# Cross-functional integration for managing customer information flows in a project-based firm


## ABSTRACT

The delivery of integrated solutions calls for effective integration across the functional interfaces of the project-based firm (PBF) throughout the solution's life cycle. We scrutinize cross-functional integration in a triadic setting involving the PBF's sales, project operations, and services functions by focusing on the flow of customer information (information from and about customers) across three functional interfaces. Drawing on a qualitative case study, we develop a categorization consisting of four distinct types of integration mechanisms: *meetings, IT systems, personal involvement,* and *processes and rules*. Our results show that in the focal PBF, customer information flows are strongest in the sales–project operations interface and weakest in the sales–services interface. Furthermore, sales and services functions were found to rely predominantly on *personal involvement* mechanisms in transferring customer information. Our results highlight the need to integrate and manage customer information flows, especially between the sales–services interface, when delivering integrated solutions.



**Keywords:** integrated solutions, customer information, cross-functional integration, integration mechanisms


## 1. CROSS-FUNCTIONAL INTEGRATION IN SOLUTION DELIVERY PROJECTS

A project-based firm (PBF) needs to manage customer information effectively so that a solution meeting the customer's unique needs can be delivered. Customer information deals with the information that is gathered about customers (information about potential customers and customer segments) and from customers (information fed back or contributed by existing customers, such as information regarding their preferences) (Perks, 2000; Rollins and Halinen, 2005; Rowley, 2002). The focus of this study is on cross-functional integration in solution delivery projects, which relates to managing customer information in a PBF across functional interfaces. In PBFs, sales, project operations, and services

functions are often separated and have their own tasks and responsibilities throughout the project life cycle, but they all need customer information to carry out their work. Since projects are temporary organizations that involve individuals from different functions, acquired information (e.g., documents) and experiences (e.g., learning from the projects) may be difficult to transfer across functional boundaries during and after the project (Adenfelt and Lagerström, 2006; Disterer, 2002; Prencipe and Tell, 2001). Information flows may be hampered, for example, because information is not stored systematically, it is irrelevant to future projects, its sharing is not common practice or desirable to individuals, or it is dispersed all over the permanent organization.

To manage customer information effectively, the PBF needs integration across the functional interfaces. Integration has been acknowledged as capable of responding to the challenge of information sharing in organizations (e.g., Barki and Pinsonneault, 2005; Galbraith et al., 2001; Lawrence and Lorsch, 1967; O'Leary-Kelly and Flores, 2002). By integration (or organizational integration), we refer to "a process of achieving unity of effort among the various subsystems in the accomplishment of the organization's tasks" (Lawrence and Lorsch, 1967: p. 4) that reflects a broader concept comprising both internal and external components (such as organizational units, departments, and partners, from suppliers to customers) (Barki and Pinsonneault, 2005). In firms organized functionally, integration can offer several advantages — such as an increase in the frequency of communication and flexibility of the resource use — as well as disadvantages, such as organizational conflicts between individuals from different backgrounds and increased costs in terms of managing the coordination between functions (e.g., Davis and Lawrence, 1978; Ford and Randolph, 1992; Galbraith et al., 2001).

However, cross-functional integration in PBFs still remains a difficult challenge to overcome, despite numerous studies on different settings and contexts (e.g., Adler 1995; Artto et al., 2015; Kraut and Streeter, 1995; Nidumolu, 1996; Sicotte and Langley, 2000; Turkulainen et al., 2013). Earlier studies have emphasized the challenges of integration between sales and manufacturing (e.g., O'Leary-Kelly and Flores, 2002; Piercy and Lane, 2003; Trautmann et al., 2009), sales and project operations (Cooper and Budd, 2007; Turkulainen et al., 2013), and project operations and services (Artto et al., 2015) separately, thereby focusing on a single cross-functional interface instead of three as in our study. The

integration of sales and project operations is necessary because sales links the demands of the environment (especially customers) to the internal operational capabilities of the organization so that it can develop offerings and create value for its customers (Shapiro, 1977; Turkulainen et al., 2013). Furthermore, integrating the services function, which is typically responsible for managing the service-related interactions with customers, with both the project operations and sales functions of the PBF is especially important for exploiting after-sales opportunities (such as warranties, spare parts, repairs, and maintenance) and preventing discontinuity in the customer relationship (Artto et al., 2016; Morris, 1983). The interface between project operations and services functions has received little attention (Artto et al., 2015), even though the services function plays a central role in the delivery of integrated solutions (Tikkanen et al., 2007; Wikström et al., 2010).

In this exploratory case study, we focus on Energy Systems (a pseudonym), a PBF operating globally and delivering integrated solutions for various process industries. Integrated solutions are innovative combinations of products and services designed to fulfill unique customer needs throughout the system life cycle (Brady et al., 2005; Davies, 2004; Hobday, 2000). The aim of this study is to broaden the understanding of cross-functional integration in the delivery of integrated solutions and the management of customer information across solution delivery functions' in a PBF. More specifically, we seek to reveal how Energy Systems integrates sales, project operations, and services functions across the project life cycle and thereby ensures access to customer information across the firm.

To guide this study, we pose the following research question: *how does a project-based firm manage customer information flows across functional interfaces involving sales, project operations, and service functions during the different phases of the project life cycle?* Specifically, we investigate the integration mechanisms used to support the flow of customer information across cross-functional interfaces. Organizations rely on different integration mechanisms, such as the use of routines, information technology (IT) applications, and team meetings, to manage the flow of the information, and these mechanisms differ both in their capacity to facilitate information processing and their cost of use (Galbraith, 1973; Lawrence and Lorsch, 1967; Tushman and Nadler, 1978). We also seek to reveal

how the nature of integration changes as the project proceeds across its life cycle, observing the use of different integration mechanisms in functional interfaces.

This paper is structured as follows. First, we discuss previous research on delivering integrated solutions and the integration of internal functions in the context of complex delivery projects. Then, we introduce the qualitative case study method and its analysis, followed by the findings, highlighting the integration mechanisms and customer information flows observed across the project life cycle in different functional interfaces. Finally, we discuss the implications of the findings in light of the previous literature and suggest avenues for further research.

## 2. LITERATURE REVIEW

### 2.1 Organizing the delivery of integrated solutions and the management of customer information

Many firms offer integrated solutions that are innovative combinations of products and services designed to fulfill unique customer needs (Davies, 2004; Davies et al., 2007). Such deliveries combine products and services into complete solutions to meet users' needs throughout the system life cycle (Artto et al., 2015; Brady et al., 2005; Hobday, 2000; Hobday et al., 2005). Examples of industries offering integrated solutions include shipbuilding, transport, military, capital goods manufacturing, telecommunications networks, and offshore oil and gas (Ahola et al., 2017; Hobday et al., 2005). By delivering solutions instead of products, PBFs can tailor their offerings to more accurately meet specific customer or industry needs (Davies et al., 2007). Integrated solutions may also include supplementary services (such as maintenance) delivered during the operation of the asset (Cusumano et al., 2015).

Delivering integrated solutions represents a difficult integration challenge not only between firms (Ahola et al., 2017; Hobday, 2000) but also within the focal firm, i.e., across its functional interfaces. In most PBFs, project sales and project operations (Cooper and Budd, 2007; Tikkanen et al., 2007) and services (Artto et al., 2015; Gebauer et al., 2009; Oliva and Kallenberg, 2003) are organized as separate functions. These organizational boundaries can create conflicts of interest and hinder both knowledge flows and collaboration and trust (Artto et al., 2015; Wikström et al., 2010). Poorly managed integration across the project life cycle can seriously hamper the development of customer relationships (Artto et

al., 2015; Möller and Rajala, 1999; Tuli et al., 2007). In order to achieve overall organizational goals and meet the challenges in managing the information flows, the functions involved in projects need to be linked together. For example, integration between sales and project operations functions aims to ensure that projects have access to a sufficient workforce and that the firm does not promise that which it cannot deliver satisfactorily (Cooper and Budd, 2007). Furthermore, the integration between project operations and services is vital for identifying and leveraging after-sales opportunities (Artto et al., 2015; Gebauer et al., 2009).

