Management international
International Management
Gestiòn Internacional

Managing international knowledge flows at the fuzzy front end of discontinuous innovation
Mobiliser les flux de connaissances internationaux pour favoriser les innovations discontinues
Movilizar los flujos internacionales de conocimiento para fomentar la innovación discontinua

Marion Neukam and Claude Guittard

Volume 27, Number 6, 2023

Le management des connaissances à l'épreuve des nouveaux « objets » de la gestion du XXI[e] siècle
Knowledge management put to the test the new "objects" of 21st-century management
La gestión del conocimiento a prueba de los nuevos "objetos" de la gestión del siglo XXI

URI: https://id.erudit.org/iderudit/1108844ar
DOI: https://doi.org/10.59876/a-7ast-rs7p

See table of contents

Publisher(s)

HEC Montréal
Université Paris Dauphine

ISSN

1206-1697 (print)
1918-9222 (digital)

Explore this journal

Cite this article

Neukam, M. & Guittard, C. (2023). Managing international knowledge flows at the fuzzy front end of discontinuous innovation. *Management international / International Management / Gestiòn Internacional*, *27*(6), 32–43. https://doi.org/10.59876/a-7ast-rs7p

Article abstract

Spatially distributed knowledge in MNCs presents a challenge for the emergence of discontinuous innovations. Our study suggests that a firm's ability to efficiently exploit international knowledge during the 'fuzzy front end' (FFE) depends on the relationship between international subsidiaries and the rest of the firm. Based on an in-depth case study in an international industrial firm, our empirical work identifies two coordination mechanisms firms can apply to manage their knowledge flows and thus reposition subsidiaries to favor discontinuous innovations: the managerial commitment towards local innovation activities, and the embeddedness of local employees into global innovation processes.

Managing international knowledge flows at the fuzzy front end of discontinuous innovation

Mobiliser les flux de connaissances internationaux pour favoriser les innovations discontinues

Movilizar los flujos internacionales de conocimiento para fomentar la innovación discontinua

Marion Neukam
University of Strasbourg, University of Lorraine, CNRS, BETA, 67000, Strasbourg, France
mneukam@unistra.fr

Claude Guittard
University of Strasbourg, University of Lorraine, CNRS, BETA, 67000, Strasbourg, France
claude.guittard@unistra.fr

ABSTRACT

Spatially distributed knowledge in MNCs presents a challenge for the emergence of discontinuous innovations. Our study suggests that a firm's ability to efficiently exploit international knowledge during the 'fuzzy front end' (FFE) depends on the relationship between international subsidiaries and the rest of the firm. Based on an in-depth case study in an international industrial firm, our empirical work identifies two coordination mechanisms firms can apply to manage their knowledge flows and thus reposition subsidiaries to favor discontinuous innovations: the managerial commitment towards local innovation activities, and the embeddedness of local employees into global innovation processes.

Key words: Knowledge, Discontinuous innovation, MNCs, Global innovation process, Managerial Commitment

Résumé

Le fait que les connaissances sont localisées à distance représente un défi pour l'émergence des innovations discontinues dans les entreprises multinationales. Notre travail suggère que la capacité à exploiter efficacement les connaissances internationales au cours du processus d'innovation dépend de la relation entre les filiales internationales et le reste de l'entreprise. En s'appuyant sur une étude de cas dans une entreprise industrielle internationale, nous identifions deux mécanismes pour gérer ces flux de connaissances et ainsi repositionner les filiales pour favoriser les innovations discontinues : l'engagement managérial envers les activités d'innovation locales, et l'intégration des employés locaux dans les processus globaux.

Mots-Clés : Connaissances, Innovations Discontinues, Entreprises Multinationales, Processus d'innovation global, Engagement managérial

Resumen

El hecho de que el conocimiento se localice a distancia representa un reto para la aparición de innovaciones discontinuas en las empresas multinacionales. Nuestro trabajo sugiere que la capacidad de explotar el conocimiento internacional durante el proceso de innovación depende de la relación entre las filiales internacionales y la empresa. A partir de un estudio de caso en una empresa industrial, identificamos dos mecanismos para gestionar estos flujos de conocimiento y reposicionar así a las filiales para fomentar las innovaciones discontinuas: el compromiso directivo con las actividades de innovación locales y la integración de los empleados en los procesos globales.

Palabras Clave: Conocimiento, Innovaciones discontinuas, Empresas multinacionales, Proceso global de innovación, Compromiso directivo

Pour citer cet article : Neukam, M. & Guittard, C. (2023). Managing international knowledge flows at the fuzzy front end of discontinuous innovation. *Management international*, 27(6), 32-43.
DOI: https://doi.org/10.59876/a-7ast-rs7p

The internationalization of a firm's innovation strategy offers tremendous potential for multinational companies (MNCs), and this is not simply a matter of the increased opportunities presented by global markets; for the richness of international knowledge assets equally encourages the generation of highly creative ideas (Mayrhofer and Urban, 2011; Neukam and Guittard, 2018). MNCs already have a reservoir of international knowledge at their disposal, this being expressed in the diverse competencies of employees at their various international locations. Among other advantages, this knowledge enhances the strategic long-term vision of the top management team by boosting the emergence of discontinuous innovations (Harvey and Griffith, 2007; Kleinschmidt *et al.*, 2007)managerial, and transformation-based competencies effectively, the firm can configure a repertoire of strategic choices (e.g., marketing plans throughout the product development process. Garcia and Calantone (2002) define discontinuous innovations in opposition to their incremental counterparts as innovations that integrate a new technology, a new user benefit, or both simultaneously. They are stimulated at the early innovation phase, the 'fuzzy front end' (Reid and De Brentani, 2004), during which a promising opportunity is detected, an idea is refined, and a coherent concept is developed (Cohendet *et al.*, 2013). It is during that phase, previous studies suggest, that informal and interdisciplinary interactions are crucial to ensure that knowledge is sufficiently shared between team members (Gassmann and Schweitzer, 2014; Harvey *et al.*, 2015). However, the agglomeration decisions of an MNC restrict spontaneous informal interactions, since actors are located at the various international subsidiaries over more or less great distances. If a firm fails to manage knowledge flows from and to these actors, knowledge remains unused, which increases the firm's 'creative slack' (Cohendet and Simon, 2007).

In this paper, we suggest that the position of a local subsidiary within the MNC network strongly influences a firm's ability to gain access to this creative slack and exploit it successfully during the early innovation phase. As illustrated by Eling and Herstatt (2017), previous studies have not taken into account the impacts of MNC network structures on performance at the fuzzy front end. However, given the significant innovative potential inherent in successful international knowledge management, it is crucial to determine the preconditions a firm must meet in order to fully exploit the knowledge possessed by its international subsidiaries. Thus, the research question of this article is formulated as follows: **How can MNCs enhance headquarters—subsidiary collaborations so as to support the emergence of discontinuous innovations at the fuzzy front end?**

In this paper, we first provide the theoretical framework of our study, which combines research in innovation management with a special focus on the fuzzy front end of innovation and international management. In a second step, we provide further details about our in-depth case study at FLUID, a medium-sized German firm operating on an international level (we use a pseudonymous acronym to preserve the anonymity of the company). We then present the results of our coding process, leading us to position four subsidiaries of the firm with regards to the quality of knowledge flows (geographic dimension and direction of knowledge flows) from and to other entities. Also we explain the underlying patterns that led us to make this distinction. In the discussion, we draw on these observations to present two coordination mechanisms that have been identified in our empirical work as a means to reposition a firm's international subsidiaries at the FFE phase to foster discontinuous innovations on an international scale: the commitment on a strategic level towards local innovation activities, and the embeddedness of local employees into global innovation processes.

