# Sharing the burden of integration: An activity-based view to integrated solutions provisioning

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## ABSTRACT

While earlier research stresses the integration of suppliers and their diverse technological capabilities as a core capability of systems integrator firms, research on ways in which this integration is achieved in practice remains scant and rarely considers the suppliers' perspective to integration. We analyse how ABB, a systems integrator, delivered a complex subsea transformer solution to a customer in the oil and gas industry. Our dyadic, empirical, qualitative case study drawing on interviews of 17 informants revealed that while the responsibility for achieving cross-organizational integration lies primarily by the systems integrator, when motivated by potential of future collaboration, suppliers also actively participate in specific integrative activities. In addition, selection of integrative activities appears to reflect involved actors' priorities amongst time, cost, and scope objectives.



Keywords: Integrated solutions; systems integrator; supplier integration; integrative activities

## 1. INTRODUCTION

Many traditional manufacturing firms have assumed the role of a systems integrator (SI) by shifting from the delivery of standardized products and services towards provision of bespoke integrated solutions (IS) responding to unique customer needs (Brady et al., 2005; Davies et al., 2007; Davies & Brady, 2016). The role of innovative technology is emphasized as deliveries frequently rely on technologies which are new to the world (Magnusson et al., 2005). Earlier research has shown that while SIs excel at integration of technologies at an architectural level, much of the domain-specific technological knowhow is situated within their supplier bases (Prencipe, 1997). Indeed, the essence of the concept 'systems integration' denotes bringing together resources that reside with various actors and compiling them to a coherent entity (Rutten et al., 2008). Thus, SIs need to know more than they make (Brusoni et al., 2001). As noted by Pagell (2004), integration can be studied at different levels of analysis. Internal integration refers to functions and departments within a single organization that "work together in a co-operative manner" (Pagell, 2004, pp.460) whereby external integration refers to the establishment and use of co-ordinating structures, technologies, processes and practices with downstream and upstream business partners in order to support and collaboratively manage the flows of information, goods and services (Vijayasarathy, 2010; Flynn et al., 2010). Thus, when internal integration takes place inside company boundaries, external integration takes place across company boundaries. Internal integration can be regarded as an important enabler for external integration (Yu et al., 2013). This paper focuses on supplier integration, with emphasis on integrating across company boundaries with upstream business partners.

The key role of the SI in coordinating activities that reside within its supplier base has been emphasized in earlier research (Hobday et al., 2005; Davies and Brady, 2016; Winch and Leiringer, 2016). The suppliers, on the other hand, have simultaneously been portrayed in a much more passive role. This is somewhat surprising, since suppliers taking part in IS provisioning are frequently world leaders in their technological domains (Prencipe, 1997; Ahola et al., 2008) and can thus be expected to possess considerable expertise regarding the integration of their technologies in customer applications. Furthermore, most of the earlier studies focusing on the provision of IS have addressed integration from the perspective of organizational capabilities (e.g. Hobday et al., 2000; Gann and Salter, 2000), focusing on e.g. processes and knowledge that support the SI in their integrative role. In addition to this dominant macro perspective, a number of studies (e.g. Martinsuo and Ahola, 2010; Jaakkola & Hakanen, 2013) have addressed integration from the micro perspective, focusing on distinct *integrative activities*, *i.e. purposeful activities for facilitating the coordination of tasks across organisational boundaries*. Besides delivery projects, the coordination of supplier activities has also been discussed in the context of new product development (e.g. Wagner and Hoegl, 2006; Lau, 2014) and manufacturing (e.g. Choi and Hong, 2002).

While earlier research has identified various integrative activities used by SIs to coordinate tasks across organizational boundaries (e.g. Söderlund et al., 2008; Ruuska et al., 2009; Davies and MacKenzie, 2014), there is a lack of detailed knowledge regarding under which circumstances, and how these activities are used in system delivery projects. In particular, it is unclear to which extent the use of integrated activities is planned vs. emergent, or pro-active vs. reactive.  Also, the contribution of individual integrative activities to project management objectives (i.e. cost, time, and scope) remains ambiguous. Finally, while earlier research emphasizes the role of the SI in achieving integration, the role of individual suppliers has received less interest. To broaden the current knowledge of how integration is achieved between the SI and its suppliers in IS provisioning, we studied project Åsgard in which ABB, a globally leading supplier of automation and power solutions, delivered a complex underwater transformer solution to an energy company operating in the offshore oil and gas industry. The focal project called for integration of multiple new-to-the-world technologies mastered by the participating suppliers.

