Resource interaction in product development: a cross-functional analysis

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by

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Competitive paper

Abstract

Inter-organizational collaboration and joint resource combining is a necessity in new product development (NPD) in order to access technology and knowledge of various actors. The aim of this paper is to investigate how customer relationships in NPD involving technology that is new to the firm affects product development. A single case study is conducted at a world leading industrial tool manufacturer. The project under study is the development of a product that is new to the firm, a new application, that involves a world leading automotive manufacturing customer as well as two specialized suppliers. In their efforts of developing a hand-held digitalized tool for quality assurance in the production of cars numerous resources are combined over time, crossing the boundaries of several actors. Data has been collected through semi-structured interviews with nine representatives of three units of the industrial tool manufacturer. In addition, secondary data in the form of protocols and other documents containing information of the product development process provide important input to the case. Analysis of the case consists of identification of key resource interactions in the product development process where business relationships are of significant importance. Thus, inter-organizational interaction comes in focus and in combination with analysis of cross-functional collaboration several findings are revealed. The study points to the meaning of managing knowledge sharing with external partners as well as within the focal firm. Having customer and supplier relationships in order to organize and manage collaborative development is of significant importance for firms that traditionally focus on manufacturing hardware products to provide digitalized products. The study thus demonstrates how product focused firms embrace new digital technology. In addition, customer contribution varies over time depending on the need for specialized resources, for instance, technology and knowledge, as in-put for the product development through joint resource combining. Accordingly, relationships with external partners are managed differently depending on their scope of contribution in the product development project. Finally, the study shows that in addition to fruitful external relationship collaboration, firms need to have well-functional collaboration among various internal functions in order to reap the most benefits from external collaborations in NPD.

Keywords: product development; inter-unit collaboration; resource interaction; cross-functional

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INTRODUCTION

Interaction in business relationships is a significant means for new product development (NPD). As technologies are evolving faster products are becoming more complex and actors becoming more specialized, firms do not possess all necessary technologies in-house. Inter-organizational collaboration and joint resource combining hence becomes a necessity for product development. In particular, many studies point to the benefits for firms of involving customers in product development processes (see e.g. Gadde et al., 2012; Laage-Hellman et al., 2014; Lagrosen, 2005). In line with this, as of today, product development through customer collaboration has become a necessity to embrace digital technologies for traditional hardware focused companies in order to develop products with content of software. However, there is a lack of studies focusing on interaction among firms and their customers in this specific context of hardware product focused companies copying with development of a product that is new to the firm in terms of digitalized technology.

New product development commonly involves intra-collaboration taking place among various functions in the firm. Moreover, the external connections to other firms these respective functions have add to the complexity in terms of organising the product development process. In this process, internal and external resources are combined for the purpose of creating something new. Crucial for this resource combing is the business relationships as they provide the arena for interactive resource development (Gadde & Håkansson, 2001; Håkansson & Snehota, 1995).

The aim of this paper is to investigate how customer relationships in NPD involving technology that is new to the firm affects product development. The investigation explores how firms collaborate with customers in interaction in NPD projects and addresses the challenges that are faced in such product development collaborations.

THEORY

The investigation of customer relationship involvement in NPD calls for a theoretical foundation capturing resource interaction, inter-unit collaboration and cross-functional collaboration. This is further explored below.

Resource interaction in product development

Due to heterogeneity, the value of a resource depends on the way it is being combined with other resources (Penrose, 1959). The development of new products thus calls for resource combining, either in a different way than before among existing resources or by "bringing in" new resource to an existing context. To investigate product development from an interactive perspective the 4R-model has been developed as a research tool for studying the interplay between physical and organizational resources (Håkansson & Waluszewski, 2002b). Physical resources include: *i) products* being exchanged among firms and *ii) facilities* that are used for the transformation and exchange of products. Organizational resources comprise of: *iii) business units* that entails skills and capabilities needed for resource development and, *iv) business relationships* between organizations involved in resource combining. The 4R-model has been applied in several studies of resource development (see e.g. Baraldi, 2003; Holmen, 2001; Ingemansson, 2010). Through the interplay among resources various types of connections evolve, so called resource interfaces (Gadde & Håkansson, 2008; Håkansson &

Waluszewski, 2002a). Resource interfaces can be standardized in such a way that the resource can be combined with further resource without any specific modification of adjustments. Another option is to adapt the interfaces between any two (or more) resource as to make them function better together in a certain resource constellation. As this might improve resource interaction in that particular constellation this will also restrict the ability to combine with other, not adapted, resources.