Theoretical framework

Increasing the radicalness of innovations: focus on the fuzzy front end of innovation

Given the current challenges of globalization (global competition, shortening of product life cycles, etc.), firms should not underestimate the importance of so-called discontinuous innovation for their long-term survival (Harvey and Griffith, 2007; Kleinschmidt *et al.*, 2007)managerial, and transformation-based competencies effectively, the firm can configure a repertoire of strategic choices (e.g., marketing plans throughout the product development process.

De Brentani and Reid (2012) have clearly identified that the difference between discontinuous and incremental innovation is already effected during the first phase in the innovation process, namely the fuzzy front end of innovation (FFE). Although long neglected by the literature (Koen *et al.*, 2001), scholars have recently started to clarify what exactly happens during this process and how it impacts the final outcome of the innovation process (e.g. Eling and Herstatt, 2017; Gama *et al.*, 2022; Koen *et al.*, 2014; Markham, 2013). While some authors have developed a processual and thus linear conception of the FFE (Eling and Herstatt, 2017), Cohendet *et al.* (2013) argue that this phase is an iterative step where actors alternate between opportunity sensing, idea seizing, and concept reconfiguration. According to them, the objective is not only to create a new idea, but also to get an idea accepted by the firm through interactions of its internal knowledge communities. They underline that this process requires frequent informal interactions between actors.

In contrast to incremental innovation, the emblematic work of De Brentani and Reid (2012) found that radical or really new innovations emerge via a bottom-up rather than a top-down process. They are pushed by the active participation of employees in certain key roles who share their knowledge, discuss interesting ideas, and generate an innovative concept. Ideas therefore emerge on the individual level via the creative recombination of existing knowledge and the integration of new knowledge from the external

environment. This process depends not only on explicit knowledge about a specific domain, but also on tacit knowledge, namely the skills and capabilities needed to generate new and useful ideas (Mudambi and Swift, 2012).

Even though in both cases (incremental and discontinuous innovation), the objective at the FFE is to reduce the fuzziness of an idea before embarking upon the new product development process (Gama *et al.*, 2022), this takes more effort in the case of discontinuous innovation (Herstatt *et al.*, 2004) as uncertainty is higher than in the case of incremental innovation (Markham *et al.*, 2010; Verworn *et al.*, 2008). As discontinuous innovations address a new user benefit, a new technology, or even both simultaneously (Garcia and Calantone, 2002), less market and/or technology information is available than for incremental innovations. Furthermore, whether an idea for a discontinuous innovation is finally communicated to the firm's decision-makers depends on the individuals acting at specific decisional gates (De Brentani and Reid, 2012). From this point of view, Duan *et al.* (2022) found that constant knowledge flows have a positive moderating role on the innovation process as this motivates individuals to share their knowledge with others. Consequently, a knowledge-based view of firms would maintain that a consistent knowledge management structure is required for a positive impact on a firm's innovation quality and for fostering the emergence of discontinuous innovations (Duan *et al.*, 2022; Ferreira *et al.*, 2020; Grant, 2002). However, considering at the same time that the FFE is chaotic, and less structured than the later development phase (Koen *et al.*, 2001), knowledge cannot and should not be formally managed by structured processes as this would be a barrier to creativity (Björk and Magnusson, 2009; Griffin *et al.*, 2014). Instead, its main challenge remains to identify efficient coordination mechanisms that facilitate the integration of such highly valuable knowledge (Grant, 2002; Szulanski, 2003) and thus to create a knowledge-enabling context (Von Krogh *et al.*, 2000).

Knowledge management in MNCs

In multinational corporations (MNCs), knowledge management gains in complexity due to the international dimension within teams. On one hand, previous research has identified the importance of diverse internationally dispersed knowledge for innovation (Bell and Zaheer, 2007; Gassmann *et al.*, 2010; Johanson and Vahlne, 2009; Neukam and Guittard, 2018). According to Johanson and Vahlne (2009), varying international knowledge opportunities alter a subsidiary's relevance within the network. Also, Kafouros *et al.* (2022) show that international collaborations within innovation teams foster the emergence of specifically discontinuous innovations through the access to a diverse knowledge base.

On the other hand, despite advances in information and communication technologies (ICTs), geographic distance remains a barrier, especially when international teams seek to share tacit knowledge (Enkel *et al.*, 2020; Von Zedtwitz, 2020). Several studies suggest that this is linked to the stickiness of tacit knowledge (e.g. Ardito *et al.*, 2018; Cecchi *et al.*, 2022), leading therefore to a strong regional localization of knowledge (Kafouros *et al.*, 2022; Yeung, 2021).

The importance of the geographic dimension of knowledge underpins related discussions on headquarters—subsidiary relationships (e.g. Ferraris *et al.*, 2020; Hohberger and Wilden, 2022; Kafouros *et al.*, 2022). Defining an MNC as a network of several subsidiaries which are not located at the same geographic place, Gupta and Govindarajan (1991) consider the characteristics of knowledge flows as predetermining the strategic role of the subsidiary within the MNC network. Harzing and Noorderhaven (2006a) reaffirmed the typology of Gupta and Govindarajan and found that today's MNCs reveal clear tendencies towards the transnational solution developed by Bartlett and Ghoshal (2002). This solution describes a promising configuration where dispersion, specialization, and interdependence are predominant characteristics of the MNC network. Gupta and Govindarajan (1991) propose their framework in order to describe the MNC network, as well as several informal and formal control mechanisms that can be employed to reposition its subsidiaries. However, the decision to implement appropriate coordination mechanisms is impacted by the geographic space between the headquarters and the foreign location (Harzing and Noorderhaven, 2006b). In addition, knowledge flows depend equally on social interactions between the managers of the different entities; a high level of social interaction at a top-management level stimulates the knowledge-sharing process between subsidiaries, which is especially important for the transfer of tacit knowledge (Ferraris *et al.*, 2020; Noorderhaven and Harzing, 2009).

Nevertheless, research is still required to determine the exact role of international subsidiaries during the innovation process; this role depends, for instance, on their available R&D capabilities and the existence of a coherent incentive system (Ben Mahmoud-Jouini *et al.*, 2015), as well as their embeddedness into the MNC's innovation activities with regards to the firm's routines for integrating knowledge (Ferraris *et al.*, 2020)

Summary: generating discontinuous innovation in MNCs

With respect to geographic boundaries, theorists of innovation management have only rarely focused on the international perspective to the FFE, even though Eling and Herstatt (2017) call for more research on the impact of cultural and environmental factors on performance. For instance, Neukam (2017) and later Neukam and Guittard (2018) analyzed the impact of different cultural systems on teams collaborating during that early innovation phase, looking at how firms may enhance a team's absorptive capacity, but they also called for further research on that topic at firm level and not only at the individual or team level.

There is high inherent potential in the internationally distributed knowledge within a firm. Scholars suggest that cross-country collaborations that exploit that knowledge diversity may lead to the creation of discontinuous innovations and thus enhance a firm's profitability, and do so better than collaborations within the same country (Kafouros *et al.*, 2022). At the same time, interactions across space are resource-intensive and coordination costs increase with geographic distance (Kogut and Zander, 1993). Hence, especially in the case of discontinuous innovation, it is currently not clear how subsidiaries may efficiently innovate together with their headquarters during the FFE phase. In that particular case, MNCs have to ensure that knowledge circulates from the individual to the firm level (bottom-up) by maintaining a certain "fuzziness" and thus adopting a rather informal approach.

Therefore, by applying the knowledge-based view of the firm, we combine insights from international business theory with innovation management literature. From this point of view, this paper addresses a question that still remains unclear: **How can MNCs enhance headquarters—subsidiary collaborations so as to support the emergence of discontinuous innovations at the fuzzy front end?**

To answer this question, a single case study was conducted at FLUID, a medium-sized German firm which has diversified its innovation activities via several international subsidiaries. The focus of this case study is on the identification of underlying coordination mechanisms to enhance knowledge flows (bottom-up as well as cross-country) despite geographic distance at the FFE.

