ensure knowledge transactions beyond organizational boundaries. The units are located in the US and China to pull external market knowledge and cutting-edge technologies into the firm. TechCorp has also established an incubator in Europe to monetize internal knowledge and technologies through spin-offs, licensing, and joint ventures in external products and services. In terms of knowledge transfer performance, during 2010 the two units processed 29 spin-ins and nine start-ups for the knowledge inflow dimension. For the same year, the knowledge outflow dimension recorded eight spin-offs and 29 licensing agreements. Besides monetizing technological capabilities through knowledge inflows and outflows, the technology transfer units promote a culture of innovation and intrapreneurship within TechCorp.

Next to the central R&D department and the dedicated open innovation centers, the business service units in TechCorp's four industry sectors have an important role in transferring knowledge about emergent market needs into the firm. One example is the industry sector in which TechCorp provides customer-centric solutions on common technology platforms. Service experts in this ecosystem acquire a high level of in-depth knowledge of customers' business challenges. This contextual knowledge about value perceptions of key customers is a valuable resource for nurturing organizational learning and results in the reconfiguration of existing business models and the development of the next generation of technologies. The service experts receive incentives to share their insights through technology-based networking and corporate conferences in corporate knowledge repositories. These documented

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Table 2
Microfoundations of innovative capabilities originating in 'structures'.

Microfoundation source	Microfoundation property	Microfoundation function
Central R&D department	Worldwide R&D locations Large technology portfolio Interdisciplinary research clusters	Knowledge brokering through creation, recombination and exploitation
Configuration of innovation projects	Cross-sectional/cross-divisional teams Diversity of research partners Networked work organization	Knowledge spanning beyond structural and disciplinary boundaries
Technology transfer units	Spin-ins of external lead technologies Spin-offs, licensing and joint ventures of internal technologies	Knowledge inflows and outflows
Business service unit	Deep insights about customer needs and emerging business models	Business-oriented market knowledge transfer
Communities of practice	Informal organizational learning spaces Peer-driven shared interests	Focused tacit and explicit knowledge creation for emerging innovation topics Improving absorptive capacity

knowledge assets are then proliferated in formal and collaborative channels. The resulting knowledge inflow fosters TechCorp's innovation capabilities and ensures that new product and service development projects meet emerging customer needs.

A final element in the *structure* category is the impact of formal management structures on knowledge sharing, which in turn influences TechCorp's innovative capabilities. While the leadership management understands and supports the need for strategic innovation, TechCorp – like many other large corporations – faces the problem of internal silos, as the following interview quote illustrates:

> One of the main challenges in the traditional corporate structure was the strong position of independent business units, which created a real silo mentality in the firm. We needed to address this challenge for the sake of corporate knowledge sharing and innovation efforts. [Senior Innovation Project Manager, May 2010]

The growth and internationalization of TechCorp has led to a structural differentiation into various hierarchical levels, business sectors, departments, and operational units. This fragmentation of the workforce creates difficulties in establishing communication channels that enable mutual learning and knowledge sharing across silo boundaries. TechCorp's hierarchical structure and bureaucratic work organization result in a substantial influence of middle management on innovation decisions. As many middle managers tend to focus on tightly defined business tasks and the efficient management of day-to-day operational processes, team members may lack the time and energy for developing creative and innovative ideas. In other words, the operational mindset of middle managers threatens the exploration of ideas for future innovation that would exploit current work routines and algorithms.

To counter the threat that size and bureaucracy may stifle its innovation capabilities, TechCorp began to nurture communities of practice in the early 2000s. Communities of practice aim to connect employees across formal silo boundaries, to identify shared learning interests, and to define knowledge needs for emerging innovation topics. To date, TechCorp counts around 1600 corporate communities of practice with more than 100,000 members total. TechCorp's knowledge management unit promotes two kinds of communities of practice. Role-based communities are sponsored by business units and focus on common learning interests that extend the formal work objectives of the unit's members with closely related knowledge sharing. For example, technology experts of TechCorp rely on role-based communities of practice to improve their forecasting capabilities for emerging technological trends in markets.

While senior management influences objectives in role-based communities of practice, peer-based communities of practice provide free access for all employees who wish to join, as long as they share common learning interests for the respective topic. Community members have equal status. Peer-based communities are not endorsed by specific business units and attract members across departmental and divisional boundaries. Formal reporting lines do not exist, and interests in emerging innovation topics drive community creation and participation.