Delivering integrated solutions that meet customers' needs calls for established practices to collect and process customer information, that is, information about and from the customers (Gebert et al., 2003; Gibbert et al., 2002; Rollins and Halinen, 2005; Rowley, 2002; Wu et al., 2013). Relevant and accurate customer information needs to be identified and delivered to the correct functions across functional interfaces at the right time to respond to customer needs and requirements (Cova et al., 2001; Lehtimäki et al., 2009) and when developing and creating valuable solutions with customers (Griffin and Hauser, 1996). Moreover, learning from projects (Bresnen et al., 2003; Todorović et al., 2015) and creating after-sales service opportunities through customer involvement in the service innovation process (Kindström, 2010) requires the transfer and processing of customer information across functional interfaces. In a project, customer information is often embedded in the project's contract, in different document management systems, in meeting memos, and in individuals' minds and memories (Disterer, 2002; Prencipe and Tell, 2001), which makes transferring the experiences and knowledge from projects to the permanent organization a challenge (Adenfelt and Lagerström, 2006; Disterer, 2002; Lehtimäki et al., 2009; Reich et al., 2012).

A PBF delivering integrated solutions poses a specific managerial challenge in managing integration and customer information across functional interfaces. Challenges in integrating a company's marketing and sales into operations and other functions have been discussed in the context of manufacturing firms (O'Leary-Kelly and Flores, 2002; Piercy and Lane, 2003; Shapiro, 1997; Soler and Tanguy, 1998; Swink and Nair, 2007; Wind, 2005). In addition, integration has been studied in cross-organizational settings in terms of supplier integration (Ahola et al., 2017; Jaspers and van den Ende, 2006; Luzzini et

al., 2015), customer integration (Brax and Jonsson, 2009) and network integration (Jaakkola and Hakanen, 2013). Similarly, several integration challenges have been identified in new product development processes (e.g., Enberg, 2012; Gonzalez-Zapatero et al., 2016; Hirunyawipada et al., 2010; Tsai and Hsu, 2014). However, the delivery of integrated solutions requires the processing of accurate customer information. PBFs cannot rely on assumptions or the anticipation of general customer needs (common to the repetitive manufacturing industry and new product development); rather, they need to manage actual and accurate information about and from customers so that unique solutions can be delivered. In managing these information flows, a variety of integration mechanisms can be utilized.

### 2.2 Integration mechanisms and cross-functional integration in project business

Functional structures have been implemented in organizations to maintain functional specialization and to allow these functions to focus effectively on specific tasks or problems (Dietrich, 2006; Galbraith et al., 2001; Griffin and Hauser, 1996). According to Dietrich (2006), the need for integration arises because of organizational fragmentation that divides an organization into various subsystems with their own responsibilities and tasks that in turn create the need to link these units together and manage integration and coordination (Lawrence and Lorsch, 1967). Integration reflects on how harmoniously the different departments of an organization work together and how tightly coordinated their activities are (Barki and Pinsonneault, 2005). Through integration, companies aim to organize their operations so that they work seamlessly together to deliver value to their customers (Davies, 2004), achieve a competitive advantage (Barki and Pinsonneault, 2005), and increase their performance (e.g., Barki and Pinsonneault, 2005; O'Leary-Kelly and Flores, 2002; Turkulainen and Ketokivi, 2012). When integration is achieved, the organization is able to transfer, process, interpret, and exploit information across functional subunits without friction, and the organization is able to work as a unified whole (Turkulainen and Ketokivi, 2012).

A prominent stream of integration research addresses specific integration mechanisms. As organizations differ in their capacity to process information and the requirements thereof (Tushman and Nadler, 1978), firms resort to a broad range of mechanisms. Based on our review of these different mechanisms, their definitions are not particularly consistent and their usage varies depending on the context (Grant,

1996; Trautmann et al., 2009; Tushman and Nadler, 1978; Van de Ven et al., 1976). In general, the existing literature makes a distinction between *vertical* (integration within a unit through centralization, standardization, formalization, and vertical information systems, for example) and *lateral* (integration across the units, such as job rotation, cross-unit teams, and integrators) integration mechanisms (Galbraith, 1973; Nidumolu, 1996; Trautmann et al., 2009; Turkulainen et al., 2013; Tushman and Nadler, 1978). Integration mechanisms can also be categorized as *impersonal*, *personal*, or *group mechanisms* (Van de Ven et al., 1976) or as *networks*, *lateral processes*, *teams*, *integrative roles*, or *matrix structures* (Galbraith et al., 2001). The different mechanisms vary in their capacity to facilitate information processing and their cost of use (Galbraith, 1973; Lawrence and Lorsch, 1969; Trautmann et al., 2009; Tushman and Nadler, 1978). We conclude that the mechanisms are very different in nature and anticipate that the use of these mechanisms in the project business environment can vary considerably.

Cross-functional integration has received attention in project research focusing on research and development (R&D) projects (Adler, 1995; Sicotte and Langley, 2000; Song et al., 1997), system delivery projects (Artto et al., 2015; Turkulainen et al., 2013), and software development projects (Kraut and Streeter, 1995; Nidumolu, 1996). Recently, attention has also shifted toward integration in change programs and between the program and the parent organization (e.g., Dietrich, 2006; Lehtonen and Martinsuo, 2009; Turkulainen et al., 2015; Vuorinen and Martinsuo, 2018). These studies are, however, beyond the scope of this paper since we are concerned with single projects of integrated solution delivery with customer information flows (that are not studied in intra-organizational change programs or product development) specifically. Some lessons learned from previous research on cross-functional integration in project business are useful, however, and Table 1 summarizes the findings.

**Table 1.** Findings on cross-functional integration in project business.

| Author(s) | Context and method | Project type | Findings |
|---|---|---|---|
| Adler, 1995 | • Studies design manufacturing interfaces in 13 electrical and mechanical engineering organizations<br>• Firm-level analysis | Product development projects | • Identification of 12 distinct mechanisms for coordinating design and manufacturing, divided into *non-coordination*, *standards*, *schedules and plans*, *mutual adjustment*, *and teams*<br>• Pre-project, product, and process design and manufacturing phases addressed |

| Author(s) | Context and method | Project type | Findings |
|---|---|---|---|
| Kraut and Streeter, 1995 | • Surveys 65 projects in one large software development company<br>• Project-level analysis | Software development projects | • Different formal and informal, impersonal and interpersonal, electronic communication, and interpersonal network mechanisms recognized<br>• Use of formal and impersonal mechanisms correlated positively with the size of the project<br>• Informal interpersonal mechanisms were used, especially in the planning stage<br>• Electronic communication was used more often when the project was dependent on the other groups in the organization |
| Nidumolu, 1996 | • Examines 64 information system projects in various industries<br>• Project-level analysis | Software development projects | • Vertical integration through decisions made by authorized entities (project managers or steering committees) enabled project teams to reduce project risk and uncertainty<br>• Horizontal integration through mutual adjustments and communication correlated with improved project performance |
| Song et al., 1997 | • Studies cross-functional coordination between marketing, R&D, and manufacturing personnel in 300 high-technology Mexican firms<br>• Project-level analysis | New product development projects | • Effective cross-functional coordination was perceived to be a significant driver of new product performance by R&D, manufacturing, and marketing personnel, respectively<br>• External forces (such as market demand uncertainty) were not associated with internal coordination mechanisms or cross-functional cooperation |
| Sicotte and Langley, 2000 | • Examines the use of integration mechanisms and their links to project performance in a sample of 121 R&D projects in a large research laboratory<br>• Project-level analysis | R&D projects | • *Formal leadership, planning, and process specification* (and to a lesser extent *information technology use*) were related to project performance<br>• Positive effects of *horizontal structures* were apparently balanced out by their costs<br>• Integration mechanisms were least useful in less uncertain and equivocal projects |
| Huang and Newell, 2003 | • Examines the dynamics of knowledge integration in the context of cross-functional project implementation within four large organizations (a bank, an engineering firm, a retailer, and an oil company)<br>• Compares four different projects | Internal process innovation projects | • An organization's previous experience in implementing large-scale projects played a key role in determining the level of its integration efficiency and scope<br>• Knowledge integration was found to be in essence a process of engaging organizational members through the promotion of project benefits and the management of social networks |
| Adenfelt, 2010 | • Studies how knowledge sharing affects transnational project performance within a multinational corporation in the communication and business intelligence industry<br>• Project-level analysis | Transnational product development project | • Addressed the importance of knowledge sharing (enabled by coordination and communication) and shared knowledge<br>• As a result of ineffective communication and coordination, there was a low degree of knowledge sharing within the transnational project, which subsequently affected performance |
| Turkulainen et al., 2013 | • Studies which contextual factors create integration needs and how global PBFs manage the integration of the sales and operations interface in three projects<br>• Project-level analysis | System delivery projects | • Different formal and informal lateral and vertical mechanisms recognized in the sales and implementation phase of the project, such as *standard procedures*, *meetings*, *liaison roles*, and *co-location of the project members*<br>• Integration was managed differently depending on the project phase |