Methodology

As the objective of this research was not to test an existing model but to develop a new approach for an international innovation strategy, this research uses an inductive approach based on a qualitative methodology. The longitudinal case study with multiple units of analysis (Yin, 2003) was conducted at FLUID, a German family-owned firm active in the industrial sector. The development of new products takes place in its European R&D departments, most of which are located in Germany with one in France. In addition, FLUID also has several international sales subsidiaries and two international factories in China and the United States. The latter are in charge of adapting already existing products to local markets. In our study, we focused on several international entities where each entity represents a unique unit of analysis.

Methods

During the entire period of the case study (four years), one researcher was fully integrated into FLUID's daily business activity. This led to a rich collection of participant observations in the French and German R&D centers and facilitated access to internal documents about the fuzzy front end. Data collection was completed via semi-structured field interviews which concentrated on FLUID's overall innovation processes on an international scale. The interview partners were chosen with regard to their strategic position within the company and their experience with international and/or innovation activities. The interviewees included members of the Portfolio Management and the HR department, as well as R&D Team coaches and former expatriates—the latter being able to provide information about the operational implementation of the innovation strategy abroad. The interview guide considered the overall innovation processes within the MNC network. As the focus of our research was the FFE phase, we asked for concrete examples of innovation initiatives at the subsidiaries that happened before an official development project was considered. Here, we asked in a second step about the outcomes according to the position of the subsidiaries within that network (discontinuous vs. incremental vs. no further development projects) as well as the knowledge flows from and to the subsidiaries during that phase. Table 1 provides an overview of the data collection process. All interviews have been recorded and fully transcribed.

To generate a theoretical model based on the field data derived from the case study, we conducted an iterative comparative analysis in line with Miles and Huberman's (1994) recommendations. In a two-round coding process, we went through the interview transcriptions (13 hours and 5 minutes in total) and participant observations. First, we applied a vertical coding process for each unit of analysis where we noted barrier and success factors related to international headquarters—subsidiary collaborations during the fuzzy front end phase and classified them into relevant first-order concepts. Second, we used a horizontal coding process to identify common patterns between collected data and thus between all international entities that have been analyzed. Here, we merged first-order concepts into aggregated dimensions to detect core concepts. An extract from that coding process can be found in Appendix A.

TABLE 1
The Collected Data

14 Semi structured interviews				
Position	**Date**	**Location**	**Content**	**Duration**
Product Portfolio Manager	24.03.2015	Headquarters	General structure of product portfolio and project landscape	54 min
Technology Portfolio Manager	17.02.2015	Headquarters	General knowledge management structure	44 min
HR member	18.02.2015	Headquarters	General structure of the innovation process and HR strategy	50 min
R&D Project Manager	17.02.2015	Headquarters	Creative phase of a project with members located in France and Germany	56 min
R&D Team Coach	25.03.2015	SUB 3	Knowledge management during technology projects	64 min
R&D Team Coach	25.03.2015	Headquarters	Experiences about projects with actors located at several locations	60 min
R&D Team Coach	12.01.2015	SUB 4	Project leader of a project with actors from diverse locations	80 min
Former Expatriate	28.04.2015	SUB 2	Experiences about international knowledge management	23 min
Product Portfolio Manager	28.04.2015	Headquarters	International project landscape and product development process	60 min
R&D Project Manager	28.04.2015	Headquarters	Project leader of a project with actors from diverse locations	56 min
R&D Team Coach	06.03.2015	SUB 4	Insights about geographic challenges in the innovation process	60 min
R&D Project Member	18.02.2016	Headquarters	Collection of further information about geographic challenges in an international project	57 min
Former Expatriate	19.02.2016	SUB 1	Experiences about international knowledge management	61 min
R&D Team Coach	05.07.2016	SUB 4	Deatils of historical evolution of the creative processes at the company	60 min
TOTAL DURATION				**13h05 min**
Further collected material				
Participant observations	Participation in team meetings, informal conversations with colleagues, and in-depth observations of the innovation processes during the FFE mainly in France and Germany. As the FFE is a less structured phase, participant observations were particularly relevant to identify implicit patterns.			
Document analysis	General information about the company: industrial sector, organizational strategy, organizational culture, etc.			

Case description

FLUID has been family-owned since its foundation in the late 1940s in Germany. Since then, it has developed its business in the industrial sector, encompassing all kinds of devices to measure and regulate liquids and gases. Today, this MNC counts more than 3,000 employees. Besides the German headquarters, the firm also has production and service entities in the United States and China for local markets, as well as several international sales subsidiaries that sell products and systems all around the world. Concerning our research question, we regard FLUID as a relevant case because the objective of the firm is to develop high-tech products and its innovation activities are therefore of fundamental importance. Moreover, its innovation teams are located in several countries providing varying levels of international knowledge opportunities in line with Johanson and Vahlne (2009).

R&D is not only located at the headquarters, but also in a second German R&D center, which is close to local universities as well as between the headquarters and a third R&D center constructed in the late 1950s in France. The latter has evolved since then to become one of the firm's technology competence centers.

Based on the locally available knowledge and thus their importance for the firm's innovation strategy, we chose multiple units of analysis for our case study: one of the two factories abroad producing for local markets—hereby called SUB 1—due to their unique position within the MNC network (i.e. geographically distant and large scale of local competencies); a North American sales subsidiary called SUB 2 as this entity has been identified as an active knowledge provider within the firm during our interviews; the decentralized R&D center called SUB 3; and the French factory called SUB 4. For the latter, the collected data motivated us to distinguish between its role before the year 2001, between 2001 and 2005 and after the year 2005.

Results

FLUID is present in several locations worldwide, and these subsidiaries play different roles for innovation within the firm. Closer investigation into the innovation strategy with regards to the geographic mobilization of knowledge (within the same country or cross-country collaboration) as well as to the direction of knowledge flows during the FFE phase (whether top-down or bottom-up) enabled us to identify varying roles of the chosen four international subsidiaries. In the following, we explain in further detail how exactly those subsidiaries distinguish from each other. First, we provide separate descriptions for each subsidiary. Then, we perform a cross-case analysis to reveal common patterns between all entities.

Separate case study reports for each entity

SUB 1: A local innovator of discontinuous innovations

SUB 1 is an entity which delivers customized versions of existing products for local customers. This requires technical knowledge with a clear focus on local market needs. Furthermore, even though production facilities are not as developed as in the German and the French factories, this factory is to a certain extent able to take charge of local industrialization and production processes.

In recent years, the entity has grown significantly and acquired further competencies through its HR strategy, which has enabled it to develop a highly innovative product. The idea for that product emerged through the initiative of some employees at that entity. As one interviewee remarked: "This was a great idea. [...] there are incredibly high quality requirements in that sector, and over there somebody had a great idea to simplify the process [...] a very innovative concept" (2FG). This innovation integrated a new technology and created a new user benefit compared to already existing products and can therefore be classified as discontinuous innovation.

However, decision-makers were not aware of this development until its industrialization: "They developed the idea and obtained a patent. They constructed it and then wanted to introduce it to the market and make us produce it. But besides the team over there, nobody else in the firm knew about that thing. It would have been nice to discuss the general idea and analyze how to insert this in our general pipeline. But now, this is inserted into our organization, no matter if it can digest it or not" (2FG).

The belated communication between the local development team and the decision-makers about the existence of the innovation posed difficulties for the international sales and marketing forces in charge of the distribution of this new product, as well as for other local production sites which were not prepared to produce such a complex product.

"The local employee thought: 'I have a really good idea with a high market potential which will revolutionize the market. But if I insert it into the official innovation processes, the idea might be averted and this will not work. I'll do it locally.' I don't think that he had a malicious intention. They only feared that their idea would not be accepted" (2FG).