The learning and knowledge sharing taking place in communities of practice is captured in different formats. While much of the tacit knowledge stays within each community, explicit knowledge ranging from formal reports to unstructured discussion streams is made accessible *via* the corporate SharePlatform to TechCorp's workforce. Table 2 summarizes the main microfoundations of TechCorp's innovative capabilities residing in the *structure* category.

4.2. Microfoundations originating in organizational and managerial systems

In 2007, TechCorp created a knowledge management unit within the central R&D department to enhance learning and knowledge sharing in corporate innovation projects. The team consisted principally of experts from knowledge management and information technologies. The unit piloted SharePlatform in 2008 as a collaborative platform for TechCorp's workforce. The main purpose of SharePlatform is to foster learning and knowledge sharing throughout TechCorp's corporate environment and thereby leverage innovation capabilities of the firm. We differentiate the role of SharePlatform into two principal functions. Its collaborative component fosters implicit knowledge sharing in expert networks, and its search component provides access to an integrated repository of explicit knowledge. We detail below how the systemic properties of SharePlatform foster implicit and explicit knowledge sharing.

The knowledge-sharing components of SharePlatform integrate a portfolio of collaborative social media tools, such as wikis, blogs, microblogging tags and RSS feeds, to capture and generate implicit knowledge of domain experts. SharePlatform hosted in late 2011 more than 15,000 members from TechCorp's four business sectors and the central R&D department. While most of its current users work in innovation projects, access to SharePlatform is by default open to all employees of the firm. The project team identifies needs-driven use in additional business units to roll out the platform across the firm's divisions.

The number of networks within SharePlatform generating cross-sector knowledge sharing is growing exponentially. In 2012, SharePlatform hosted more than 290 networks connecting employees from industry and energy sectors and more than 180 networks for employees from the industry and health sectors of the firm. Beyond purely sector-based networks, the system hosts around 120 integrative networks connecting employees from all four sectors and the central R&D department to collaborate on emerging innovation topics. The network clusters in SharePlatform combine diverse knowledge assets from TechCorp's business units and provide a highly diversified place for mutual learning experiences of employees, as the following interview quote demonstrates:

> Another opportunity is to connect to partner networks and to extend the limited perspectives of your own community. This provides members with the opportunity to develop connections to related themes … Colleagues joining network clusters experience definitely

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positive things. We connect and exchange our ideas and experience, contributing this way to the value-added of the firm by the respective domain expertise of all members. All this leads to a real value-added for the firm. [Senior Manager Technology Outsourcing, September 2011]

With these learning and knowledge-sharing effects, the network clusters contribute substantially to the innovative capabilities of the firm.

Network topics often originate in established communities of practice. For example, the distributed projects network was created in 2003, and the corporate knowledge management network dates back to 2000. Network topics cover different aspects of innovation. Some networks focus on managing innovation, covering topics like managing complexity and open innovation. Other networks look into the technology-driven invention phase of innovation, covering topics like IT-related innovation ideas or telecommunication research. Emerging technology scouting is covered by topics like cloud computing and model-driven architecture. Several networks address the business model side of innovation.

In summary, SharePlatform's networks capture and nurture a rich variety of expert knowledge that all platform members can access. Furthermore, networks interconnect in activity streams that bridge individual network communities. The information architecture of SharePlatform creates corporate-wide network clusters in which people learn and share knowledge on strategic innovation topics.

The search component of SharePlatform applies semantic content analysis to provide access to the knowledge repositories of the networks. Semantic algorithms enable personalized search functions to find experts and contents, and an intelligent recommendation system aggregates meta-information in network activity streams to propose relevant topics to members in similar networks. Search queries are not restricted to SharePlatform, but cover the wider corporate information system of the firm. The integrated search solution comprises TechCorp's document management system, specific knowledge repositories, all social software contents, and the public intranet of the firm. Search findings combine access to explicit knowledge that is documented in repositories with links to profiles of respective topic experts. For example, more than 30 explicit knowledge repositories are linked to expert profiles from the innovation management and central R&D departments. In this way, the search interface of SharePlatform provides integrated access to explicit knowledge repositories and tacit knowledge holders.