| Author(s) | Context and method | Project type | Findings |
|---|---|---|---|
| Artto et al., 2015 | • Examines a project-based firm's four system delivery projects<br>• Integration of project and service business units at the level of a single-system life cycle | System delivery projects | • The eight micro-level integration mechanisms found were divided into *customer relationship overlap*, *enhanced internal relationship*, and *life cycle perspective* mechanisms<br>• Integrating these functions was found to enhance the marketing of long-term service agreements and deepen customer relationships |

The literature review demonstrates that a wide variety of integration mechanisms have been empirically observed in different contexts. For example, meetings, negotiations, information systems, face-to-face communication, and standards and processes have been suggested as integration mechanisms in projects (Artto et al., 2015; Cooper and Budd, 2007; Kraut and Streeter, 1995; Turkulainen et al., 2013). When examining the interfaces and cross-functionality aspect of integration, many studies have focused on a single interface (such as Adler, 1995; Artto et al., 2015; Turkulainen et al., 2013) rather than multiple interfaces. One exception is the work of Song et al. (1997), which examined a triadic setting involving marketing, R&D, and manufacturing. For example, a salesperson can play either a minor or a major *liaison role* in sharing customer needs and requirements with the project's operations (Turkulainen et al., 2013), or a service and project unit can hold formal or informal meetings from as early as the project implementation phase in order to create service opportunities (Artto et al., 2015). Studies regarding product development (Sicotte and Langley, 2000; Song et al., 1997), software development (Kraut and Streeter, 1995; Nidumolu, 1996), and process innovation (Huang and Newell, 2003) projects have adopted the perspective of project team integration in which many of the firm's functions are involved in the product development project.

These and other studies mentioned in Table 1 have investigated integration mechanisms in specific industries, therefore limiting the generalization of the results to a broader context. Indeed, many of these studies have examined how mechanisms are used depending on different contextual (e.g., Kraut and Streeter, 1995; Song et al., 1997) or temporal factors (Adler, 1995; Turkulainen et al., 2013) and how they affect performance (e.g., Adenfelt, 2010; Nidumolu, 1996; Sicotte and Langley, 2000). These studies' results highlight that the use of different mechanisms varies according to industry, project type, and project life cycle phase. In terms of how this relates to the present study, little attention has been paid to integration mechanisms used by PBFs delivering integrated solutions to integrate their sales and

project operations (Turkulainen et al., 2013) and services together (Artto et al., 2015) throughout the project life cycle. Even though some of the studies consider aspects of information processing (e.g., Adenfelt, 2010; Huang and Newell, 2003; Turkulainen et al., 2013), none specifically addresses the customer information perspective in cross-functional integration during the project life cycle.

We conclude that PBFs actively utilize different integration mechanisms to support cross-functional integration between sales, project operations, and services functions. Interfaces between these functions and their main tasks in solution delivery are presented in Figure 1, which serves as the starting point for this study.

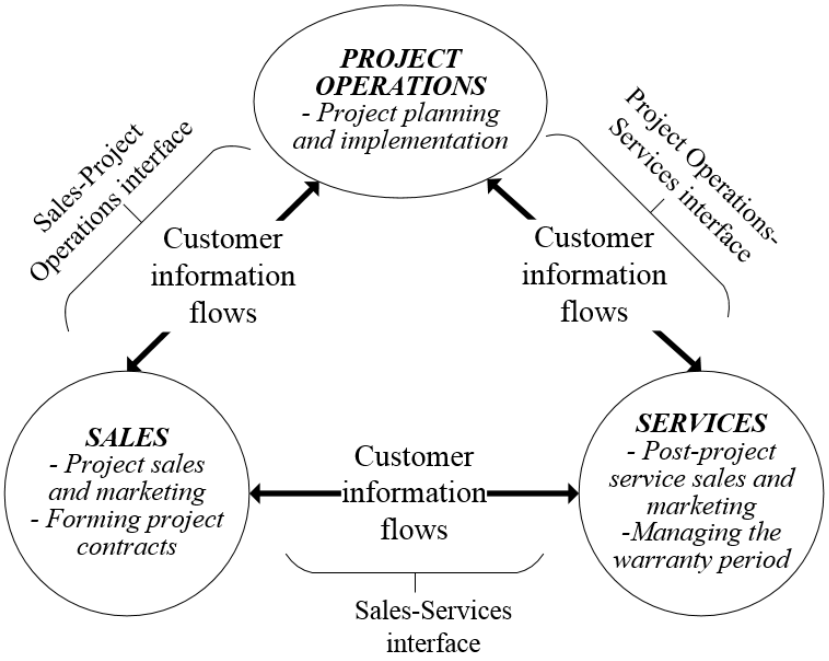


**Figure 1.** Interfaces, information flows, and functional responsibilities between sales, project operations, and services in solution delivery projects.

Integration between these functions is necessary to allow customer information to flow smoothly throughout the project life cycle. As stated by Kirsilä et al. (2007), integration should not be considered only during a single project phase but throughout the project life cycle; therefore, it should be seen more as a process than as a goal to achieve. Studying integration as a whole can increase the understanding of how PBFs manage customer information flows throughout the project life cycle and across functional interfaces.

## 3. RESEARCH APPROACH

### 3.1 Research design

Due to the exploratory nature of the study and its contemporary setting (Ellram, 1996; Yin, 2009), a case study research design was chosen. A qualitative single-case study is considered to have the potential to paint a rich picture and provide a deep understanding of under-researched topics (Yin, 2009; Lehtimäki et al., 2009). Our study focuses on Energy Systems (a pseudonym used for reasons of confidentiality), a PBF operating in a waste-to-energy process industry. The focal firm is a medium-sized PBF that delivers integrated solutions to a global base of customers. Energy Systems has a functional structure in which Sales, Project Operations, and Services (uppercase used henceforth to differentiate the functions) are separated, each with its own responsibilities in solution delivery, as illustrated earlier in Figure 1 (for previous empirical research on this phenomenon, see e.g., Artto et al., 2015; Kirsilä et al., 2007; Turkulainen et al., 2013).

Energy Systems' solution deliveries provide equipment and customized process systems that its customers use to sort and convert raw materials into new forms. The relevant materials are then used as fuel for the customers' power plants. Energy Systems organizes its operations on a project basis and most of the customer solutions are delivered as turnkey project deliveries. In a typical customer project, the whole process line is designed, built, and installed by Energy Systems. Typical deliveries also include services such as consulting, spare parts, upgrades, and maintenance. The firm relies on its supplier base when designing and delivering the solutions, and subcontractors are used during the project. Energy Systems' headquarters, including its main sales and assembly manufacturing offices, are located in its home country X (country removed for the duration of the peer review process to support blindness of the review process), and it has three additional sales offices located in other countries. Besides providing integrated solutions, different services, such as spare parts, life cycle maintenance, and modernizations, are also offered separately.