At one point in time, technical and organizational resources are combined in a certain way for specific purposes. In order to allow for development, over time these resource combinations are changed to form new resource constellations. This development process can therefore be analysed by capturing how the constellation of resources change over time in illustrations of "snapshots of time" of central development episodes for the purpose of new product development. Experiences form previous interaction episodes influence and impact on current episodes and their outcomes (Håkansson et al., 2009).

Accordingly, the first research issue concerns how resources interact over time in product development processes.

Inter-unit collaboration

A review on innovation in networks point to the importance of relationships, in particularly trust, communication and commitment (Blomqvist & Levy, 2006). In a similar vein, Tsai (2001) shows that firms' organizational units are more innovative if they have a central network position and have access to knowledge that is produced in other units. In addition, Tsai (2001) points to the importance of absorptive capacity, where firms are able to integrate and use new knowledge. Hence, it seems that accessing different knowledge bases and being able to combine these are important in product development. However, in order to access knowledge, relationships are important. Relationships built through previous collaborations facilitate knowledge sharing as settings for coordination between individuals already has been established.

Previous research has indicated that the internal organization of the buying firm influences the relationship between the partners and eventually the outcome of the cooperative venture. Studies on supplier management point out that the way firms organize internally is related to the way they interact with external firms (Dubois & Wynstra, 2005; Eslami & Lakemond, 2016; Hessel, 2014). In the interaction with suppliers, purchasing is an important function in the firm. As purchasing has evolved from an operational function to a strategic asset in firms, it has become an important contributor in collaborative NPD involving suppliers (Luzzini & Ronchi, 2011; Schiele, 2006; Walter, 2003). As such, purchasing collaborates with specialists from other functions of the firm and manages supplier relationships. Similarly, marketing and sales are important functions when firms collaborate with customers in NPD.

The second research issue thus investigates organizational units and how inter-unit collaboration affects product development.

Cross-functional collaboration

Internal collaboration within firms between functions are important, as these are identified as mechanisms for both incorporating knowledge from external collaborations as well as initiating new external collaborations (Hillebrand & Biemans, 2003). There are many studies focusing on cross-functional collaboration in product developments (see e.g. Lovelace et al., 2001; Melander, 2018; Sethi et al., 2001). There are a number of studies identifying important factors

for cross-functional collaboration. In collaborative efforts, physical proximity facilitates coordination and interaction between functions (Okhuysen & Bechky, 2009). Similarly, alignment of multiple functions within the firm is important (Storbacka et al., 2011). Internal facilitators that have effect on cross-functional collaboration in NPD are identified as a firm's evaluation criteria, reward structures and management expectations (Song et al., 1997). Goals, rules and procedures and physical proximity impact collaboration in cross-functional teams (Pinto et al., 1993).

McDonough (2000) reviews literature on cross-functional collaboration in new product development and identifies a number of factors influencing team success. These factors are categorized into "stage setters", "enablers" and "team behaviours". Stage setters include project goals, empowerment, human resources and climate. Enablers consist of team leaders, senior management support and champions. Finally, team behaviours include cooperation, commitment, ownership and respect/trust. Teams with greater levels of functional diversity tend to have greater level of disagreements (Lovelace et al., 2001). The authors show that the effect of that disagreement on the team's performance depends on three things: how the disagreement is being communicated, how free the team members are to express doubts and how effective the team leader is perceived to be. Sethi et al. (2001) investigate cross-functional development teams and identify contextual influences and team characteristics that affects innovativeness. Contextual influences include extent of project monitoring, customers' influence and encouragement to take risk. Team characteristics include social cohesion, superordinate identity and functional diversity. However, the authors find that functional diversity has no effect on innovativeness. Although many studies have been made on cross-functional collaborations and what makes these collaborations successful, there is no clear answer on how firms should act. That is due partly to that internal collaboration between functions in projects is a complex and dynamic process (Calamel et al., 2012).