One of the best uses of SharePlatform is a function signaling the need for urgent support, which is the capacity of the system to rapidly connect knowledge seekers and knowledge holders for joint problem-solving. The signaling function provides network members with help in situations where they urgently need to obtain specific knowledge to master challenging work tasks under time pressure. The signaling function of SharePlatform allows users to send questions *via* a microblogging channel to specific networks whose members are likely to have the required knowledge. The average response time for the signaling function has been within 24 h, and many users have highlighted the usefulness and value of the knowledge they have obtained through direct contact with topic experts. The following statement reflects this added value of the signaling function:

> The ability to send out requests for support to such a wide variety of corporate experts in the network communities is a real killer application within the platform. We have experienced return times that are really fast, as people have a natural tendency to try to help out in these situations. Everybody has in the end already gone through a similar thing of being in real need of some knowledge to respond in a competent manner to customer needs. [Vice-President Information Technologies Unit, October 2011]

The ongoing evaluation of the impact of SharePlatform on corporate learning and knowledge sharing is positive. User feedback and system performance measures so far indicate positive effects of the system for collaborative project work and corporate innovation processes. Examples of these innovation processes include a better identification of innovation opportunities through clear emergence of priority trends in the network cluster; a better visibility and faster deployment of new corporate technologies, with considerable time-span reduction for adoption processes across divisions; a significant performance increase and cost reduction in distributed project processes through the signaling function; and an increase of the reuse rate of existing knowledge repositories. Innovation-specific platform effects comprise the facilitation of cross-sector and cross-regional innovation project work and the positive support of the system for creating an internal innovation culture. Through its combined collaboration and semantic search properties, SharePlatform provides a platform that facilitates sharing of tacit knowledge and leverages access to explicit knowledge. The technological platform constitutes an important source for the systematic development and sustainment of TechCorp's innovation capabilities. Table 3 summarizes the main microfoundations of TechCorp's innovative capabilities residing in the *system* category.

4.3. Microfoundations originating in organizational and managerial processes

According to the director of TechCorp's central R&D CT department, research and innovation function as a coupled process. While corporate research transforms capital investments originating in reinvestments of firm profits into new, scientifically grounded knowledge assets, corporate innovation transforms these new assets into monetizable products and services. New product and service developments in turn generate additional firm profits. Creation and exploitation of knowledge assets depend on each other. Corporate research is therefore a necessary but insufficient condition for innovation. It is necessary, because it creates new knowledge assets as input factors into innovation. It is insufficient, because the new knowledge assets are usually technological and do not result from the logic of economic value creation. The efficiency of corporate R&D to create new economic value depends on its capability to create feasible business models that complement technological innovation. This dynamic of the coupled process highlights the importance of combining knowledge from different domains as sources of innovative

Table 3
Microfoundations of innovative capabilities originating in 'systems'.

Microfoundation source	Microfoundation property	Microfoundation function
SharePlatform as a knowledge management platform	Combining collaborative and search component into integrative IT platform	Leveraging internal knowledge flows Supporting intra-firm knowledge networking
SharePlatform expert networks	Multi-channel communication Collaboration with social software	Distributed tacit knowledge creation and sharing
SharePlatform network cluster	Interconnection of network conversations Bridging disciplinary boundaries	Capturing variety of knowledge sources Fostering complementary innovation
SharePlatform semantic search	Integrated search solution Intelligent recommendation system	Access to explicit knowledge repositories Linkages to tacit knowledge holders
Signaling functionality	Using microblogging to get instant help on complex problem	Rapid connection of knowledge seekers and knowledge holders

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capabilities of the firm. To sustain its innovative performance, TechCorp must be able to create both technologically feasible and economically viable innovation solutions that meet emerging market needs.

TechCorp invests systematically in organizational learning processes that aim to deeply understand emerging customer needs and market trends in the firm's main industry sectors. The expertise of key account managers is a valuable microfoundational source to capture changing customer demands and to identify emerging innovation opportunities. Key account managers work closely with the central R&D department to provide feedback on existing solutions and to suggest improvements based on their daily communication with customers of the firm. These business-driven processes of discovering and understanding emergent customer needs initiate new product and service development, which follows a three-stage process of invention, project development within the firm, and product implementation in markets.

The perception of customer needs is particularly important in the invention phase, as technology innovations *per se* do not provide any added value for business applications. Therefore, the central R&D department actively involves key customers in the early phase of innovation to co-create ideas for potential new product development in joint creativity workshops. Once customer perspectives are well understood, the innovation process enters the stage of idea selection. Along with existing knowledge resources and benchmarking of competition, value creation for customers is one of the three evaluation criteria for deciding whether innovation projects move from the invention to the project implementation phase. The importance TechCorp gives to the discovery and understanding of emergent customer needs demonstrates the awareness that this learning process constitutes a key source of its innovation capabilities.