Correspondingly, the aim of our case study was to obtain a thorough understanding of how integration occurs on the micro-level by identifying integrative activities and describing their role in the focal project. More specifically, we sought answers to the following research question:

> *How are activities coordinated across organisational boundaries in integrated systems deliveries?*

Our analysis of semi-structured interviews of 17 individuals representing the focal SI and six suppliers revealed that while the SI assumes the primary responsibility for integrating tasks across organizational boundaries in solution deliveries, the suppliers may take an active role in supporting integration especially when they are motivated by the potential for future collaboration with the SI. Furthermore, our observations indicate that the selection and use of a particular integrative activity is context-specific, i.e. activities are selected to support the achievement of time, cost, and scope objectives of the project.

This paper is structured as follows. We first review research on integrated solution provisioning and supplier integration, and then proceed to describe our research methodology, including the research approach and context, data collection and analysis. We then present the results of our study, focusing particularly on salient characteristics of the 13 integrative activities identified. In the discussion section, we contrast our findings to earlier literature, highlight their managerial implications, and review the main limitations of our study.

## 2. LITERATURE REVIEW

### 2.1 Provisioning of integrated solutions

In many industries, IS deliveries represent the predominant mechanism for renewing production assets (Davies et al., 2007; Cusumano et al., 2015). For example, in the offshore oil business, oil producers acquire highly sophisticated production platforms tailored to the characteristics of the oil field in question. In shipbuilding, cruise line operators demand larger and larger vessels featuring new-to-the-world experiences, such as cocktail bars served by fully autonomous robots to meet the ever-growing expectations of passengers. The provision of IS represents a difficult integrative challenge calling for the involvement of several complementary firms, each of which are specialized in specific technologies or subsystems. Motivated by the rapid growth in IS deliveries worldwide, a growing number of high-technology firms are assuming the role of SI that are responsible for delivering high-technology solutions to their customer base (Hobday, 2000; Roehrich & Caldwell, 2012; Davies and MacKenzie, 2014).

Integrated solutions encompass numerous interconnected components in which even minor changes may induce significant implications for the design and manufacturing of other components or subsystems (Prencipe, 1997). As a result, the delivery of IS requires sophisticated management processes and design approaches. As ISs are unique and highly challenging to produce, the effectiveness of the outcome is of paramount importance as, for example, the cost of an oil production platform is marginal compared to the value of oil produced over its life-cycle (Hobday, 1998). To ensure reliability and effectiveness of the delivered system over its life-cycle, ISs are typically produced in projects involving a specialized SI which draws on the complementary expertise of several suppliers that are frequently world-leaders in their technological domain. Prencipe (1997) has further elaborated the technological interfaces between the SI and its suppliers by distinguishing between inner core technologies fully mastered by the SI and outer core technologies where the SI holds a full design capability, but the locus of expertise lies in the supplier base.

SIs must be able to cope with numerous challenges including the need to proceed with incomplete technical and commercial information, the need to rely on complicated non-routine tasks, and the need to deal with highly complex design interdependencies (Hobday, 2000). Additional challenges relate to the management of inter-organisational business processes, design of bespoke organisation structures, addressing technological uncertainties and frequently changing specifications and responding to changes in the dynamic external environment (Ren and Yeo, 2006). Furthermore, the reusability of technological solutions developed for a specific customer application is often low giving rise to high research and development costs (Oshri and Newell, 2005; Prior, 2013). Essentially, SIs need to coordinate both their own internal tasks and the innovative activities of the participating suppliers which adds to the complexity.

### 2.2 Supplier integration in complex projects

Supplier integration has received increasing scholarly attention during the past decades (Jaspers and van den Ende, 2006; Luzzini et al., 2015). In the context of new product development (NPD) projects, supplier integration has been associated with partnering with suppliers for innovation purposes by tapping their knowledge of new technologies (Thomas, 2013), with the collaborative development of a specific part or sub-assembly during the different stages in a new product development project (Fliess and Becker, 2006) and with the activities undertaken by the manufacturer to integrate supplier's assigned tasks with its internal operations in order to  improve new product performance (Parker et al., 2008).

Two extensively investigated issues in supplier integration are decisions regarding the role and scope of the supplier contribution, and how to best coordinate daily interaction with the supplier (Brem and Schuster, 2012). In addition, the importance of timing of the supplier involvement has been emphasized (Parker et al., 2008; Martinsuo and Ahola, 2010). Literature emphasizes specific pre-determined tasks and activities that are performed by the supplier, such as developing components and sub-assemblies, and incorporating them into the focal firm's new product development processes (Jaspers and van den Ende, 2006: Koufteros et al., 2012; Zhao et al. 2014). Suppliers may assume different roles in the context of new product development projects, which range from having full responsibility for the design, development and manufacturing of a component according to the performance specification of the buyer (black-box integration), to being a co-development partner (grey-box) or simply making to print whilst the buyer makes all the decisions concerning the design and development (white-box integration), (Petersen et al., 2005; Koufteros et al. 2007). Manufacturers can conduct various activities to boost supplier integration, including information sharing, product co-development and involving suppliers early in new product development projects (Lau, 2014).