The third research issue addresses how cross-functional collaboration influences product development.

METHODOLOGY

A qualitative case study was conducted as it allows for capturing the phenomenon in a real-life context (Halinen & Törnroos, 2005) and allows for understanding dynamics in a specific setting (Eisenhardt, 1989). A firm called IndTool (fictitious name) was selected as it is a leading global manufacturing firm that is used to collaborate both internally across functions and units as well as externally with customers and suppliers in new product development. IndTool has customers with high demand on sustainable development and IndTool's suppliers are leading in new technologies. IndTool is a manufacturer of industrial tools. A purposive sampling strategy was used to select a case that was particularly instructive for this research, aimed to understand new product development involving three internal units (Patton, 2002). The case involves a number of internal functions and organizations at different geographical locations at IndTool. The case aims to illustrate resource combining in new product development as well as business networks and relationships (Siggelkow, 2007). To ensure that rich data could be attained, IndTool participated in the case sampling.

The product under study is a quality product aimed towards automotive manufacturing plants. IndTool develops a number of quality products, but this product, here called DigiQual, has an application that is new to IndTool. An interview guide was made that incorporated the main topics while allowing for flexibility and follow-up questions. Semi-structured interviews were

conducted with nine knowledgeable individuals at IndTool. The respondent and their organizational belonging is shown in Table 1.

Respondent	Organizational location
Sales manager	US
Sales zone manager	US
Product marketing specialist	US
After sales specialist	US
Product specialist	US
R&D manager	Sweden
R&D project manager	Sweden
Voice of the customer manager	Sweden
Business manager	Italy

Table 1 Respondent and their organizational belonging

All interviews were made face-to-face except one interview that was made by phone. The interviews lasted between one to three hours. Two individuals were interviewed multiple times to follow-up the project's progress. In addition, documents were studied consisting of project reports, internal documents and practices for external collaborations. A case report was written where narratives were presented to include rich and detailed descriptions of the project.

A within case analysis was conducted where data was analysed, organized, categorized and coded (Eisenhardt, 1989). Data was coded and structured according to time perspective, interactions and 4R as well as cross-functional collaborations to create a story from the occurrences in the project (Miles & Huberman, 1984). By using interview-data, microanalysis was made that took the interviewees' interpretations of the project into consideration (Strauss & Corbin, 1998). Empirical data and theory were systematically compared in an iterative process (Dubois & Gadde, 2002; Eisenhardt, 1989). Key variables from theory was used to categorized data that was displayed in a meta-matrix. A case study database was used to store collected and analyzed data (Yin, 2009).

DIGIQUAL: NEW PRODUCT DEVELOPMENT

The case of DigiQual starts with a description of the organizations involved in the development of the tool. Thereafter, three significant phases are presented, where each phase represents various steps in the product development process.

Organizations involved in the development of DigiQual

One of IndTool's most important products is a hand-held tool used in various production lines for manufacturing in for instance the automotive industry. The product under study, DigiQual, is an accessory that belongs to a product group closely associated with the hand-held tool. The product is a measurement tool that can be described as having a hardware part and a software part that are integrated. DigiQual, is classified as quality equipment. IndTool is a large global company with clear boundaries for their products, where it is clear within IndTool which organizations that owns which type of products. However, there is some flexibility as well, as it is possible for organizations to do new product developments for their national market. For example, a specific factory is responsible for a product range globally. But a national entity is allowed to develop a product within that range for their own national market if needed. The handheld tool is a central product for IndTool. DigiQual is a quality product and is considered

an accessory. DigiQual is a product developed for the car manufacturing plants, but it can be used in other manufacturing plants as well.