TechCorp has developed a wide range of continuous education programs to increase its employees' expertise through formal learning processes. Continuous education received a budget of more than €250 million in 2011 and formal learning curricula cover topics such as managing in international markets, delivering graduate certificates to attract top talent from universities, and gaining directly applicable practical knowledge. Core learning programs comprise functional and cross-functional training measures. To ensure group diversity and create synergies across organizational units, management seminars are by default cross-sectorial and international. Finally, the continuous education unit runs a leadership program that supplements the classroom-based transfer of leadership knowledge with the systematic job rotation of participants into at least two functional areas and two different countries coupled with an intense personal mentoring process and access to the alumni network.

While formal learning primarily aims to efficiently transfer subject matter knowledge to participants, we identified some interesting features in TechCorp's continuous education programs that relate formal knowledge acquisition to innovative capabilities of the firm. A common theme in the curricula of the educational programs is preparation for risk-taking and the uncertainty dimensions of innovation processes. Management-related programs and technology-oriented programs both specify intended learning outcomes of open-mindedness, curiosity, and global networking capacities. Systematic job rotation in the leadership program enables learners to perceive business problems from various angles and to deal with diversity, as this interview quote documents:

> I'm in a rotational program so now I work in a completely different area, a completely different job. My task right now is to rotate through the company for one year to understand where I want to go and how things work in different units. [Program Manager Sales and Marketing Development, February 2010]

The mentoring scheme fosters an intense sharing of tacit knowledge with experienced senior managers. Furthermore, the ability to effectively document and share knowledge with colleagues worldwide is a transversal learning objective at the core of a knowledge management module that is a foundational part of all education programs. TechCorp also organizes seminars and guest lectures on management topics that address the creation of a corporate culture that fosters open-mindedness and mutual support. These features fit well with the challenging job requirements in TechCorp's innovation projects and contribute at the individual employee level to the development of innovative capabilities of the firm.

Work organization in innovation projects occurs mostly at the group level. Project teams define targets and specify resource requirements. Next to formal learning processes taking place in projects, knowledge-sharing interactions of team members often reach beyond the work group to expert communities, for example to access complementary knowledge inflows or to evaluate the potential value of innovative technologies for the project context. In these recurrent processes of pulling expertise into innovation projects, peer-based communities of practice within TechCorp provide the advantage of fostering informal knowledge sharing, as agendas are open and arise from the learning interests of community members. The peer status empowers community members to freely express innovation ideas without the fear of negative consequences, such as sanctioning people for proposing alternative schemes for resource allocation and work organization that implicitly criticize established hierarchies and routines. In this way, communities of practice serve as important levers to nurture knowledge-sharing processes in corporate innovation projects.

While learning and knowledge sharing take place in community conversations, the quality of conversations depends on cognitive and attitudinal prerequisites of community members. Open-mindedness on the cognitive level and trust on the attitudinal level are two examples of prerequisites, as the following interview quote states:

> I think that this cultural dimension is really important for the future success of the firm. I mean that we have to develop a real community which allows us to think about and discuss contrasting perspectives in a respectful way. [Senior Manager Information Technology Solutions and Services, October 2010]

While personal contacts between people help to create trust, they are not always feasible in large firms like TechCorp. The technological functions of SharePlatform address this problem. The capacity to display and interlink the domain expertise of employees constitutes a key strength of the platform, and the design of SharePlatform facilitates the creation of user connections. Through information processing activities, users establish and continuously update profiles of their knowledge domains and interests. For example, users create entries in the wikisphere and blogosphere of communities of practice. They publish content in the news areas, tag relevant information in their fields of interest, and join and participate in specialized networks. This dynamic representation of expertise creates a rich source of information for employee profiles and increases the visibility of tacit knowledge domains within the firm. The visibility of expertise in communities and the flow of personal knowledge in networks help employees take a first step toward knowledge sharing across physical locations and divisional boundaries. Interactions taking place in communities of practice and in SharePlatform thus support the development of important cognitive and attitudinal prerequisites for innovative capabilities that reside in individual team members.

With the rapid evolution of the internet, the generation of information is growing at exponential speed. Employees' resulting information overload has been identified as a real challenge that threatens to stifle TechCorp's innovation capabilities. The total amount of information relating to TechCorp's key markets doubles approximately every four years, creating strong barriers to forecasting emerging innovation trends in the massive amounts of data. While TechCorp invests in semantic technologies, it also relies on human expertise in its wide range of networks to filter out relevant innovation trends. As an

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example, the central R&D department relies on information-processing skills of people in SharePlatform to identify new innovation trends. As SharePlatform is designed to be a decentralized system, the extended use and referencing in the platform conversation lead over time to the emergence and clustering of topics that users perceive as strategically important for the firm. Relevant information streams aggregate like centers of gravity around key innovation topics within TechCorp's ecosystem. This synergy between signaling functions of SharePlatform and opportunity-sensing capacities of the networked collective workforce intelligence results in trend-scouting processes for emerging innovation topics that complement computer-based analytics of data streams and accelerate the recognition of innovation opportunities in the markets. Table 4 summarizes the main microfoundations for TechCorp's innovative capability in the *process* category.