Energy Systems operates globally and has established a solid presence within the waste-to-energy market. Recently, Energy Systems has begun placing a greater emphasis on the Asian markets due to the increasing need for waste processing systems in that region. Customers, their requirements, and

their geographical locations vary highly, and every solution delivery is unique in terms of its scope, duration, and the number of stakeholders involved. Various customers and their needs have also changed the requirements for efficiently collecting customer information. For example, to tailor its solutions, Energy Systems requires information on the consistency and amount of waste to be processed, local culture, and capacity of the customer's production process.

### 3.2 Data collection

Data were collected through semi-structured interviews within Energy Systems. The selected informants were central personnel representing the company's Sales, Project Operations, and Services functions. They were selected based on their organizational positions, the extent of their experience working on several projects, and their in-depth knowledge of the processes used by the company. Heterogeneity in terms of the interviewees' areas of expertise was emphasized to develop a rich understanding of how the functions work together when delivering bespoke customer solutions. The informants were chosen in close collaboration with an Energy Systems representative to ensure that they would possess a thorough understanding of the phenomenon of interest in our study. Altogether, 14 interviews were carried out (see Table 2). Twelve interviews were conducted face-to-face and two by telephone. Interviews were mostly held by one person and all of them were recorded and transcribed. When considering the size of the firm (medium sized), the phenomenon studied (cross-functional integration within a single firm), the interviewees' experience in the company, and the interviewees' backgrounds, including the main people working in a specific function, these 14 interviews were regarded as sufficient. In the later interviews, many of the themes and specific practices began to be repeated, indicating that an acceptable level of saturation had been reached.

**Table 2.** Interviews carried out for the study

| Interviewee | Expertise primarily related to | Experience in the company (years) | Duration of interview (minutes) |
|---|---|---|---|
| Service Sales Engineer | After-sales and services | 14 | 76 |
| Project Chief Engineer | Project implementation | 7 | 87 |
| Senior Sales Manager | Sales | 15 | 79 |
| Technology Manager | Sales, project implementation, after-sales, and services | 10 | 83 |
| Business Development Engineer | Sales, project implementation, after-sales, and services | 3 | 91 |
| Workshop Manager | Project implementation | 10 | 58 |
| Erection Manager | Project implementation | 3 | 71 |
| Manager, Product Management | After-sales and services | 9 | 81 |
| Vice President, Implementation | Project implementation | 28 | 81 |
| Sales Manager | Sales | 17 | 67 |
| Country Manager (China) | Sales | 4 | 76 |
| Project Manager | Project implementation | 27 | 82 |
| R&D Engineer | Sales, project implementation, after-sales, and services | 7 | 85 |
| Sales Manager | Sales | 10 | 85 |

The interview outline focused on Energy Systems' offerings in general, how customer information is managed across functional interfaces, and the project management practices followed in the firm. In particular, we directed our attention toward the interplay between Sales, Project Operations, and Services during the different phases of the project delivery. We placed an emphasis on discussing the generation, sharing, and use of customer information throughout the life cycle of the project delivery. The scope of each interview was slightly adapted to match each interviewee's role in the company. For example, in interviews with representatives of the Sales function, a greater emphasis was placed on the front-end phase, whereas in the interview with the project manager representing Project Operations, interactions of internal functions during project planning and implementation were emphasized.

### 3.3 Data analysis

Following standard practice in qualitative analysis, the transcribed data and research notes were first explored freely to provide a holistic and shared understanding of the practices followed in the focal firm during solution delivery. We then proceeded to the first round of coding in order to group the data into a smaller number of analytical units (Miles and Huberman, 1994). We were especially looking for

evidence concerning the specific activities relating to communication, coordination of work, monitoring of progress, and any other forms of cross-functional interaction. Such activities were mapped at the general level first before identifying the specific integration mechanisms that support the flow of customer information. We linked each identified activity to the specific project phase in which it was used. In addition, we identified different customer information types, such as customer preferences and requirements, from the data. This means that any information that was related to customers and its communication to another function was sought out and later linked to the specific cross-functional interface it concerned.

Proceeding to the second round of analysis, we sought to identify and describe specific integration mechanisms. Following the broad definition of integration proposed by Lawrence and Lorsch (1967: p. 4), we looked for evidence of any kind of mechanism promoting unity of effort across functional interfaces within the focal firm that dealt with customer information specifically. This analysis resulted in a categorization of four distinct types of integration mechanisms: *meetings*, *IT systems*, *personal involvement*, and *processes and rules*. Table 3 summarizes how individual mechanisms were described during the analysis, listing the category of the integration mechanism, its description (what kind of data was coded under this category), more detailed evidence in the case company (specific mechanisms under each category), and illustrative quotes from the interviews that supported these findings. This process allowed us to systematically categorize the findings, and consequently, integration mechanisms in the case firm included, for example, organization of lessons learned meetings, personal involvement across project phases, and utilization of an established project management process. Drawing on the data, we linked each identified mechanism to the specific cross-functional interface and project phase during which it was reportedly employed, and this cross-tabulation resulted in Table 4.

The analysis resulted in contemplating different integration mechanisms in separate project phases in three interfaces, the identification of customer information types, and the directions of these flows between interfaces. We use illustrative quotes throughout the text to link the main findings directly to the empirical evidence. As the quotations were translated from the interviewees' native language to English, the expressions have been slightly edited to enhance their meaning and clarity. To preserve the

confidentiality of the interviewees, the quotations were anonymized. To increase the validity of the results, the results were first reviewed by and commented on by the company representative and then a two-hour presentation and review session was arranged at Energy Systems' headquarters for most of the interviewees and representatives of senior management. In this presentation session, the findings were discussed and accepted by the company's employees, thereby confirming that relevant findings were indeed discovered by the researchers. The results were further reviewed by and given the support of four other researchers working on the topic in a two-hour workshop held by the research project.

## 4. RESULTS

### 4.1 Functions and overview of integration mechanisms across the project life cycle

Energy Systems has separate functions for Sales, Project Operations, and Services, and each plays its own role in project delivery. *Sales* carries responsibility for customer relationship management and conducting the firm's sales and marketing processes. Therefore, the marketing and sales of the projects and the collection of customer information are managed by the Sales unit. Sales receives new customer bids through its own proactive work, direct contact with potential customers, and with the help of different intermediaries, such as local sales agents. It is therefore the main responsibility of the Sales team to communicate this information to other functions within Energy Systems in order to prepare them for a possible future project. The sales manager's responsibility for the project usually ends when the contract has been signed and the project has been transferred to Project Operations. Since Sales needs to contact various functions within Energy Systems in order to create the offer that it presents to the customer, such as the technology team, Project Operations, and pricing and purchasing, it reflects a great overall picture of the internal dynamics of the company.

*Project Operations* is responsible for the implementation phase of the project. Its task is to plan and implement the project according to the timeframe and budget agreed upon and to follow up on the project at every stage of the implementation. Project Operations is staffed by different individuals such as project managers, lead designers, erection team representatives, and the general manager of the entire project operations team. A project manager and lead designer are assigned to each individual project. Projects are executed following established project management processes. Since many people are

involved in a specific project, careful integration and follow-up is needed to deliver the project successfully. Project Operations needs to communicate the customer's requirements and deliver the drawings of the solution to the manufacturing facility (the company has its own workshop where equipment are assembled) as quickly as possible so that the workshop can create the production plan and assemble the equipment on time. In the end, the installation team also needs to know what agreements have been made with the customer and in what kind of environment the process line is due to be assembled. The long duration (one to two years) that is common in such projects also poses integration challenges for Energy Systems as customer information needs to be processed and transferred unaltered across various stakeholders over the course of the project.