For this case story, three different organizational locations have been involved: US, Italy and Sweden (see Figure 1). The headquarter is located in Sweden, where the hand-held tool is developed and manufactured. For the hand-held tool, there is a global market team and a global product owner also located here. The global product owner is mainly concerned with the technical aspects of the product, future development, production and quality. The global market team supports local market teams around the world. They contact the different local markets and gather information about the customers' needs. The global market team makes sure that IndTool has the right product offerings and collaborates with the global product owner to ensure that R&D efforts are focused on what the market requests. The factory and R&D team for quality assurance products is located in Italy. They also have a global market team and global product owners for their products. The US organization consists of application center, service, administration and market support. There is a local market team and product support in the US. Within IndTool, US is the biggest customer centre. It was IndTool's US organization developed the DigiQual product, which is in the product range belonging to the Italian organization.

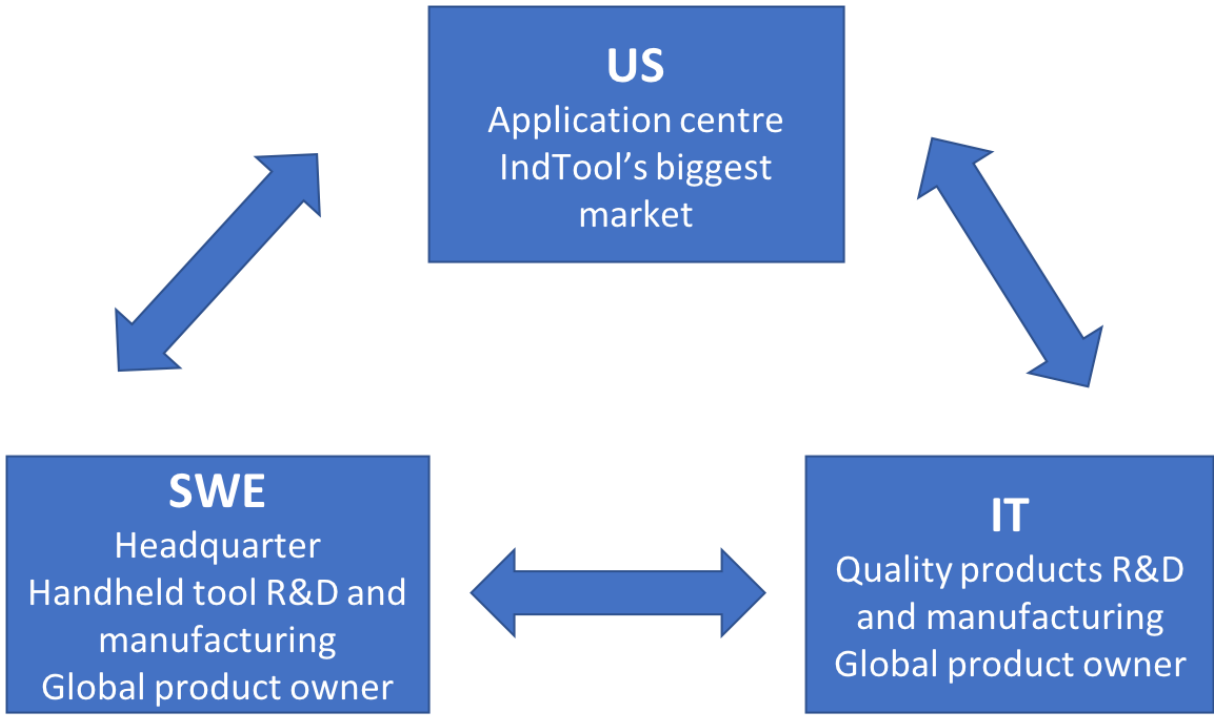

Figure 1 Units at IndTool in the study

External collaboration partners in the development of DigiQual are a customer and two suppliers. The customer is one of the world's largest automotive manufacturers. The customer's manufacturing plant that was involved is located in the US. The customer has close collaboration with IndTool's US organization, with almost daily communication between the two firms. The suppliers are two small specialized suppliers located in the US. One supplier provided hardware, where specifications are quite clear. The other supplier provides software for DigiQual, here the relationship is of a more collaborative nature, where IndTool and the supplier has a strategic partnership. The supplier is leading in the field of wireless handheld communication devices for industrial applications.