4.4. Microfoundations originating in organizational and managerial procedures

TechCorp has established a range of organizational and managerial *procedures* to ensure that decisions and work processes are in line with its innovation strategy. In particular, to foster emergent innovation opportunities, the central R&D department has developed a corporate evaluation framework that applies a systematic four-stage evaluation process. The first stage consists of identifying major innovation topics and preselecting innovation opportunities that fit TechCorp's knowledge base and technological capacities. The second stage elaborates detailed action plans and business models to evaluate the feasibility and profitability of preselected innovation opportunities. The third stage then selects the most promising innovation opportunities and specifies project ownership and resource needs. The final stage engages top-level management to discuss the fit of selected innovation opportunities to the corporate innovation strategy. The Chief Executive Officer, Chief Financial Officer and Chief Innovation Officer make the final decision to pursue or abandon innovation opportunities and to launch and allocate project resources. The evaluation procedure has led to the funding of 10 major lighthouse projects, which develop groundbreaking technology solutions to open new business opportunities for TechCorp. The central R&D department implements and manages these key strategic innovation projects, which bundle a considerable part of TechCorp's innovation resources in a long-term perspective. The procedural steps of the evaluation framework mobilize a variety of high-level expertise to ensure that the purpose and developmental direction of selected lighthouse projects fit the innovative capabilities of the firm.

Benchmarking TechCorp's corporate innovation and identifying particular product requirements for emerging markets are two additional procedures that mitigate risks of managerial bias in decision-making. Innovation benchmarking uses a range of key indicators to monitor TechCorp's innovative capabilities and performance and its competitive position *vis a vis* its key rivals. Key indicators comprise the corporate R&D budget, the management of core innovation processes, the number of patents and standards, innovation incentives provided in the corporate culture, the qualification and capacity levels of the workforce, and the integration of innovation objectives into corporate strategy. The relevance of the indicators is weighted according to their contribution to TechCorp's corporate strength and their importance for sustaining the innovation capabilities of the firm. For example, strategy, workforce capacities and technology are weighted as the most important innovation criteria. Benchmarking results from 2010 indicated that TechCorp has a leadership position in technology and a strong position in workforce capacities, whereas it needs to improve the integration of innovation objectives into its corporate strategy.

The identification of particular product requirements is an evaluation scheme that is part of TechCorp's frugal innovation strategy to push new product development in emerging markets. New product development projects in frugal innovation need to meet the five criteria of simplicity, simple maintenance, affordability, reliability, and fast time-to-market. The evaluation scheme relies on contextual knowledge of emerging markets to adapt product performance requirements accordingly. Market specifics comprise challenging climatic conditions, such as dust or humidity, as well as buying power of consumers. The application evaluation scheme for frugal innovation helps TechCorp to adapt business models and technology in such a way that they respond to market conditions in developing countries.

As part of TechCorp's open innovation strategy, the central R&D department has developed ideation contests that rely on crowdsourcing methods and web-based collaboration platforms to pull external knowledge into the firm. The ideation contest was first launched in 2011 as a two-stage process. During the initial public phase everybody could submit, comment, and rate ideas, while in a second phase research units of universities were invited to submit new product development concepts, apply for co-funded PhD research, and compete for start-up funding schemes. From 448 submissions of ideas, a committee of experts selected four projects from the public phase and 10 projects from the university phase for funding. As the selected projects are currently in development, it is too early to objectively measure their business impact. Nevertheless, both the organizing team of TechCorp and expert reviewers reported a positive impression regarding the quality of the submitted proposals, as reflected by the following interview quote:

> We realized during the contest that we could profit from a lot of distributed expertise out there. Our topic raised immense interest and we are currently working through the concept proposals to see what we can really integrate. [Head of Electricity Infrastructure Solutions, October 2011]

As a side effect of the contests, a number of young researchers participating in the contest have been hired or retained by TechCorp's R&D unit for prospective job applications. By using social media to reach TechCorp's wider ecosystem, the contest has attracted interest of young talent.