As a consequence, despite the high innovative level, the market potential of the idea was not globally optimized, since the final product does not fully correlate with the existing product portfolio of the firm.

SUB 2: Unidirectional knowledge flows

SUB 2 is a sales subsidiary in North America and has around 20 employees, all of whom are charged with the commercialization of FLUID products abroad. Besides this sales force, most of the employees have a sufficient technical background to assure an appropriate marketing strategy for the local market. Due to this combination of market vision and technical know-how, these employees regularly identify new opportunities for innovation. They freely communicate with employees at the headquarters in Germany, and they are "also very autonomous. Our manager does not want us to let him handle everything by himself. His managerial style is based on flat hierarchies" (2FH).

The local manager regularly motivates his employees to share their knowledge directly with the headquarters when they see an interesting potential: "I think that our manager has a huge influence on the atmosphere. He attached great importance to the FLUID culture and expected us to live these values and to act with respect for the corporate strategy" (2FH).

However, this insistence on a flat structure has its drawbacks. As one employee remarked, "if somebody has an idea for a product or an improvement in any form, then they do not know to whom to address this idea" (2FH).

All decision makers for new projects are located at the headquarters, but this entity was described as a *black box* by one interviewee. Employees at SUB 2 share the predominant assumption that if they send an idea to a particular person at the headquarters with whom they are already in touch, the idea will indeed be systematically taken into account. However, it is possible that the contacted person would not know to whom to transfer the idea internally at the headquarters, and "If you don't send it [the idea, *ed.*] to the right address, it remains somewhere in the factory" (2FH).

At the same time, SUB 2—like any other sales subsidiary of the company—does not have proper production facilities and therefore depends on the rest of the firm to push an idea towards development. They thus depend on the headquarters to develop an idea into a viable product.

SUB 3: A decentralized R&D center

As decentralized R&D center, SUB 3 is located close to local universities and therefore has access to valuable external knowledge: "[SUB 3] was founded as a research entity, because there are universities closely located and we can access talents more easily" (2P5B). Being the only pure R&D center of the group, this location is tasked with pushing new technologies and inserting this knowledge into the firm. However, it does not dispose of a local production site, and in this respect, it is similar to SUB 2; instead, it continuously seeks to share its insights with the rest of the corporation in order to find appropriate product applications for new technologies: "Even before the group started to systematically create expert teams for specific technologies on a corporate level, we had some of those groups here, where we discussed some technologies" (2FJ). Nevertheless, it was observed that not long after the beginning of its activities in 2011, several project proposals for discontinuous innovations were being refused by the decision-makers at the headquarters during the final Go/No-go decision, even before a development project started: "I don't say the decisions were wrong. If I were CEO, I would have decided like that as well because the market potential was just not there" (2FJ). Despite the transparency of those decisions, SUB 3 displays all the idea proposals which did not make the transition to development in what they call their "cemetery of stranded ideas" (2FJ).

SUB 4 before 2001: Limited collaboration for innovation

Historically, collaborations between SUB 4 and the rest of the firm were limited: "I remember the time [before 2001, *ed.*] when I started to work for FLUID. During my first two years at FLUID, I think that I have only been to Germany twice. We did not have permission to go to the headquarters." (1FA)

The French entity is one of the firm's five factories. It therefore has not only an R&D department, but also production and even local sales forces in charge of the commercialization of FLUID products on the French market. But decision-makers realized "that there are competencies on both sides of the border. It was therefore the intention of our CEO to collaborate" (1FC). Hence, in order to increase collaboration with that entity, in 2001 the firm decided to restructure the corporate innovation processes so that the subsidiary became entirely embedded into the innovation strategy. "FLUID claimed [after 2001, *ed.*] that France is an important entity and it is important to maintain it, also due to historical reasons. There was now a new top-management team in France and they said: 'ok, we'll try it'. After some years, they saw that this worked out and that the people started to work with Germany" (1FA).

SUB 4 between 2001 and 2005: An implementor

Since then, the decision-makers at the headquarters have entirely guided the product portfolio and made the decisions on the products to be developed by SUB 4 based on global market information. Even though the factory had acquired valuable competencies since then, activities concentrated on the re-engineering of existing products and 'me-too' solutions: "[The product manager at the headquarters] only described a competitor's product in the product specifications. Apparently, this was the kind of market where he wanted FLUID to be competitive and this is why he wanted us to develop such a product" (2P3C).

Over the years, this led to the development and production of several product innovations that enlarged the product portfolio, without, however, integrating new significant technologies or addressing new customer benefits as such.

SUB 4 after 2005: A global FFE phase

Due to the increasing collaboration between the French entity and headquarters after 2001, corporate R&D managers decided to intensify their efforts. For two reasons, the year 2005 marked a crucial step in that process. First, between 2005 and 2007 an innovative product matrix was developed together with a French R&D member and several other R&D employees in Germany, which eventually defined the technological future of the firm for the next few years. The first product that resulted from that matrix was launched in 2014 and today represents one of the core innovations of the group. This was the first time that a product and technology roadmap was designed not solely by headquarters, but in close collaboration with the French R&D manager and his local team. Those projects intensified the international contacts: "Thanks to the regular meetings, I really have a closer contact with my international colleagues than with those located just upstairs" (2P1B).

Also in 2005, the firm's technology portfolio manager created several what he called Technology Focus Groups. Those groups are tasked to investigate emerging technologies in the firm's seven core technology fields. Each of these groups systematically integrates the engineers of the French subsidiary, thus facilitating information flows: "Those groups act like a multiplying factor to diffuse information. That's a very good solution to provide a pool of information where everybody has access" (2P1B).

Since 2005, two of FLUID's newest core products have been developed by cross-country collaborations between the French and German R&D teams. Both products integrate new-to-the-field technologies that have never before been used in this area. Also, both products address new user benefits that have not previously been addressed by solutions on the market and can thus be classified as discontinuous innovations.

Common patterns between units of analysis

The description in the previous section shows that the local subsidiaries do indeed exemplify different positions within FLUID's network as regards to early innovation activities. For instance, after 2005 the French subsidiary actively collaborated during the FFE phase by participating in the development of the innovation matrix, leading to two discontinuous innovations. Here, from the very beginning, knowledge and information were freely and openly shared between employees independently of their geographic location.

On the other side of the continuum, SUB 1 is an example of an international subsidiary with important innovative potential that has not been exploited by cross-country collaborations, leading to a highly innovative product idea that emerged through the initiative of one employee (bottom-up), but with an as-yet unexploited market potential. Figure 1 summarizes the positions of the four entities with regards to two dimensions: the geographic dimension of knowledge flows (within entities/across entities) and the direction of knowledge flows at the FFE (top-down/bottom-up).

We point out two observations. First, SUB 4 changed position over time. Before 2001, this entity developed product solutions on a local level. Between 2001 and 2005, we observed knowledge flows across entities as collaborations with the headquarters intensified. Finally, starting from 2005, bottom-up knowledge flows improved the overall innovation strategy of the firm leading to two discontinuous innovations. Second, SUB 1, SUB 2 and SUB 3 provide an important innovation potential as local employees have precious knowledge. However, this knowledge is not exploited at the MNC's level and remains therefore local, even though employees of SUB 2 and SUB 3 actively tried to share their knowledge with the rest of the firm. All in all, our coding process (see an extract of that coding process: appendix A) analyzed the common patterns of levers and barriers exemplified by the international collaborations explaining these different levels of knowledge exploitation of the four subsidiaries. This led to two aggregated dimensions illustrated in figure 2: embeddedness of local employees, and commitment on a strategic level.