Last in the project life cycle, *Services* takes over the project once it has been handed over to the customer. Services is mainly responsible for the warranty period of the project and for creating after-sales opportunities for the firm. Energy Systems offers consulting, project management, spare parts, upgrades, and maintenance services, but the service business is still in its infancy and Energy Systems is still developing the services it offers to its customers. However, developing service business requires a detailed understanding of the customers and their requirements in terms of what kinds of services can be offered. Therefore, the smooth flow of customer information from Sales and Project Operations to Services is crucial.

In Figure 2, the involvement of the functions in each of the project phases is presented through the curves. It is clearly demonstrated that Sales is mainly responsible in the front-end phase of a project, Project Operations is responsible in the implementation phase, and Services is responsible in the use phase. The functions are also to some extent involved in other project phases, as described below.

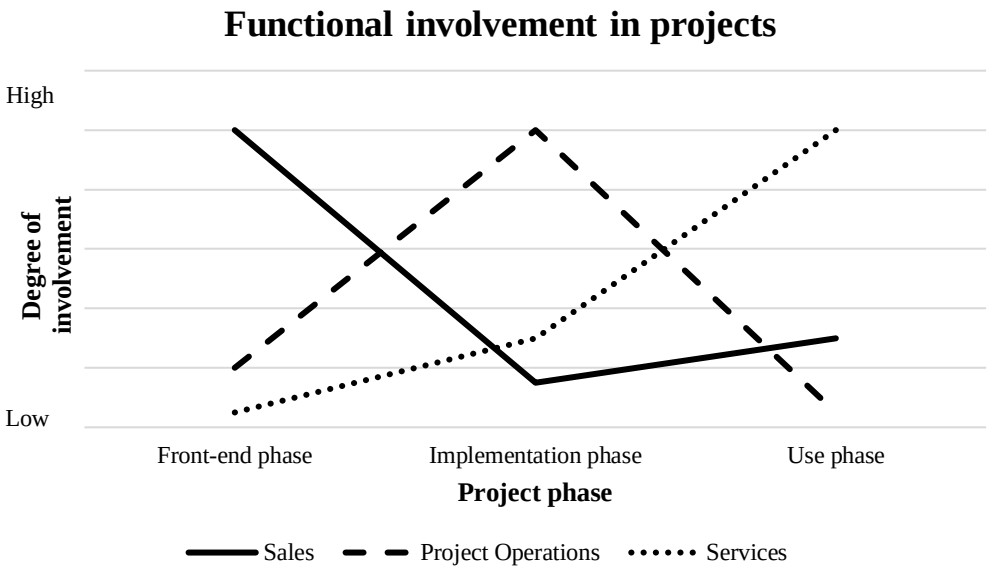


**Figure 2.** Functional involvement in each project phase.

Between these functions, different integration mechanisms are utilized in managing the customer information flows. Table 3 presents the findings and summarizes the integration mechanism categories identified (meetings, IT systems, personal involvement, and processes and rules), their description, what kind of evidence was found in the company, and offers illustrative quotes from the interviews.

**Table 3.** Identified integration mechanisms and the evidence in the case company

| Category | Description | Evidence in the case company | Example quotes from the interviews |
|---|---|---|---|
| Meetings | Different kinds of cross-functional meetings that involve people from Sales, Project Operations, and/or Services | • Project kickoff meeting (where the project officially starts and is introduced to the organization)<br>• Project start-up meeting (project meeting organized after the kickoff)<br>• Lessons learned meeting (organized after the handover to the customer)<br>• Other meetings during the project life cycle | *"When we get the deal then the sales manager invites functional managers, project managers, and designers to the kickoff meeting."* [sales manager]<br><br>*"The lessons learned meeting is organized some time after the handover. The project manager invites, after some consideration, the necessary people to this meeting."* [implementation manager] |
| IT systems | Different kinds of information management systems that are utilized in managing project- and customer-related details | • Document management system<br>• Document databases<br>• Project management system<br>• Emails and email archives<br>• Product management system | *"The meeting memo from the lessons learned meeting is saved on our document management system. There it is visible to everyone."* [implementation manager]<br><br>*"In addition to the document management system, all the project-related emails are stored in project folders…There you can find them in chronological order."* [implementation senior manager] |
| Personal involvement | Any kind of formal or informal personal involvement and discussions across project phases and between interfaces | • Project manager involvement<br>• Sales people involvement<br>• Service people involvement<br>• Changing business opportunities (related to both projects and services) between functions<br>• Other informal communication between individuals (e.g., face-to-face communication) | *"If conflicts occur during the implementation with the customer, then most often a sales manager is also involved in these meetings."* [sales manager]<br><br>*"Usually in the bigger deals the project manager is involved in the last rounds of negotiation with the customer."* [project manager]<br><br>*"At the moment, normally service people are involved at the beginning of the project implementation so that they know where are we going with the project and later they will be involved a bit more deeply in the introduction to the customer, at least."* [implementation manager] |
| Processes and rules | Established rules, written policies, and processes that are utilized in project management | • Established project management process<br>• Formal rules on how to transfer the project to next project life cycle phase | *"When we get the deal and it's officially transferred to project operations, we have clear instructions on how to do it."* [sales manager]<br><br>*When the contract has been signed and the kickoff has been held the project manager takes on the customer responsibility."* [sales manager] |

We further analyzed how these mechanisms are utilized to manage customer information flows in the three different interfaces between the functions and throughout the project life cycle. In Table 4, the interfaces form rows, the project phases are in columns, and where the rows and columns intersect, evidence of the utilization of integration mechanisms have been described category by category.

**Table 4.** Integration evidence in transferring customer information between different functions over the project life cycle

| | **Project phase** | | |
|---|---|---|---|
| **Interface** | **Front-end** | **Implementation** | **Use** |
| **Sales–Project Operations** | *Meetings:*<br>Sales informs Project Operations about the tendered projects and they regularly evaluate them together, for example in different meetings.<br><br>*IT systems:*<br>Sales opens the project in the project management system where it is visible to Project Operations. Also emails are exchanged between functions.<br><br>*Personal involvement:*<br>Project manager participates in the late contract negotiations with Sales and the customer to get familiar with the customer. | *Meetings:*<br>A cross-functional project kickoff meeting, where the project team is confirmed, is organized by the Sales function. Later, a cross-functional project start-up meeting (after the kickoff meeting) is organized by Project Operations.<br><br>*Personal involvement:*<br>A sales manager can participate in the project start-up meeting so that the project begins smoothly. A sales manager is also often involved in case of conflicts with the customer. A sales manager can participate in the project follow-up meetings and have informal communication with the project manager throughout the implementation. The project manager acts as a contact point throughout the implementation.<br><br>*Processes and rules:*<br>Formal process has been established in transferring the project from Sales to Project Operations. | *Meetings:*<br>Lessons learned meeting is organized by Project Operations after handover to the customer.<br><br>*IT systems:*<br>Meeting memos that could be utilized in the sales phase are saved in the document management system. Also, all the other project-related documentation is stored in the document management system. |

| | | | |
|---|---|---|---|
| **Project Operations–Services** | No integration mechanisms for transferring customer information recognized. | *Personal involvement:*<br>Service personnel become familiar with the customer from the beginning of the project by participating in the implementation as early as possible. For example, Services participates in the training sessions that Project Operations organizes for the customers. | *Meetings:*<br>Lessons learned meeting is organized by Project Operations after the handover to the customer.<br><br>*IT systems:*<br>Meeting memos that could be utilized in the use phase are saved in the document management system. Also, all the other project-related documentation is stored in the document management system.<br><br>*Personal involvement:*<br>Project manager is involved in case of bigger warranty issues with the customer.<br><br>*Processes and rules:*<br>Formal project management process is to move the project to Services after the handover to the customer. |
| **Sales–Services** | *Personal involvement:*<br>Sales inquire about customer service requirements and communicate these to Services to develop service business opportunities in the use phase. | No integration mechanisms for transferring customer information recognized. | *Personal involvement:*<br>Sales inquire about customer service requirements and communicates these to Services to develop service business opportunities and vice versa. Salespeople can visit the customers after the warranty period. |

Table 4 demonstrates that the integration mechanism types were used very differently at different functional interfaces when looking at each project phase individually. Next, we discuss the findings in each phase of the project life cycle separately. First, we address the mechanisms, proceeding from the front-end to the use phase, and see how the integration mechanisms are used in each project phase. In section 4.5, integration across the three cross-functional interfaces will be discussed separately and the types and exchange of customer information flows will be presented in more detail.