Identifying the need for a new quality product

Sales representatives in the US visit their customers on a daily basis and have very good contacts within these firms. When visiting the customer in this case, sales representatives identified the potential for the new sale, a measurement instrument. In order to further develop the idea of this product, IndTool started a partnership with the customer.

The development of DigiQual within IndTool was not a clear path. Sales representatives presented the idea of a new product, DigiQual, to the US sales group. By developing this product IndTool could provide quality assurance to more areas in the automotive plant. Before, IndTool provided quality measurement tools for torque, but with a new product they could provide quality measurements in other areas of the plant as well. The US sales contacted the global product owner in Sweden to ask them to start a development project for this new product. However, this product, considered a quality product, was not within the product range for the Swedish factory and R&D. It was another subsidiary in Italy that made the accessories, which has close collaborations with the Swedish organization.

The US organization then contacted the Italian global product owner and asked them to develop the product. There was limited response from the Italian organization. The US organization got some backing from the Swedish organization but was not able to influence the Italian organization. The Italian R&D was not interested in developing this product, pointing out that they did not have the time for this R&D project as they are busy focusing on their other products. After several attempts to get attention to this new product idea without response, the US organization decided to develop the product themselves.

New product development for the local market

The customer provided input and influenced the development of DigiQual. The customer pushed for a sustainable product and explained the needs from the factory and manufacturing processes. The customer also described what the customer would like to be able to do with the new product and which applications that would be useful, as well as technological limitation in the plant. Together with the customer IndTool developed a set of needs and features for the product. The customer also participated in the test phase of DigiQual.

Previously, most data collection tasks were done manually within the customer's automotive plant. Existing technologies have made it possible for digital data collection, but there was limited use of software for this purpose. Before DigiQual, IndTool did not have a product for this type of data collection in their product portfolio, and thus R&D investments were needed. The main enabling factors for this product was technical development and the transformation in digitalization happening at the customer's factories. The customer wanted to integrate software into handheld hardware to be used in a number of data collection processes. IndTool also knew that the customer wanted flexibility in the product and that its quality operations should be more sustainable. DigiQual is a little hand-held device with software, scanner and Bluetooth connection.

Since IndTool's US organization had formed a partnership with the customer and had a good idea of what type of product they wanted to develop, they decided to develop the product in the US limited to the US market. By developing it themselves they could to get a product faster to the customers. By involving the customer and two expert suppliers to provide the hardware and software for the product, the US organization managed to develop DigiQual for the local US market. DigiQual was introduced to the US market, first to the customer who participated in

the product development, and then to other customers. DigiQual sells well in the US for being new to the market. It has been a very good development for this type of product.

The customer performs a large number of inspections, data collections and documentations in the production processes at the automotive factory. Before DigiQual, the customer applied a very limited use of digitalization for quality operations, although the technologies for digital data collection and documentation were available. Instead, pen and paper were used for visual inspection documentations. DigiQual has replaced these manual proceedings and enabled higher quality documentation by providing bar code scanning, camera for taking pictures, Wi-Fi for providing locations and uploading forms and pictures. Previously, data as well as visual defect descriptions were manually loaded to computers for storage. Hence, DigiQual has provided better logging of defect products.