Table 4
Microfoundations of innovative capabilities originating in 'processes'.

Microfoundation source	Microfoundation property	Microfoundation function
Innovation strategy	Innovation as a coupled process combining technology invention and business model innovation	Integrating scientific and business-oriented knowledge resources for innovation success
Key account management	Close day-to-day collaboration of key account managers with customers	Capturing and transferring changing customer needs and market trends
Invention phase of innovation process	Customer-centric business model development in co-creation workshops	Thinking innovation from customer point-of-view Recognizing innovation opportunities
Continuous workforce education	Cross-functional and cross-sector training measures Job rotation and mentoring	Developing open mindsets Conceptualizing innovation processes from different angles Acquiring knowledge-sharing capabilities
Communities of practice	Peer-driven interaction Free expression of innovation ideas	Complementary knowledge resource for solving work tasks
SharePlatform expert profiles	Creating shared content with social media Creating visibility of knowledge and learning interests	Moving toward a networking behavior Building trust through better traceability of expertise

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A second measure related to formalizing the inflow of external knowledge is TechCorp's annual innovation day, which brings together corporate customers and industry partners. In 2011, event participants included more than 50 global industry partners, 15 research organizations and five public authorities. As Innovation Day relies on direct face-to-face communication in workshops and direct one-to-one partnering formats, the central R&D department has been able to capture a deep understanding of the innovation needs and interests of some of TechCorp's most important stakeholders. While the value of the knowledge captured in this event is regarded as important, its impact on TechCorp's organizational innovative capabilities depends on the efficiency by which the collected knowledge and insights on customer needs is distributed within the firm.

Capability requirements of corporate R&D equally influence staffing procedures. TechCorp's formal decision procedure for appointing leadership managers ensures that candidates' competence profiles match work requirements in vacant management positions. This formal selection procedure is based on the reasoning that a match of employee interests with work requirements increases motivation. The selection procedure relies on four criteria: candidates' professional expertise, their managerial skills and potential, their pioneering spirit, and their capacity to think in innovative ways. The selection procedure helps to systematically reduce bias for critical staffing decisions, and the criteria emphasize the individual innovation capacity of candidates as a prerequisite for appointment. The procedural mitigation of bias in staffing of leadership positions consequently reduces the risks of inhibiting TechCorp's innovation capabilities at the firm level.

Finally, TechCorp has created a set of formal and informal incentives to drive knowledge-sharing behavior and to reward innovation efforts in its corporate culture. In the late 1990s, TechCorp's top management launched a corporate-wide innovation program to create synergies between the different business units and generate new profit sources. More recently though the innovation program has shifted its focus to developing managerial capacities and an open corporate culture, which the top management perceives to be the main sources for TechCorp's innovative performance. The leadership-endorsed innovation program serves as an umbrella for all intra-firm initiatives that foster knowledge sharing and organizational learning. Apart from communities of practice and SharePlatform, the innovation program comprises formal awards and incentives that recognize exceptional innovation achievements of individuals and teams and endorse their reputation and visibility within the firm.

TechCorp has also set up a corporate idea suggestion program, to which all employees can easily submit ideas. Suggestions range from simple proposals for improving work places to more complex propositions to reconfigure process efficiencies and innovate products and services. To date, approximately 1.5 million ideas from the database have been put into practice. The idea management team reports that every day 400–500 new ideas are implemented corporate-wide, and estimates that new value creation through innovative products and processes, cost reductions, and process efficiency has generated revenues of more than €3 billion for the last 15 years. In the same time span the innovation program has awarded bonuses of as much as €300 million for top idea contributors. Table 5 summarizes the main microfoundations for TechCorp's innovative capabilities in the *procedures* category.

5. Conclusion, limitations, and future research

In this paper, we have investigated microfoundations of innovative capabilities of a large multinational firm. Microfoundations of dynamic capabilities represent an emerging concept in the strategy and innovation literatures. The microfoundations concept integrates research perspectives from behavioral and social sciences to investigate the lower-level origins and the creation, development, and management of firm-level capabilities and performance. Our study addresses organizational and managerial microfoundations of dynamic capabilities.