Commitment on a strategic level

In several cases, the local manager played a crucial role in favoring knowledge flows between a local subsidiary and the headquarters. For instance, the manager of SUB 2 with a rather small structure (20 employees) attached great importance to the FLUID culture and its values. As a result, his exemplary behavior induced local employees to share knowledge voluntarily and frequently. Working within a system of flat hierarchies, they were not obliged to validate everything with him beforehand. This commitment on strategic level, fostered by the local manager, therefore facilitated bottom-up knowledge flows. On the other hand, we observed in the French example from before 2005 that if the local manager refuses collaborations, then local employees are also cut off from the innovation process, as this created an environment of mutual mistrust: "There was a wall between us. Now [after 2001, ed.], we had to work together and this was also our intention. I for myself was sometimes blamed because I used the same software for the conception as them. For me, it was logical to use the same program as the Germans. But they often said to me 'This is an error because now, they can get all our documents'" (1FC).

Then again, we have also seen that top-management commitment can create the foundation for cross-country collaborations, as when in 2001 FLUID acknowledged the strategic role of the French entity as a center of competence for a core technology of the firm. Due to this collaboration on a strategic level, French employees gained confidence to share knowledge freely with their colleagues at the headquarters. Even employees who did not know each other started to share their knowledge: "The communication channels are short. I have a good contact with the colleagues from France. It is easy to create the contact due to the corporate culture. This is not the same in other firms, where you have to communicate via hierarchies" (2FE).

FIGURE 1
Classification of Sub-Cases

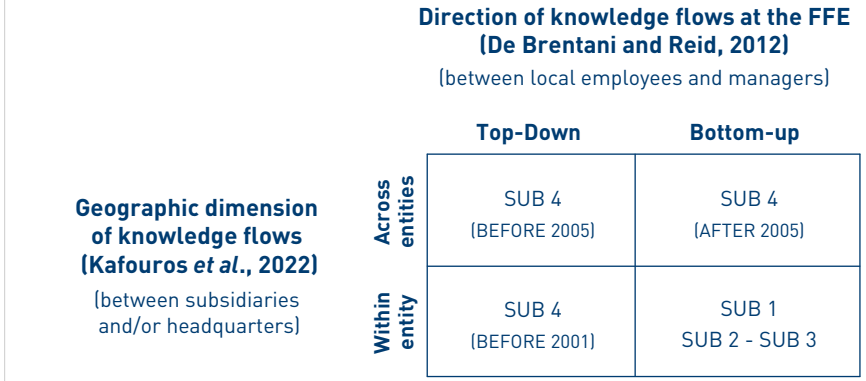
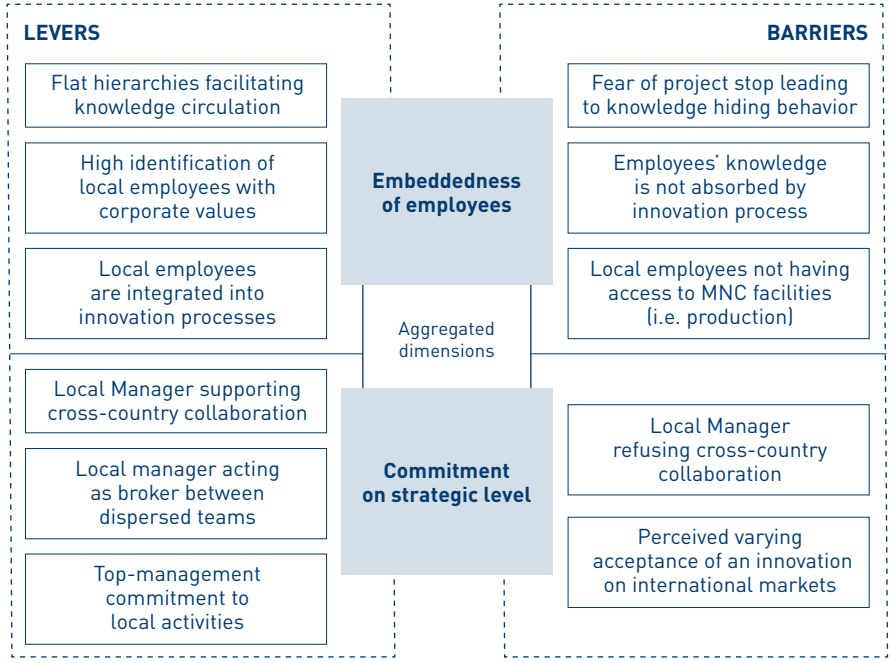


FIGURE 2
Aggregated dimensions of coding process



Thus, commitment on a strategic level induced local employees to actively share knowledge from the very early beginning of their reflections, and thus already during the fuzzy front end phase of innovation. In the case of SUB 3, this commitment was also supported by a local manager who acted as broker between two dispersed teams due to his double-sided formal responsibilities for the two local teams.

Embeddedness of local employees

As we saw, the employees in SUB 1 feared that their highly innovative idea would be refused by headquarters before it could enter development. Local employees of that entity were not embedded in the corporate innovation processes, as the development of new products is historically located at the European factories. At the same time, SUB 1 has its own local production facilities and is able to take care of the entire innovation process until global market introduction. They did not share their knowledge with the rest of the firm. Similarly, SUB 2 is not explicitly integrated into the corporate innovation strategy. Even though employees identify with the corporate values and its flat hierarchy facilitates knowledge flows, this knowledge was not exploited during the FFE. This phenomenon was described by local employees as the creation of a black box—an ambiguous place where they did not know exactly what happens with their knowledge. The same situation was observed at SUB 3. The role of this entity was initially created to engage in applied research activities to advance the core technology fields. Local employees shared their insights with all other subsidiaries through newsletters on specific topics and other open communication channels. Nevertheless, knowledge remained unused. SUB 2 as well as SUB 3 do not dispose of local production facilities and thus require access to corporate processes to assure the transition towards development. As those employees, however, had no direct access to MNC facilities such as production, their output was not systematically exploited, neither globally nor locally.

The French subsidiary became actively integrated into the innovation processes starting from 2005, when a local employee participated in the development of the innovation matrix. This was the first milestone for the creation of an international innovation strategy that targets discontinuous innovation based on the combination of French and German competencies. Today this entity is an integrative part of a technology strategy based on the technology focus groups, and knowledge is actively used and exploited during the FFE. At the same time, we observed that local employees showed an important identification with corporate values, and that flat hierarchies also support this cross-country collaboration.

Discussion

Our case study leads us to formulate several important considerations with regards to the FFE phase in MNCs. First, as summarized in our theoretical framework, we agree with recent literature arguing that the geographic dimension of knowledge flows (cross-country/within country) in combination with the direction of knowledge flows (top-down/bottom-up) from and to subsidiaries determines the innovation capacity of MNCs (De Brentani and Reid, 2012; Kafouros *et al.*, 2022). Based on the two dimensions, we identified different positions for our observed subsidiaries explaining their contribution to the firm's overall innovation processes. Also, the successful development of two innovative products within cross-country collaborations in our case study (SUB 4 and headquarters) underlines that cognitive diversity and an international pool of knowledge favor the emergence of discontinuous innovations (Gassmann *et al.*, 2010; Kafouros *et al.*, 2022; Neukam and Guittard, 2018).

Second, local subsidiaries of MNCs can have the potential to develop discontinuous innovations during the FFE phase, but results remain locally locked-in when collaborations between subsidiaries and the headquarters are not sufficiently managed at that moment in the innovation process. In extension to the work of Cohendet *et al.* (2013) our results therefore suggest that in MNCs, the creation of a new idea during the FFE in a local subsidiary is not as much a challenge as is the absorption of this idea by the decision-makers at the headquarters.

To efficiently exploit those international knowledge opportunities in the sense of Johanson and Vahlne (2009) and absorb these opportunities for discontinuous innovations at the FFE phase, we argue that an MNC may provide strategic decisions based on two coordination mechanisms to reposition a local entity within its innovation strategy: the commitment on a strategic level between the headquarters and a local subsidiary, and the degree to which local employees are embedded during the FFE phase.