For quality assurance, the customer conducts a number of measurements manually during the manufacturing process. These were previously written on paper and later transferred manually to a computer for uploading in the system. DigiQual can conduct some of these measurements and log these directly to the network. Other measurements can be read by DigiQual and uploaded or put manually in DigiQual for direct upload to the network. Similarly, inspections are made in vast carparks of newly produced cars. Operators have to locate a specific car and check some specific aspects of that car. Previously, there has been a problem of finding the correct vehicle and operators have cheated the system by simply claiming to have performed an inspection without actually having located the vehicle. By using DigiQual, operators can easily locate the vehicle by tracking it. Photos of the vehicle ensures that the operator has located the correct vehicle as well as ensures that inspections of specific parts have been conducted by uploading photos of these parts. Hence, DigiQual has improved quality and accuracy of inspections. DigiQual has improved quality assurance as well as traceability of repairs by using barcode scanner, where date, time, repairs, spare parts and operators are logged into the system. Hence, the new product improves productivity, reduces costs and risks. Quality assurance uses digitalization to improve quality and reduce manual labour.

The customer that participated in DigiQual's development wants to buy this product for their factories in other countries. But IndTool only allows for DigiQual to be sold to the US market. However, for the customer, IndTool is a global company who should be able to sell their products globally.

A new product for the global market

The success of DigiQual and future potential of digital quality product has gotten IndTool's Italian R&D's attention. After DigiQual's introduction to the US market, IndTool's Italian R&D has now started their own R&D project to develop a similar measurement tool for the global market. The Italian R&D is developing software for the new hand-held tool where the US sales provide input from their experience with DigiQual and input from customers. The new product will be more complex than DigiQual and will be able to complement a wider range of products. It is a big undertaking for IndTool, as the product needs to be able to communicate with a number of different applications and software. Once the new product has been developed it will replace DigiQual in the US, and it will be sold globally to automotive manufacturers, as well as to similar industries.

The global product will have a higher digital content, have more functions and be able to communicate with a wide range of IndTools other tools sold to car manufacturers. It is particularly important that the quality product can be integrated with the handheld tool that

IndTool has. Hence, the Italian unit has much communication and joined work with the Swedish unit, which is responsible for the handheld tool. Here, R&D shares much knowledge and tests the products. In the development of the global quality product, the US organization shares its experiences with DigiQual, providing input to the development at the Italian unit. Also, through the US's customer relationships, it shares knowledge about customers' expectations and needs from a new product. The US unit and their customers also reviews ideas and prototypes that the Italian unit develops.

ANALYSIS

DigiQual is a new product enabled through digitalization with the aim to have clear sustainability gains for the customer. Through close customer collaboration, IndTool managed to develop a product that was new to the firm, had new applications and provided a number of benefits for the customer. Hence, IndTool created a new product category and thus entered a new market, something which has been pointed out as important for product developments (Dangelico et al., 2013). DigiQual, the quality assurance product in automotive operations, was able to replace a number of manual data collection tools and operations.

Resource interaction analysis

Figure 2 below illustrates the key resources involved in product development in three phases of resource interaction.