### 4.2 Cross-functional integration in the front-end phase

In the Sales–Project Operations interface, we observed that integration mechanisms between these two functions are well established and multifold in nature. In the front-end phase, integration mechanisms

are rather formal through different cross-functional meetings and the use of internal IT systems. The front-end phase is managed through established sales processes in which project bids are entered into the project management system. Sales and Project Operations work together in evaluating the tendered projects and decide whether Sales should make an offer to the customer. After the tenders are evaluated by the Sales team and Project Operations, and if the bid turns into an active project quotation (meaning that the customer is willing to continue and the project officially exists), Project Operations nominates a project manager who will be involved in the later stages of the front-end phase. At this stage, the project manager is informed of the project's specifications and the customer's requirements, and a project manager can also comment on the project offer from the viewpoint of Project Operations. As one sales manager describes:

> [The] *project manager is often invited, by the sales unit, to the final stages of the negotiation rounds regarding the project offer so that he/she is able to give* [an] *opinion on the project, especially regarding the price or lead time … But only when it's getting close is there a possibility of getting the deal or losing it.*

Sales also presents the project offer to the rest of the organization (such as purchasing, technology departments, and the legal department) to ensure that these functions can reserve the resources required by the possible project.

The integration mechanisms used in the Project Operations–Services interface are less evident and fewer in number when compared with the Sales–Project Operations interface. In the front-end phase, Services' involvement is not recognized at all. Sales has the biggest responsibility during this project phase and integration between Project Operations and Services does not happen particularly well. Based on the interviews, Services did not have a clear role in the front-end phase of the project; for example, service sales prospects were not formally evaluated. However, some informal communication takes place between Sales and Services, which is partly explained by the small size of the organization, i.e., Services staff are more or less aware of the upcoming projects:

> *But all the time we* [Services] *aim to be involved from the beginning in a project that is already in the offer phase … Of course spare parts are included in the offers, but at the same time with projects it has been rather weak until now.*

Sales occasionally contacts customers about possible service needs in the front-end phase (and subsequently in the use phase) and these requirements are communicated to Services. The project is usually sold by Sales, then after some time Services contacts the customer about the possible service agreements. All the agreements regarding after-sales are made separately between the customers and Services.

### 4.3 Cross-functional integration in the project implementation phase

When entering the project implementation phase, in the formal kickoff meeting organized by Sales, responsibility for the project officially shifts to Project Operations and the composition of the project team is confirmed. This transition is facilitated by well-established integration mechanisms and a clear project management process. In many cases, project contracts are very detailed and difficulties related to what has been agreed with the customer are addressed. In the event that some information (e.g., specific technology characteristics) is missing then it is not properly transferred to Project Operations. Transferring this information correctly is crucial since Project Operations needs to pass this information along to all the product designers of the delivered solution, for example. In this project phase, the project manager plays an integrator role because the main formal communication with the rest of the organization primarily passes through him or her. As one project manager describes:

> *It has been agreed that* [the] *project manager is the main responsible contact person for the customer … If some conversation is confirmed in writing then* [the] *project manager is always copied into the email.*

Later, in the project start-up meeting organized by Project Operations, the sales manager is often also involved to ensure that all customer requirements are communicated to the project team. A sales manager can also be involved in the project implementation phase. The clear distinction between the roles of sales and project managers in the sales and implementation phases is important in order to avoid

possible conflicts regarding their project implementation responsibilities. Some sales managers want to participate in the project follow-up meetings not only to follow up on or solve possible customer conflicts, but also to learn what to take into account in future project sales, as stated by one sales manager:

> *It could easily happen that if a sales manager is too eager in managing the project then* [the] *project manager can feel like* [they are] *being ignored as a project manager.*

In the implementation phase of the project, Services starts to gradually increase its presence. It becomes familiar with the customer by taking part in the project meetings, by visiting the customer, or by participating in the training sessions for the customers. Services personnel are involved in the later stages of the project implementation to facilitate the transfer of responsibility in the after-front-end phase so that the company can better exploit the service business opportunities. Sales–Services interface integration during the implementation phase is limited as no established integration mechanisms were observed.

### 4.4 Cross-functional integration in the use phase

When the project has been executed and handed over to the customer, responsibility for the project is transferred to Services and the project progresses to the use phase. In the use phase of the project, a lessons learned meeting is organized by the project manager involving all the parties to the project. The main methods of communication between Sales and Project Operations are different meetings, email threads conversations, and document sharing systems where all the project-related details are stored. All parties related to the project have access to this system so that project-related information (meeting memos, email conversations, technology details, etc.) is available to everyone.

Based on our analysis of this case, we found that a slight increase in the number of integration mechanisms and procedures was established when integrating Project Operations and Services. A greater variety of mechanisms was being used in this project phase as compared to the project implementation phase where integration mechanisms were more person-dependent. The lessons learned is an important integration mechanism to share customer information and project-related details, but

how individuals actually utilize its outcomes remained unclear. If conflicts or broader warranty issues occur with the customer in the use phase, the project manager can be involved in the discussions since he/she knows what has been agreed with the customer. Moreover, based on the following quote from a project manager, that project manager still has a financial responsibility:

> [The] *project manager needs to take a stand on and decide how to treat bigger warranty issues since* [the] *project manager still has a financial responsibility* [for] *the project.*

Services and other functions related to the project have access to a database in which all the project-related documents are stored. Different information is not always stored very systematically and personal communication with a specific person is often needed if a specific item of information is required. After the project ends, the project manager moves on to the next project, so gaining access to information at that point becomes difficult and some crucial information may be forgotten. Issues related to the transition of the project in the Project Operations–Services interface have been recognized and addressed, and the mechanisms are more established in the use phase than in the front-end phase of the project in this interface.

After the project ends, Services' cooperation with the other functions in the company, such as Sales and Technology, continues when creating after-sales opportunities. The Services, Sales, and Technology units sometimes work together to develop service business opportunities. Based on the following statement made by one sales manager, Sales can visit the customer after the warranty period to create new service business opportunities:

> *In most of the projects, I still go after the warranty period to check with the customer whether some services have been offered.*

We conclude that the integration mechanisms between Sales and Services very much rely on communication between individuals when developing after-sales opportunities.

### 4.5 Managing customer information flows across the three interfaces

The results show that customer information is shared somewhat differently across functional interfaces, using rather different packages of integration mechanisms during the different phases of the project.

Sales and Project Operations and Project Operations and Services rely heavily on a variety of mechanisms (including *personal involvement*, *meetings*, *IT systems*, and *processes and rules*), whereas Sales and Services rely solely on *personal involvement* mechanisms. In each project phase, different kinds of customer information are collected and managed with these mechanisms, and we identified the different types of customer information flows in the different functional interfaces. Table 5 lists the most frequent customer information types between the different functions.