Identified coordination mechanisms for an international FFE

The FFE is less structured and formalized than the later development steps, and knowledge transfer is less easily managed via explicit processes (Koen *et al.*, 2001). Still, our research corroborates other current literature illustrating that discontinuous innovations emerge through bottom-up knowledge flows (Cohendet *et al.*, 2013; De Brentani and Reid, 2012). The ideas for discontinuous innovations that we observed in our case study emerged through individual initiatives, where employees shared their knowledge with others. Specifically in the case of the French subsidiary after 2005, we argue that these initiatives gained organizational awareness thanks to a clear top-management commitment towards the local innovation activities on a strategic level. In other cases (e.g., SUB 2 and 3), this was enhanced by local managers who actively supported cross-country collaborations or who acted as brokers between dispersed teams. This is also in line with research in international business that has shown that an inter-organizational relationship can engender a consistent framework where even tacit knowledge can circulate across boundaries (Ichijo *et al.*, 1998; Noorderhaven and Harzing, 2009). In line with the social learning perspective of Noorderhaven and Harzing (2009), we agree that social interactions between the top managers of each entity can establish an organizational relationship between headquarters and the local subsidiaries which eventually encourages employees to share knowledge (Balland *et al.*, 2015; Ferraris *et al.*, 2020). This is especially important during the FFE phase of discontinuous innovation, as the heterogeneous knowledge of employees which is shared in the course of unexpected encounters enhances the combination of diverse knowledge and so fosters the creation of new and innovative ideas (Parjanen, 2012). But in MNCs, actors do not necessarily know each other in advance, and in such configurations they do not always have the time to construct a proper relationship based on their own experiences with peers in order to openly share knowledge (Blomqvist and Cook, 2018). By maintaining and continually reinforcing a close relationship on a corporate level, therefore, local managers can create a solid foundation for bottom-up knowledge flows, decreasing the barriers posed by knowledge-hiding behavior on an individual level (Duan *et al.*, 2022). At the same time, subsidiary managers act as boundary-spanners, aligning local activities with corporate interests and thus creating knowledge-intensive linkages (Ferraris *et al.*, 2020).

However, commitment on a strategic level that clearly acknowledges the innovative potential of a local subsidiary—even though it represents an important enabler for creativity on an international scale—is still not sufficient for a global approach to the FFE phase. We observed barriers to cross-country collaborations during the FFE phase, such as the perception of the innovation process as a black box or a missing access for local employees to MNC facilities (i.e., production). In those cases, the MNC does not successfully manage the transition from the FFE to new product development with regards to the relationship between a local subsidiary and the headquarters. According to Markham *et al.* (2010), this may be linked to the fact that different teams are in charge of each different phase, each with a different perception of risk and varying expectations towards the outcomes of that phase. This gets even more problematic if the subsidiary depends on facilities at other locations in order to push a project forward. For instance, we observed that neither SUB 2 nor SUB 3 disposed of their own production facilities. Local teams may take care of the FFE, but later development phases have to be taken over by other entities such as the headquarters. In such cases, knowledge from such local teams remains locked in the creative slack (Cohendet and Simon, 2007) and is not exploited during the FFE phase on a global level.

Even though their research does not directly address the FFE phase, we consider the approach of Ferraris *et al.* (2020) as a solution to those barriers as they argue in the case of MNCs that the innovation performance also depends on the internal embeddedness of a subsidiary. This joins the research of Wang *et al.* (2018) who also underlined that embedded employees are inclined to quickly acquire heterogeneous knowledge. Then again, embeddedness should not be understood as being fully achieved simply by introducing global innovation processes in local subsidiaries. Indeed, the challenge remains in providing a knowledge-enabling context that spreads out to encompass the international subsidiaries. We add to that discussion the work of Von Krogh *et al.* (2000) arguing that collective creativity cannot be dictated or enforced by management, and it is not by introducing standardized innovation processes that employees can be enabled to contribute to innovation. This is why we suggest that commitment on a strategic level is not enough, and why embeddedness at the individual level retains a crucial role when firms seek to efficiently exploit international knowledge at the FFE phase. As Von Krogh *et al.* (2000) state, firms require to create an environment that is positively inclined to innovation and creativity. We propose that our two identified coordination mechanisms enable an MNC to support such an environment and that this, again, facilitates the transition towards development between dispersed teams.

In our study, only the French example illustrates the dimension of efficient cross-country knowledge flows between those local employees and their colleagues at the headquarters due to the effective embeddedness of their local employees into global processes. This embeddedness was facilitated through flat hierarchies, a high identification of local employees with corporate values, as well as an innovation strategy that actively considers input from those local employees. The MNC takes this knowledge actively into account, as employees are entirely embedded into the innovation culture, for instance by participating in the Technology Focus Groups mentioned earlier. At the same time, that entity is today a well-established competence center in the firm, and actively continues to develop discontinuous innovations in international teams. Hence, since commitment on the strategic level and embeddedness of local employees increased after 2005, local employees have continuously shared their expertise and ideas with the rest of the corporation. Therefore, the relationship between the headquarters as well as the subsidiary is designed in a way such that it not only facilitates cross-country knowledge flows, but also encourages bottom-up initiatives by local employees. Consequently, we conclude that only the combination of both factors favors the generation of discontinuous innovations during the FFE phase in MNCs.

Conclusion

The objective of this research was to analyze an innovation strategy for the FFE in multinational corporations by answering the question: **How can MNCs enhance headquarters—subsidiary collaborations so as to support the emergence of discontinuous innovations at the fuzzy front end?** To the best of our knowledge, this international dimension of the FFE in MNCs has been neglected by current literature and we therefore provide first insights of how to efficiently manage this early innovation phase in MNC networks.

Theoretical implications

Our results underline previous research that subsidiaries have different positions within the innovation network of an MNC. In respect of their activities during the FFE phase, we consider that these positions are determined by the quality of knowledge flows within the network. Understanding the role of subsidiaries during the FFE phase is of tremendous importance to ensure a firm's long-term survival in light of increasing international competition. Thus, to develop a consistent innovation strategy that efficiently exploits international knowledge assets during that phase, we identified two coordination mechanisms which a firm may use to reposition its international subsidiaries during the FFE. First of all, knowledge flows can be enhanced by the commitment towards local activities on a strategic level, supported by a strong collaboration between local managers and top management. This commitment motivates local employees to freely share their insights with others, and positions an entity as an actor that is able to actively participate in the innovation process instead of simply executing top-down decisions.

At the same time, the innovation process may be seen as a black box, or local employees may feel uncomfortable sharing their ideas with others. Hence, besides that commitment, an MNC also needs to actively embed local employees within the innovation process. This integration into global processes is supported by flat hierarchies and a high identification of local employees with corporate values. One mechanism without the other is not sufficient and only the combination of both mechanisms create a context for headquarters—subsidiary collaborations that eventually may lead to discontinuous innovations exploiting internationally available knowledge in MNCs.

Managerial implications

First, the proposed framework provides a tool for managers to analyze their international innovation activities considering international knowledge opportunities. Based on this analysis, and in accordance with the underlying corporate innovation strategy, firms should focus on the repositioning of their international subsidiaries by using the two coordination mechanisms identified above. The corporate processes require to be modelled in a way that opens the possibility for local employees to participate actively in innovation processes (embeddedness). Once modelled on a corporate level, it then has to be transferred to the international operative units of the firm.

However, the inculcation of a sense of identification by local employees with corporate values is a long and time-consuming process. Employees should feel comfortable sharing knowledge. Firms can reduce knowledge-hiding behavior by actively encouraging effective knowledge flows (Duan *et al.*, 2022) and by creating a favorable organizational context (Von Krogh *et al.*, 2000). Those aspects facilitate the embeddedness of local employees and, despite the substantial time investment that is required, this enhances an MNC's overall innovation performance as globally available knowledge is actively exploited within corporate innovation processes.