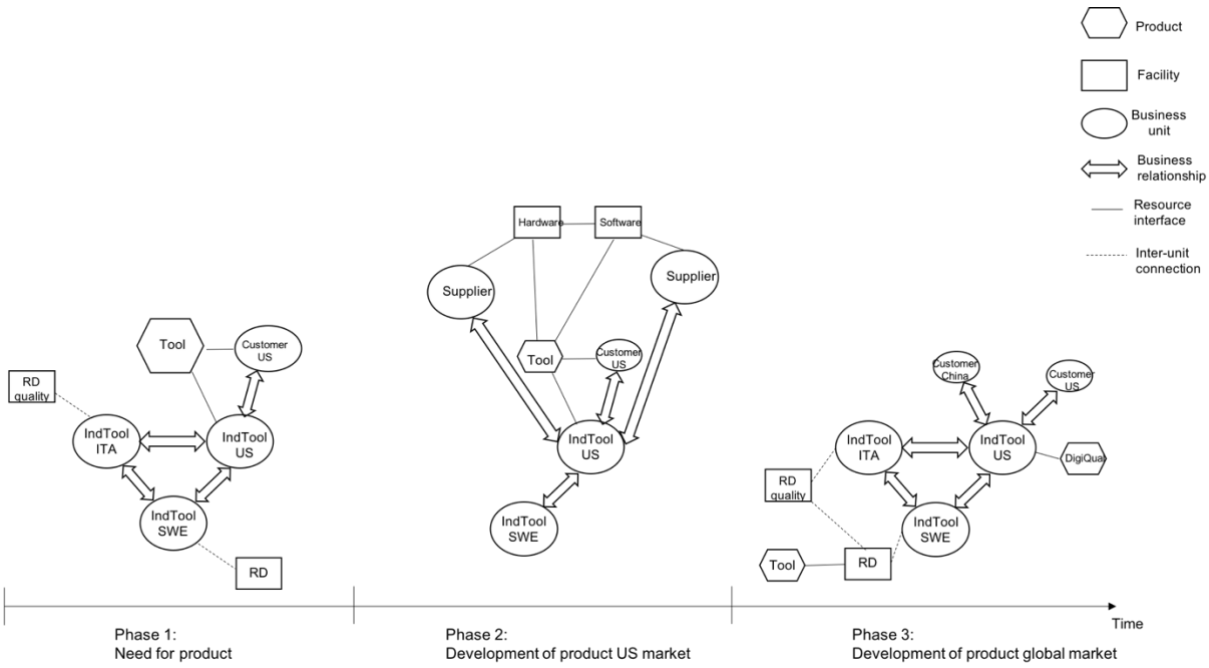

Figure 2. Resource interaction in three phases

The first phase involves the resource interaction as sales representatives as the opportunity of developing a new product, a measurement instrument, is discovered through the business relationship between IndTool US and the US customer. IndTool US thus get in contact with IndTool SWE in an attempt to activate the RD facility for this resource development. However, as the tool is considered a quality tool, the RD facility responsible for quality and being part of IndTool ITA is instead identified as the appropriate resource for development of the tool. But the unit of IndTool ITA are not interested in participating in the required resource interaction due to other internal development processes. Therefore, IndTool US develops the tool themselves in close interaction within its US customer, with an adapted resource interface to fit with the needs of the customer.

The second phase illustrates further resource development as a business opportunity to develop a tool for the US market further as to exploit the experiences from the customer interaction in the first phase. Through the development of the product DigiQual IndTool expanded their product portfolio to fit with the needs of customers asking for digitalized resources regarding quality control. DigiTool did not have that experience or knowledge in-house wherefore the interaction with two suppliers, one providing the hardware and one providing the software was crucial. DigiTool became a product adapted for the US market, with adapted interfaces to fit with customers' manufacturing resources. The digitalized features of DigiQual has improved the internal quality checking processes of the customers significantly.

In the third phase, the relationships between IndTool's units plays a significant role. Due to the success of IndTool on the US market, IndTool ITA's R&D facility working with quality wants to exploit the resource further as to enable a product that fits with customer's resource constellations on several markets. By learning from the experiences of the development of DigiTool and the feature this resource possesses, the Italian unit of IndTool now develops the quality tool further, with standardized interfaces to be able to sell the product to several markets. Moreover, more features of the resource are developed as to enable resource interaction with more resources at the customers.

The analysis of critical resources in the three phases of product development points to the significant importance of resource combining across firm boundaries as to develop new resources and exploit resource interfaces. In the next section the internal collaboration between the IndTool units are analysed further as to allow for exploration of internal coordination and cross-functional collaboration.