Our main contribution is the delineation of the microfoundations of innovative capabilities that reside in a range of organizational learning processes and knowledge management practices of a multinational firm. We have relied on top-down theorizing (Lee et al., 1999; Shepherd and Sutcliffe, 2011) to establish the analytic framework of the categorization scheme and on inductive theory building and elaboration (Eisenhardt, 1989; Ridder et al., 2014) to systematically uncover and categorize microfoundations. To analyze the case data, we focused specifically on knowledge management practices and organizational learning processes as potential microfoundations of innovative capabilities of the firm. The study findings demonstrate that microfoundations of innovative capabilities reside in a wide and diverse range of sources that we traced and sorted into the analytic categories of organizational and managerial structures, systems, processes, and procedures. Furthermore, our findings display interactions and interdependencies in the categories that foster organization-wide knowledge creation and learning processes and lead to higher-level firm behavior and performance in dynamic industry contexts.

Adding to this main contribution, the study's results inform the research streams underlying the conceptual framework of microfoundations of dynamic capabilities. Our review of research streams and theoretical concepts reflects the theoretical tenet that microfoundations of dynamic capabilities reside in a variety of organizational and managerial sources, and our evidence empirically supports the wide scope of this conceptual framework. We describe below how our investigation extends prior research and raises new questions on the role of knowledge sharing (Grant, 1996a; Tsai, 2001; Vera et al., 2011) and organizational learning (Lewis and Herndon, 2011; Peltokorpi, 2008) for innovative capabilities of firms and subsequent firm performance.

Our study contributes to the literature on knowledge brokering by identifying how the decentralized structural configuration of the

Table 5
Microfoundations of innovative capabilities originating in 'procedures'.

Microfoundation source	Microfoundation property	Microfoundation function
Corporate innovation process	Four formal stages for evaluation of major innovation fields	Ensuring fit of key investment decisions to corporate innovation strategy and capability
Innovation benchmarking	Benchmarking innovation performance indicators against top competitors	Identifying organizational knowledge gaps Defining continuous improvement priorities
Five-stage evaluation of product portfolio	Adapting product specifications for developing countries Business model innovation for exploiting the long tail	Avoiding managerial bias in decision-making Creating knowledge for emerging market opportunities
Ideation competition	Two-stage competition for submitting innovation proposals	Crowdsourcing ideation processes Pulling external knowledge into firm
TechCorp's Innovation Days	Face-to-face workshops and communication with key stakeholders	Ensuring knowledge inflow for innovation ideas and opportunities
Staffing decisions	Formal procedure to select leadership innovation managers	Mechanism to avoid decision bias and ensure innovation capability
Leadership-endorsed innovation program	Leadership-endorsed umbrella for formal innovation incentives	Rewarding individual risk-taking for innovation Ensuring recognition for innovation behavior
Ideation program	Idea suggestion database for employees	Bottom-up product and process innovation

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corporate R&D unit as the main internal knowledge-brokering agency supports its knowledge-brokering function *within* the firm. This delineation of the importance of structural ramifications of internal knowledge brokers complements previous research showing that knowledge brokering helps to systematize product and process innovation *across* organizations (Hargadon and Sutton, 2000; Pawlowski and Robey, 2004). The transversal embedding of the central R&D department into the firm's organizational structure helps this agency to systematize knowledge creation and recombination across sector and division boundaries. Another interesting insight in the *structures* category is the functionalist approach the firm has taken to design the work organization. Our study has shown that the modular organization of innovation teams fosters knowledge boundary spanning across structural and disciplinary boundaries. This insight adds a structural dimension to the identification of knowledge boundary-spanning mechanisms (Hawkins and Rezazade, 2012).

Our findings in the *systems* category show that the technological platform efficiently combines collaborative functionalities and knowledge repositories. This integration supports the recombination of knowledge assets that reside in intra-firm network clusters. In particular, multi-channel communication and use of social software drive the emergence of new networks around 'hot' topics and foster potentially complementary innovation. Our findings suggest that the capacity of the information architecture to aggregate tacit and explicit knowledge substantially influences the value of knowledge networks. The insight that critical knowledge assets are located in aggregate network structures rather than in individuals adds to previous research that found individual positions of inventors in intra-firm knowledge networks to be a key determinant supporting firms' innovation capabilities (Nerkar and Paruchuri, 2005). A second interesting phenomenon in the *systems* category is the perceived importance of rapid knowledge transfer for innovation. The usefulness of the function signaling the need for urgent support indicates that the speed of sharing contextual knowledge offers added value for innovation teams and fosters the development of an agile or flexible innovation culture.