Limitations and future research

The present research is based on a single case study conducted at FLUID. Despite its explanatory power, the results of this case study cannot be generalized without restrictions. Even though the examples underline our framework, further empirical studies will be necessary to validate those reflections.

The research proposes an initial approach which helps us to understand the role of subsidiaries within the fuzzy front end phase of innovation in MNCs. However, more research is necessary to better understand how exactly and under what circumstances knowledge from employees of different geographical entities can be translated, transformed, and successfully integrated during that phase of the innovation process. Besides collaborations on the organizational level, this requires closer investigation into the cognitive as well as social processes which underpin the generation of knowledge on an individual and team level.

References

Ardito, L., Natalicchio, A., Messeni Petruzzelli, A., Garavelli, A.C., 2018. Organizing for continuous technology acquisition: the role of R&D geographic dispersion. R & D Management 48, 165–176. https://doi.org/10.1111/radm.12270

Balland, P.-A., Boschma, R., Frenken, K., 2015. Proximity and Innovation: From Statics to Dynamics. Regional Studies 49, 907–920. https://doi.org/10.1080/00343404.2014.883598

Bartlett, C.A., Ghoshal, S., 2002. Managing Across Borders: The Transnational Solution, 2nd ed. Harvard Business School Press, Boston, Massachusetts.

Bell, G.G., Zaheer, A., 2007. Geography, networks, and knowledge flow. Organization Science 18, 955–972. https://doi.org/10.1287/orsc.1070.0308

Ben Mahmoud-Jouini, S., Burger-Helmchen, T., Charue-Duboc, F., Doz, Y., 2015. Global organization of innovation processes. Management International/International Management/Gestión Internacional 19, 112–120. https://doi.org/10.7202/1043080ar

Björk, J., Magnusson, M., 2009. Where do good innovation ideas come from? Exploring the influence of network connectivity on innovation idea quality. Journal of Product Innovation Management 26, 662–670. https://doi.org/10.1111/j.1540-5885.2009.00691.x

Blomqvist, K., Cook, K.S., 2018. Swift trust: State-of-the-art and future research directions, in: Searle, R.H., Nienaber, A.-M.I., Sitkin, S.B. (Eds.), The Routledge Companion to Trust. Routledge, pp. 29–49.

Cecchi, M.A., Grant, S., Seiler, M., Turner, N., Adams, R., Goffin, K., 2022. How COVID-19 impacted the tacit knowledge and social interaction of global NPD Project Teams. Research-Technology Management 65, 41–52. https://doi.org/10.1080/08956308.2022.2020566

Cohendet, P., Harvey, J.-F., Simon, L., 2013. Managing creativity in the firm: The fuzzy front end of innovation and dynamic capabilities, in: Burger-Helmchen, T. (Ed.), The Economics of Creativity: Ideas, Firms and Markets. Routledge, Oxon, pp. 131–150.

Cohendet, P., Simon, L., 2007. Playing across the playground: Paradoxes of knowledge creation in the videogame firm. Journal of Organizational Behavior 28, 587–605. https://doi.org/10.1002/job.460

De Brentani, U., Reid, S.E., 2012. The fuzzy front-end of discontinuous innovations: Insights for research and management. Journal of Product Innovation Management 29, 70–87. https://doi.org/10.1111/j.1540-5885.2011.00879.x

Duan, Y., Yang, M., Huang, L., Chin, T., Fiano, F., de Nuccio, E., Zhou, L., 2022. Unveiling the impacts of explicit vs. tacit knowledge hiding on innovation quality: The moderating role of knowledge flow within a firm. Journal of Business Research 139, 1489–1500. https://doi.org/10.1016/j.jbusres.2021.10.068

Eling, K., Herstatt, C., 2017. Managing the front end of innovation—less fuzzy, yet still not fully understood. Journal of Product Innovation Management 34, 864–874. https://doi.org/10.1111/jpim.12415

Enkel, E., Bogers, M., Chesbrough, H., 2020. Exploring open innovation in the digital age: a maturity model and future research directions. R&D Management 50, 161–168. https://doi.org/10.1111/radm.12397

Ferraris, A., Bogers, M.L.A.M., Bresciani, S., 2020. Subsidiary innovation performance: Balancing external knowledge sources and internal embeddedness. Journal of International Management 26, 100794. https://doi.org/10.1016/j.intman.2020.100794

Ferreira, J., Mueller, J., Papa, A., 2020. Strategic knowledge management: theory, practice and future challenges. Journal of Knowledge Management 24, 121–126. https://doi.org/10.1108/JKM-07-2018-0461

Gama, F., Sjödin, D., Parida, V., Frishammar, J., Wincent, J., 2022. Exploratory and exploitative capability paths for innovation: A contingency framework for harnessing fuzziness in the front end. Technovation 113, 102416. https://doi.org/10.1016/j.technovation.2021.102416

Garcia, R., Calantone, R., 2002. A critical look at technological innovation typology and innovativeness terminology: A literature review. Journal of Product Innovation Management 19, 110–132. https://doi.org/10.1111/1540-5885.1920110

Gassmann, O., Enkel, E., Chesbrough, H., 2010. The future of open innovation. R&D Management 40, 213–221. https://doi.org/10.1111/j.1467-9310.2010.00605.x

Gassmann, Olivier, Schweitzer, F., 2014. Managing the unmanageable: The fuzzy front end of innovation, in: Gassmann, Oliver, Schweitzer, F. (Eds.), Management of the Fuzzy Front End of Innovation. Springer International Publishing AG, New York, pp. 3–14. https://doi.org/10.1007/978-3-319-01056-4_1

Grant, R.M., 2002. The knowledge-based view of the firm, in: Choo, C.W., Bontis, N. (Eds.), The Strategic Management of Intellectual Capital and Organizational Knowledge. Oxford University Press, New York, pp. 133–148.

Griffin, A., Price, R.L., Vojak, B.A., Hoffman, N., 2014. Serial innovators' processes: How they overcome barriers to creating radical innovations. Industrial Marketing Management 43, 1362–1371. https://doi.org/10.1016/j.indmarman.2014.08.010

Gupta, A.K., Govindarajan, V., 1991. Knowledge flows and the structure of control within multinational corporations. The Academy of Management Review 16, 768–792.

Harvey, J.-F., Cohendet, P., Simon, L., Borzillo, S., 2015. Knowing communities in the front end of innovation. Research-Technology Management 58, 46–54. https://doi.org/10.5437/08956308X5801198

Harvey, M.G., Griffith, D.A., 2007. The role of globalization, time acceleration, and virtual global teams in fostering successful global product launches. Journal of Product Innovation Management 24, 486–501. https://doi.org/10.1111/j.1540-5885.2007.00265.x

Harzing, A.-W., Noorderhaven, N., 2006a. Knowledge flows in MNCs: An empirical test and extension of Gupta and Govindarajan's typology of subsidiary roles. International Business Review 15, 195–214. https://doi.org/10.1016/j.ibusrev.2006.01.001

Harzing, A.-W., Noorderhaven, N., 2006b. Geographical distance and the role and management of subsidiaries: The case of subsidiaries down-under. Asia Pacific Journal of Management 23, 167–185. https://doi.org/10.1007/s10490-006-7165-x

Herstatt, C., Verworn, B., Nagahira, A., 2004. Reducing project related uncertainty in the" fuzzy front end" of innovation: a comparison of German and Japanese product innovation projects. International Journal of Product Development 1, 43–65. https://doi.org/10.1007/3-540-31248-X_16

Hohberger, J., Wilden, R., 2022. Geographic diversity of knowledge inputs: The importance of aligning locations of knowledge inputs and inventors. Journal of Business Research 145, 705–719. https://doi.org/10.1016/j.jbusres.2022.03.016

Ichijo, K., von Krogh, G., Nonaka, I., 1998. Knowledge enablers, in: von Krogh, G., Roos, J., Kleine, D. (Eds.), Knowing in Firms: Understanding, Managing and Measuring Knowledge. Sage Publications, London, pp. 173–203.