Internal and cross-functional collaboration analysis

This project has involved a number of internal organizations within IndTool. In line with previous research, this study also points to the importance of internal coordination (Praest Knudsen & Bøtker Mortensen, 2011; Takeishi, 2001). First, the US organization was responsible for the development of DigiQual. In order to make sure that DigiQual was a suitable complement to the firm's main product, the hand-held tool, the US organization collaborated with the Swedish organization that is responsible for that tool. In addition, the Italian organization is running the development of the product that will replace DigiQual and are collaborating with the US organization regarding their experiences with DigiQual. Hence, there was geographically cross border collaborations within IndTool regarding this product. This study shows that geographical, technological and organizational proximity (Knoben & Oerlemans, 2006) influences intra-firm collaborations as well as inter-firm collaborations. There have been some internal struggles, as the US organization wanted the Italian organization to develop a global product, but they showed limited interest in that product from the start. Despite pushing the Italian organization as well as getting support from the Swedish headquarter, the US organization did not get any commitment for their product idea. Hence, they decided to develop the product by themselves for the national market.

The project involved collaborations across organizations and functions. It is shown that coordination within large firms which have specialized departments can be particularly challenging (Clark & Wheelwright, 1992). In this project, sales and marketing have been vital for the development of DigiQual through their good relationship with the customer. Purchasing has had an important role in managing the supplier relationships in this project, similar to studies of supplier involvement in product development (see e.g. Luzzini & Ronchi, 2011; Melander & Lakemond, 2014; Schiele, 2006). These functions have collaborated with R&D in

order to develop DigiQual. Knowledge needed to be transferred between the functions, in particularly customer in-put needed to be described not only within IndTool, but also to the suppliers involved. A success factor for this project was the ability to create an understanding for the customer's processes and needs, as well as limitations for applying new technology in the automotive plant. Alignment between functions and across organizations has been challenging, but an important factor in order to succeed in the development of the new global product.

CONCLUSIONS

This study provides a resource interaction analysis of collaborative product development in an inter-unit context involving several functions.

In conclusion, the study has shown the significant importance of customer relationships in order to organize and manage collaborative product development. In addition, the interaction with suppliers through business relationships is equally important, especially in the case for firms that traditionally focus on physical products to provide products with large software content in line with the digitalization trend. The study thus demonstrates how product focused firms, such as IndTool, embraces new digital technology. In addition, collaboration varies over time depending on the need for specialized resources, for instance, technology and knowledge, as in-put for the product development through joint resource combining.

This study has also shown the importance of inter-unit collaboration in product development, in particularly in sharing knowledge across units. Similarly to Tsai (2001), we point to the importance of position in the network as well as the ability to share, access, integrate and co-develop new knowledge. Our study shows how both external and internal knowledge is shared across units. First, customer knowledge is shared across units to enable new product development. This knowledge consists of both market and technological knowledge. Second, internal knowledge is shared in order to develop a new product that is compatible with the firm's other products. Here, technological knowledge as well as market knowledge is shared across units. Our study has also shown how limited relationships between units acts as a barrier to new product development and knowledge sharing. Hence, not only do firms need to consider their external relationships in product development, but also their internal relationships across units as well as between functions.

This study confirms previous findings that cross-functional collaborations are important when involving external organizations in product development (Chadha, 2011; Takeishi, 2001). As this project involved both customer and suppliers, both sales and purchasing were important functions that needed to collaborate and share knowledge. As suggested by Curwen et al. (2013), it was important to have a clear goal and organizational capabilities. Functions within the firm that usually did not collaborate, namely sales and purchasing, had extensive communication and shared knowledge. As suggested by Wong (2013) the firm needed to develop knowledge management practices. Research often point to the importance of sharing knowledge with external partners (Rosell et al., 2017), but in this project, sharing knowledge within the firm was also important. For the future development, the firm shared knowledge it had gained from the development of DigiQual in the US to the Italian team that is developing the global quality assurance product. To access the customer's knowledge, sales was an enabling function, and very important for gathering information about what had been successful with DigiQual and which features that need further developments.

This study has some limitations. Interviews have been made with the focal firm, individuals at the customer and the suppliers have not been interviewed due to limited access to these firms. A single case cannot be generalized. However, the aim of this study is not to provide statistical representativeness but to provide a rich description and understanding of a specific phenomenon. Future research could investigate how firms integrate and share knowledge with additional actors in resource combining efforts when developing digital solutions.

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