Our findings in the *processes* category relate to previous studies on cognitive and attitudinal prerequisites for knowledge networking behavior (Nonaka and Takeuchi, 1995; Seufert et al., 1999). We complement research on building trust as part of the efficient orchestration of coordination activities *across* organizations (Dhanarag and Parkhe, 2006) with an intra-firm perspective. Our study shows that building trust is perceived as part of individual employee responsibilities to enable learning knowledge sharing for the future growth of the firm. Beyond their influence on knowledge-sharing processes between individuals, prerequisites like mutual trust and open-mindedness generate important firm-level phenomena and need to be further investigated to fully grasp their role as microfoundations of firm's capabilities. In our view, the question of how learning processes adapt to changing knowledge requirements provides a new perspective for the role of formal and informal learning in innovation contexts. A particularly worthwhile step might be to bring formal learning back into research inquiring into the development of organizational capabilities (Shrivastava, 2007), where its impact is observed beyond formal learning outcomes. The role of job rotation and mentoring in developing innovation mindsets also presents an interesting topic for future studies in the organizational learning field.

Our findings in the *procedures* category reveal the increasing importance of the emerging phenomena of ideation contests and crowdsourced innovation as mechanisms to pull external knowledge into corporate innovation processes. While the use of web technologies to leverage crowdsourcing is not new *per se* (Leimeister et al., 2009), we need to learn more about the efficiency of these approaches and their real impact on firms' innovative capability and performance. Our findings on innovation benchmarking, evaluating product portfolios, and incentivizing innovation behavior mostly confirm previously established knowledge regarding the importance of standardized processes to corporate innovation strategies in large firms (Jensen et al., 2007; Maurer, 2010).

We have kept the analytic focus in this case research on organizational learning and knowledge sharing as microfoundational sources for innovative capabilities of the firm. A limitation of our work is that we did not investigate other microfoundations that potentially nurture innovative capabilities. These complementary microfoundations potentially reside in strategic alliances of the firm, its financial leverage, and its industry value chain. To keep the scope of the study focused, we did not extend the analysis beyond the knowledge management and organizational learning dimensions.

Another limitation typical of case research is the limited generalizability of findings. However, the main purpose of our study was to reach heuristic generalization — that is, to reach a deeper understanding of a concept by developing an evidence-based delineation and elaboration of particular organizational and managerial nuances that represent the microfoundations of innovative capabilities.

Future research is needed to further empirically validate and complement the microfoundations of innovative capabilities we have delineated in this study. Longitudinal research designs could examine how microfoundations of innovative capabilities develop and change over time. Furthermore, our study focuses on the microfoundations of innovative capabilities of a multinational firm competing in dynamic, technology-driven industries, raising the question of whether and to what degree our insights generalize beyond this particular context. Overall, we believe the further empirical validation and systematic extension of our findings represent the main avenues for future research on this topic.

In terms of managerial implications, our findings show that large industrial firms can rely on organizational learning and knowledge sharing to foster innovative capabilities as long as the top management is aware of the success factors that derive from the four microfoundation categories. The main success factor in organizational and managerial *structures* is the design and implementation of an internal knowledge-brokering agency. In the *systems* category, firms need to invest in the deployment of a technological platform that efficiently connects people and networks, and that integrates and stores tacit and explicit knowledge for innovation processes. In the category of organizational and managerial *processes*, firms should encourage learning and knowledge-sharing behaviors among employees across functional and divisional boundaries. Finally, to incentivize in the *procedures* category transversal knowledge sharing at all corporate levels, firms should design organizational cultures in such a way that they nurture trust.

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Dr. Dirk Schneckenberg, Associate Professor of Strategic Management, ESC Rennes School of Business, Strategy & Marketing Department, 2 rue Robert d'Arbrissel, 35065 Rennes, France. Dirk is Associate Professor of Strategy at ESC Rennes School of Business and is interested in business model innovation and technology management. His work has appeared in R&D Management, International Journal of Innovation Management, Knowledge Management Research & Practice, and other outlets.

Dr. Yann Truong, Associate Professor of Strategic Management, ESC Rennes School of Business, Strategy & Marketing Department, 2 rue Robert d'Arbrissel, 35065 Rennes, France. Yann is Associate Professor of Marketing and Strategy at ESC Rennes School of Business and is interested in innovation management and new product development. His work has appeared in the Journal of Product Innovation Management, Industrial Marketing Management, R&D Management, and other outlets.

Dr. Hamid Mazloomi, Assistant Professor of Strategic Management, ESC Rennes School of Business, Strategy & Marketing Department, 2 rue Robert d'Arbrissel, 35065 Rennes, France. Hamid is Assistant Professor of Strategy at ESC Rennes School of Business and is interested in technological alliances and innovation management. His work has appeared in Knowledge Management Research & Practice, Journal of Knowledge Management, and other outlets.

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