**Table 5.** Types of customer information flowing across functional interfaces

| **Interface** | **Types of customer information flows** |
|---|---|
| Sales–Project Operations | • Market information (customer types, customer location, sales and profit, tenders and bids)<br>• Customer characteristics, needs, and requirements (cultural and relationship aspects, stakeholders involved in the project, etc.)<br>• Technology details (existing systems and equipment)<br>• Contract details (time, scope, cost, liability details, etc.) |
| Project Operations–Services | • Contract details (especially regarding warranty)<br>• Customer training requirements<br>• Customer characteristics and needs from the implementation phase (in case of changes, etc.)<br>• Details of installed equipment |
| Sales–Services | • Service requirements and service opportunities (maintenance requirements, etc.)<br>• Customer characteristics, needs, and requirements |

The types of customer information flowing varies across the three interfaces. Sales is mainly responsible for collecting the customer information related to market information, tenders, and bids and communicating this information to other departments in the organization. Contract details are transferred to Project Operations to support project implementation efficiency. Later, in the implementation phase, Project Operations updates the customer information regarding customer needs and requirements in case of possible changes and conflicts and notes what kinds of equipment have ultimately been installed. This information is transferred to Services so that it is aware of the customer's needs in the use phase and can suggest different services (such as maintenance) to the customer. These service requirements are also developed and exchanged between Sales and Services when Services requires additional information about customers. Since Sales is mainly responsible for developing customer relationships, it usually has the most accurate information about the different customers and their needs.

Based on a comparison of the interfaces, we see that the information flows between the interfaces are to some extent two-way, but based on an assessment of the use of integration mechanisms at each interface, the strengths of the flows are dissimilar. Figure 3 illustrates the information flows (the thickness of each line describes the strength of the flow) and their directions between the functions.

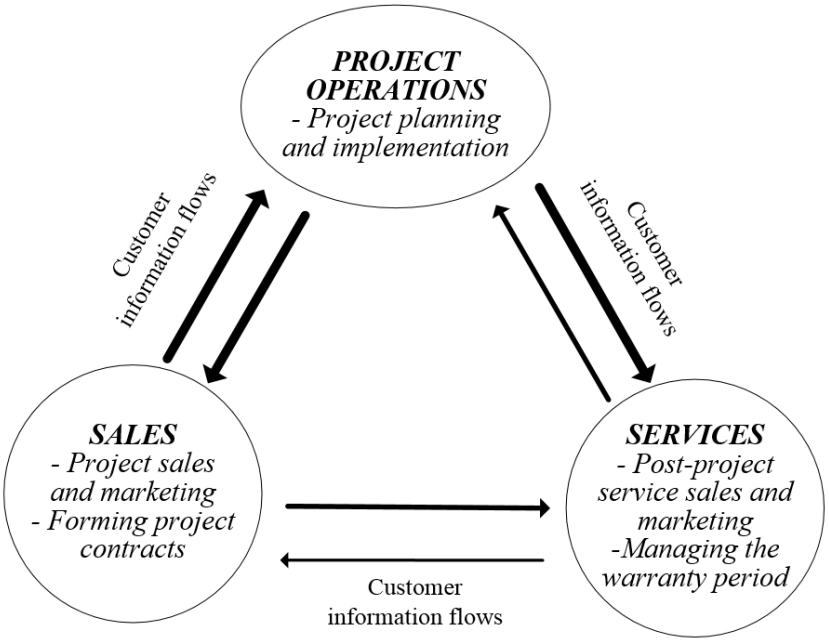


**Figure 3.** Strength and direction of customer information flows between functions (a thicker line indicates the flow is stronger based on the number of integration mechanisms found).

Between the Sales and Project Operations, the customer information flows are strong and the information exchange is two-way. Integration mechanisms between Sales and Project Operations are rather numerous in the earlier phases of the project and slightly decrease in number toward the end of the project. In the front-end phase, mechanisms range from meetings organized by Sales to the use of internal IT systems, for example, in transferring technical details from customers in the document management system. In the Sales–Project Operations interface, mechanisms are more informal and person-dependent during the implementation phase. The project manager plays the role of a main integrator, serving as a bridge across the three functional interfaces and sharing information about possible customer conflicts, for example. The main integration mechanism is the lessons learned meeting, and if some project-related customer information (email conversations, project memos, etc.)

is needed then it can be found in the document management system. Thus, mechanisms range from various formal procedures and ways of working to more passive ways of integrating Sales and Project Operations. However, the established mechanisms enable these two functions to share and transfer the customer information throughout the project life cycle.

Regarding the Project Operations–Services interface, integration mechanisms vary throughout the project from individual personal involvement mechanisms to more numerous and established ways of working. However, from the customer information flow point of view, much more emphasis is placed on the flow from Project Operations to Services than the reverse. In the project implementation phase, integration mechanisms are more diverse as Services increases its presence in the project through personal involvement in order to become more familiar with the customer. Services increases its involvement in the project implementation little by little, therefore facilitating the transition from project implementation to after-sales. Lastly, in the use phase, the number of mechanisms is even higher, including established formal processes (e.g., the lessons learned meeting and responsibility transition). Even though Services is involved in the project in the early phase, the flow of customer information is mainly from Project Operations to Services in order for Services to gain familiarity with the customer, but the information acquired by Services regarding service business opportunities, for example, is not necessarily transferred to Project Operations. Although the warranty responsibility is formally transferred to Services, the project manager may still be included in some negotiations due to the financial responsibility held by the person in that position. Therefore, it can be concluded that the direction of the information flow is to some extent from Services to Project Operations; however, it mostly contains the issues causing conflict with the customer during the use phase.

Lastly, concerning the Sales–Services interface, personal involvement mechanisms solely support the flow of customer information between these two functions. In the use phase, the use of integration mechanisms is quite extensive and the information systems holding the project-related details are emphasized. Even though information, such as project learning outcomes and customer feedback, is available in different databases in the company, that information is not actively tracked and taken into account by the project members. Inquiries about customer service requirements are made in the front-

end and use phases of the project and this information is transferred and managed through informal face-to-face communication between the Sales and Services functions. To conclude, the strengths of the flows (as measured by the number of integration mechanisms in use) are remarkably weaker between these two functions when compared with the two other interfaces.

## 5. DISCUSSION

### 5.1 Cross-functional integration for managing customer information flows in solution delivery projects

The research question of this study was: *how does the project-based firm manage customer information flows through integration across sales, project operations, and service functions during the different phases of the project life cycle?* With regard to managing customer information flows across functional boundaries, we showed the focal firm resorted to 16 distinct integration mechanisms. These mechanisms included established ways of working (e.g., the use of project management processes and kickoff and lessons learned meetings) (e.g., Adler, 1995; Kraut and Streeter, 1995), personal involvement across functions (e.g., Adenfelt, 2010; Galbraith et al., 2001; Nidumolu, 1996), and the use of various IT systems (e.g., Sicotte and Langley, 2000; Van de Ven, 1976) in managing the customer information flows. Thus, it appears that PBFs resort to a wide variety of mechanisms for managing customer information flows. The observations concerning the Energy Systems case specifically lend support to the previous findings of Artto et al. (2015) and Turkulainen et al. (2013) concerning the variety of integration mechanisms available. However, in contrast to previous studies, our findings highlight the use of IT systems generally and identify which specific systems (e.g., document management systems) the focal firm uses when transferring customer information across functional interfaces.

The analysis resulted in the categorization of integration mechanisms into four distinct categories: *meetings*, *IT systems*, *personal involvement*, and *processes and rules*. Earlier related research has suggested categorizing integration mechanisms into impersonal, personal, and group modes (e.g., Turkulainen et al., 2015; Van de Ven, 1976). While sharing some degree of similarity with Van de Ven's (1976) widely used categorization, the categorization presented in this paper highlights the role

of IT systems as a distinct category of its own, rather than including IT systems as one of many impersonal mechanisms. This may be explained as the features and usefulness of IT systems in organizations has changed dramatically over the past 40 years. Thus, the categorization developed in this paper appears to be slightly more fine-grained and suitable to the studied empirical context.