Johanson, J., Vahlne, J.-E., 2009. The Uppsala internationalization process model revisited: From liability of foreignness to liability of outsidership. Journal of International Business Studies 40, 1411–1431. https://doi.org/10.1057/jibs.2009.24

Kafouros, M., Hashai, N., Tardios, J.A., Wang, E.Y., 2022. How do MNEs invent? An invention-based perspective of MNE profitability. Journal of International Business Studies. https://doi.org/10.1057/s41267-021-00499-y

Kleinschmidt, E.J., De Brentani, U., Salomo, S., 2007. Performance of global new product development programs: A resource-based view. Journal of Product Innovation Management 24, 419–441. https://doi.org/10.1111/j.1540-5885.2007.00261.x

Koen, P., Ajamian, G., Burkart, R., Clamen, A., Davidson, J., D'Amore, R., Elkins, C., Herald, K., Incorvia, M., Johnson, A., others, 2001. Providing clarity and a common language to the fuzzy front end. Research-Technology Management 44, 46–55. https://doi.org/10.1080/08956308.2001.11671418

Koen, P.A., Bertels, H.M.J., Kleinschmidt, E.J., 2014. Managing the front end of innovation part-I. Research-Technology Management 57, 34–43. https://doi.org/10.5437/08956308X5703199

Kogut, B., Zander, U., 1993. Knowledge of the firm and the evolutionary theory of the multinational corporation. Journal of International Business Studies 24, 625–645. https://doi.org/10.1057/palgrave.jibs.8490248

Markham, S.K., 2013. The impact of front-end innovation activities on product performance. Journal of Product Innovation Management 30, 77–92. https://doi.org/10.1111/jpim.12065

Markham, S.K., Ward, S.J., Aiman-Smith, L., Kingon, A.I., 2010. The valley of death as context for role theory in product innovation. Journal of Product Innovation Management 27, 402–417. https://doi.org/10.1111/j.1540-5885.2010.00724.x

Mayrhofer, U., Urban, S., 2011. Management international: Des pratiques en mutation. Pearson Education France, Paris.

Miles, M.B., Huberman, A.M., 1994. Qualitative data analysis: An expanded sourcebook. SAGE Publications, Inc, Thousand Oaks.

Mudambi, R., Swift, T., 2012. Multinational enterprises and the geographical clustering of innovation. Industry and Innovation 19, 1–21. https://doi.org/10.1080/13662716.2012.649058

Neukam, M., 2017. Managing the fuzzy front-end in multicultural teams. European Journal of Innovation Management 20, 578–598. https://doi.org/10.1108/EJIM-11-2016-0112

Neukam, M., Guittard, C., 2018. Reach for the stars: knowledge sharing in international organizations. Journal of Innovation Economics Management 27, 9–35. https://doi.org/10.3917/jie.027.0009

Noorderhaven, N., Harzing, A.-W., 2009. Knowledge-sharing and social interaction within MNEs. Journal of International Business Studies 40, 719–741. https://doi.org/10.1057/jibs.2008.106

Parjanen, S., 2012. Experiencing Creativity in the Organization: From Individual Creativity to Collective Creativity. Interdisciplinary Journal of Information, Knowledge, and Management 7, 109–128. https://doi.org/10.28945/1580

Reid, S.E., De Brentani, U., 2004. The fuzzy front-end of new product development for discontinuous innovations: A theoretical model. Journal of Product Innovation Management 21, 170–184. https://doi.org/10.1111/j.0737-6782.2004.00068.x

Szulanski, G., 2003. Sticky Knowledge - Barriers to Knowing in the Firm. SAGE Publications Inc, London; Thousand Oaks.

Verworn, B., Herstatt, C., Nagahira, A., 2008. The fuzzy front end of Japanese new product development projects: Impact on success and differences between incremental and radical projects. R&D Management 38, 1–19. https://doi.org/10.1111/j.1467-9310.2007.00492.x

Von Krogh, G., Ichijo, K., Nonaka, I., 2000. Enabling knowledge creation: How to unlock the mystery of tacit knowledge and release the power of innovation. Oxford University Press on Demand.

Von Zedtwitz, M., 2020. Communication and Knowledge Flows in Transnational R&D Projects, in: Tiwari, R., Buse, S. (Eds.), Managing Innovation in a Global and Digital World. Springer Gabler, Wiesbaden, pp. 227–252. https://doi.org/10.1007/978-3-658-27241-8_15

Wang, M.-C., Chen, P.-C., Fang, S.-C., 2018. A critical view of knowledge networks and innovation performance: The mediation role of firms' knowledge integration capability. Journal of Business Research 88, 222–233. https://doi.org/10.1016/j.jbusres.2018.03.034

Yeung, H.W., 2021. Regional worlds: from related variety in regional diversification to strategic coupling in global production networks. Regional Studies 55, 989–1010. https://doi.org/10.1080/00343404.2020.1857719

Yin, R.K., 2003. Case study research: Design and methods. SAGE Publications, Thousand Oaks.

APPENDIX A

Extract of the Coding Process: Verbatim for Coordination Mechanisms

Quote	1st order code	2nd o. c.
"It's frustrating when the project you worked on is not developed. But on the other side, there are therefore other projects that can be realized. [...] With all the steps we have now in the process, we can decide more rapidly if we want to continue on that project or not. We ask ourselfs the right questions right away." (1P5C)	Clear process facilitate resource prioritization.	Facilitators of internationl Collaboration
"FLUID claimed [after 2001, ed.*] that France is an important entity and it is important to maintain it, also due to historical reasons. There was now a new top-management team in France and they said: 'ok, we'll try it'. After some years, they saw that this worked out and that the people started to work with Germany."* (1FA)	Top-management commitment to international activities	
	Strategic embeddedness favors cross-country collaboration	
"The communication channels are short. I have a good contact to the colleagues from France. [...] Everywhere else, you have to talk to your boss first, he talks to his boss, and only now you get the permission 'ok, you are allowed to talk to each other'. This is not the case at FLUID. I only take the phone and I get my information." (2FE)	Information and knowledge circulation facilitated by flat hierarchies	
"I think that the CEO has a huge influence on the atmosphere. He attached great importance to the FLUID culture and expected us to live these values and to act with respect for the corporate strategy." (2FH)	Local Manager: High identification with headquarters	
"[the local subsidiary] was founded as a research entity, because there are universities closely located and we can access talents more easily."(2P5B)	Top-management commitment to international activities	
"The local manager was at the same time also team coach of an R&D team here at the headquarters. [...] Over those last years, this created a very strong collaboration between the teams" (2P5B)	Local manager acts as broker between dispersed teams	
"I remember the time [before 2001, ed.] when I started to work for FLUID. We did not have permission to go to the headquarters. During my first two years at FLUID, I think that I have only been to Germany twice. We did not have permission to go to the headquarters." (1FA)	Local Managers: barrier to cross-country collaboration	Barriers to international Collaboration
"The local employee thought: 'I have a really good idea with a high market potential which will revolutionize the market. But if I insert it into the official innovation processes, the idea might be averted and this will not work. I'll do it locally.' I don't think that he had a malicious intention. They only feared that their idea would not be accepted and they did not have enough trust" (2FG)	Fear of project stop leads to knowledge-hiding behavior	
"We were innovative, but perhaps even a little too much. [...] we were known on the French market [for that technology], but not really in Germany as we do not have any activity in this domain over there."(1P5C)	Perceived varying market acceptance in different countries	
"If you don't send it [the idea, ed.*] to the right address, it remains somewhere in the factory."* (2FH)	Innovation process is perceived as black box	