The findings further indicate that cross-functional integration varies across the project life cycle. The results prove that there is a great need for information processing in both the front-end and use phases of the project. We observed that during the front-end phase, the use of cross-functional meetings and other group mechanisms was emphasized, whereas during the implementation phase, different personal mechanisms (Van de Ven, 1976), such as Sales and Services personnel involvement, were more prevalent. Evidence of the changing emphasis of integration across the project life cycle has also been reported by Turkulainen et al. (2013), who studied a large systems supplier and noted that the front-end phase often features high uncertainty, pointing out the need for high-capacity information-processing mechanisms. Turkulainen et al. (2013) argue that due to high ambiguity, the need to process information is greater during the early phases of a project as compared to later life cycle stages. In this study, we showed that the need for services is not transferred smoothly between Services and Sales functions from the front-end of the project to the use phase, as demonstrated by the few integration mechanisms (personal mechanisms) identified in these interfaces. As a result, high ambiguity also seems to be present in the use phase of the project. Therefore, the need for processing customer information increases, especially in the Sales–Services interface.

### 5.2 Contributions and research implications

Our findings expand the current understanding of the management of cross-functional integration in PBFs operating in global markets. The empirical setup included three distinct interfaces instead of focusing on one specific interface alone, as in Adler (1995), Cooper and Budd (2007), and Artto et al. (2015), for example. By including a third function in the research setup, we obtained a more thorough understanding of how integration is managed in PBFs across the project life cycle, ranging from the front-end to the use phase. In particular, the Sales–Services interface included in this study may be

crucial to understanding customer information flows during the use phase in delivering integrated solutions.

We observed that customer information flows are strongest in the Sales–Project operations interface and weakest in the Sales–Services interface. The strengths of the customer information flows between the Sales, Project Operations, and Services functions are not equally established or equally strong, and there was a clear lack of integration, especially in the Sales–Services interface. However, as information processing requirements tend to differ depending on the tasks performed (Grant, 1996; Trautmann et al., 2009; Tushman and Nadler, 1978), it could also be that the integration mechanisms or the customer information flows do not need to be equally strong or defined between these functions. Moreover, since organizational structures are constantly evolving this also possibly affects the need for integration (Fernandes et al., 2018; Maylor et al., 2018). Nevertheless, the results suggest that there is a need to identify the different integration mechanisms and the strengths of the customer information flows across these three interfaces in PBFs throughout the project life cycle if the responsibilities are separated.

This study makes some contributions to the existing research on knowledge management in a project context as well. The results showed that different kinds of customer information flows (such as customer requirements, needs, and contract details) exist at the different interfaces between functions. Furthermore, the flows between the functions are not equally strong. Even though distinguishing between different information flows in a project environment (e.g., Prencipe and Tell, 2001; Reich et al., 2012) or in general in knowledge management literature (e.g., Ritala et al., 2018; Rowley et al., 2002) is not new, this distinction between the customer information types has been given little attention in previous research. Moreover, the strengths of the information flows are rarely addressed. We found that distinguishing customer information types and the strengths of the information flows was essential since this facilitated the analysis of why some customer information did not reach all the relevant functions in the company. Customer information itself is an important type of information to be handled by the companies, for example in developing project opportunities in a constructivistic way (Cova and Holstius, 1993). From the knowledge management point of view, effective knowledge management in

projects is crucial in building the customer's trust and commitment, especially if a customer is not technically capable of evaluating the offering (Lehtimäki et al., 2009).

This study has some implications for developing service business opportunities in PBFs. In particular, when creating after-sales opportunities, efficient integration is required not only between Project Operations and Services functions (as stated by Artto et al., 2015), but also between Sales and Services functions if Sales and Project Operations are separated. Artto et al. (2016) have also suggested that to create value in the operations phase, and therefore over a system's lifetime, the value-creating network should be developed as soon as possible. Artto et al.'s (2016) study took place in a construction industry context and examined the integration between several firms, but our study's context indicates that value creation over the system's life cycle needs to be started as early as in the front-end phase of the project and therefore calls for more established mechanisms between Sales and Services functions. It has been acknowledged in the servitization literature (Story et al., 2017) that a manufacturer needs to develop new capabilities to facilitate the implementation of advanced services for its customers, and that includes having a deeper understanding of the customer's expectations and needs (Ulaga and Loveland, 2014) and readiness to offer new services (Vaittinen et al., 2018), for example. This also requires sharing information with, involving, and coordinating with the service delivery function (Kindström et al., 2015).

### 5.3 Managerial implications

The findings of this study have three distinct implications for managers. First, our results highlight the need for integrating and managing customer information across the functions of PBFs in the delivery of integrated solutions. What has been agreed with the customer is not always evident and the project may need to proceed to its implementation phase while lacking some customer information (Disterer, 2002). Customer information is often scattered across the organization and held by various people, thereby increasing the challenge of utilizing this information for the benefit of the PBF. While cross-functional meetings are frequently used to share customer information, we show that different IT systems can also play a significant role in facilitating this process. In PBFs, information is frequently exchanged informally between individuals, but vital customer information should also be documented

in case people are unavailable or leave the company. Also, since different types of customer information exist, it is crucial to collect it and store it within a company's databases so that valuable solutions can be offered to customers based on their unique needs and requirements. The use of various customer relationship management systems can help manage this information, and by allowing different functions to gain access to it, it can be better utilized in all of the project phases — from front-end to after-sales.

Second, we identified personal involvement integration mechanisms that play a crucial role in transferring customer information across functions and across project life cycle phases. These liaisons (such as sales managers, project managers, and services people) can fulfill a significant role in the integration of the functions throughout the project life cycle. Artto et al. (2015) have discussed the use of the project manager as an integrative mechanism between Project Operations and Services to promote a life cycle perspective to customers, for example. By contrast, the project managers in our study had a stronger role in the Sales–Project Operations interface than in promoting after-sales services, which may be explained through the different levels of service maturity in the case company as compared to those in Artto et al.'s study (2015). As a conclusion, it is important to acknowledge that people other than project managers can act as liaisons and improve integration in the company.

Third, mechanisms for managing information flows should vary across the project life cycle. Table 4 can be used as a tool to map the integration mechanisms or integrative activities throughout the organizational functions and the project life cycle. In addition, even though we found that integration mechanisms are not equally established between the three functions, these mechanisms do not necessarily have to be equally established or pre-defined across the functions since information-processing needs differ depending on the project phase. For example, if a company has the intention of developing service opportunities with its customers, services personnel might need to be involved in the project from an early stage, especially if the company has organized sales and services into different functions. In this case, we suggest that managing integration in the early and later phases of the project would improve the flow of customer information and ensure continuity in the customer relationship after the project handover.

### 5.4 Limitations and ideas for further research

This study was delimited to a single-company setting and the process industry context. This limits the generalizability of the findings, even if similar kinds of equipment, system contractors, and global business contexts exist in other industries. To achieve a thorough understanding of the focal PBF, interviewees were selected broadly from different functions within the organization and knowledgeable key informants within the firm were indeed reached. Even though key informants with several years of experience in the company were interviewed, respondent bias could not be completely eliminated.

Further research is needed to assess the validity of the findings on the cross-functional integration mechanisms in different PBFs and in different industry contexts. In the interviews, rather than refer to specific projects, we discussed the case company's projects in general. Therefore, the potential generalizability of the results obtained to different types of projects could be studied (as in Artto et al., 2015; Turkulainen et al., 2013). In addition, since the life cycle point of view has received scant attention in previous research on integration, more studies could be conducted to further deepen the findings on project phase-specific integration. This could be done in different markets and industries to explore whether there are systematic contextual differences between them.

Our study examined the integration mechanisms and flow of customer information across three functions within a single firm. However, since projects involve a variety of additional functions not covered in our study, further studies could assess, for example, how technology and production functions are involved in projects. Whether the integration mechanisms vary between these interfaces could also be studied, along with the type of customer information that is needed to specify the technologies required, or which customer information is crucial for the manufacturing function.

Numerous studies have examined how contextual factors such as task uncertainty, task interdependence, and task environment affect the use of different integration mechanisms (e.g., Adler, 1995; Griffin and Hauser, 1996; Turkulainen and Ketokivi, 2012) and project performance (e.g., Adenfelt, 2010; Sicotte and Langley, 2000), but our study did not directly consider these factors or which factors affect project performance and how. Consequently, how the use of these mechanisms contributes to project performance could be studied in the future.

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