Supplier integration does not always and automatically lead to the anticipated benefits such as improvements in the focal company performance (Danese, 2013). Recently, the importance of understanding enablers and ways for integrating with suppliers successfully has been raised (Lockström et al, 2010), and in project contexts, the issue of how to achieve and enhance integration between organizations has been scrutinized (Eriksson and Pesämaa, 2013).

In the context of project deliveries, knowing the supplier, assigning clear roles and taking into account the underlying characteristics of buyer-supplier relationships have been emphasized (Martinsuo and Ahola, 2010). However, developing successful integration may require longer-term buyer-supplier collaboration going beyond the joint single project (ibid.) Earlier empirical research on IS provisioning has scrutinized practices for supplier integration in different industry contexts including construction (e.g. Errasti et al.,2007), shipbuilding (Martinsuo & Ahola, 2010), automation systems (Ahola et al., 2013), and public events (Davies & MacKenzie, 2014). In these studies, the extent of observed supplier involvement has ranged from implementation phase only, to involvement in the marketing, design, and implementation of the IS. Specific integrative activities identified in multiple studies include co-location, joint problem-solving, regular coordination meetings, frame agreements, and supplier training.

Many of the integrative activities identified in research are targeted at supporting the short-term project management objectives related to time, cost, and scope. For example, inspection of supplier progress (Ruuska et al., 2009) provides support to meeting the project schedule, whereas development of shared routines (Söderlund et. al, 2008) is expected to contribute towards increased cost-efficiency. However, several of the integrative activities also contribute to the system integrators' and suppliers' business over longer time horizon. Investing in formal collaboration agreements (Martinsuo & Ahola, 2010) and in supplier training (Gosling et al., 2015) are often tied to an implicit (or explicit) expectation that the SI and the supplier are going to work together in the future as well. In addition to the differences in time horizon, also differences in the nature of integrative activities can be observed with regard to whether they are pre-planned or emergent. For example, using frame agreements (Errasti et al., 2007) is a planned activity, whereas organizing ad hoc meetings (Martinsuo & Ahola, 2010) and arranging rich ideation sessions (Jaakkola and Hakonen, 2013) highlight the emergent nature of integration in solution deliveries. Table 1 below summarizes empirical studies on supplier integration in solution deliveries.

**Table 1 – Empirical studies discussing integration of suppliers in integrated solution delivery projects**

| Study | Research context | Extent of supplier involvement in | Integrative activities used by systems integrator |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Errasti et al., 2007 | Two project-based firms repeatedly delivering solution deliveries in the construction industry | Implementation phase | • Collaboration in the process design stage<br>• Supporting development of suppliers' quality systems<br>• Use of frame agreements |
| Söderlund et al., 2008 | Technology development project in Norway | Design and implementation phases | • Development of shared routines<br>• Frequent coordination meetings<br>• Joint problem-solving<br>• Revision of client's project procedures based on experiences with suppliers<br>• Trial and error experiments |
| Ruuska et al., 2009 | Nuclear power station project in Finland | Implementation phase | • Continuous inspections of suppliers' progress<br>• Emphasizing supplier responsibility in quality control<br>• Formal delegation of responsibility |
| Martinsuo & Ahola, 2010 | Two shipbuilding projects in Finland | Design and implementation phases | • Ad hoc meetings<br>• Cross-organizational engineering team<br>• Formal cooperation agreements<br>• Regular formal communication<br>• Regular informal communication<br>• Supplier training<br>• Use of shared project management systems |
| Ruuska et al., 2011 | Two nuclear power station projects in Europe | Implementation phase | • Emphasizing supplier responsibility in quality control<br>• Joint process development |
| Ahola et al., 2013 | Several automation system delivery projects in Russia | Marketing, design and implementation phases | • Buying equity stake in supplier firm<br>• Continuous informal interaction (personal closeness)<br>• Involving suppliers in negotiations with clients |
| Jaakkola and Hakanen, 2013 | Two groups of firms offering integrated solutions in Europe | Marketing, design and implementation phases | • Emphasizing flexibility in processes<br>• Joint problem-solving<br>• Mutual adaptation of processes<br>• Rich ideation sessions |
| Lenferink et al., 2013 | Infrastructure projects in the Netherlands | Design, implementation, and operation phases | • Allowing suppliers to select working methods, materials and planning approaches freely<br>• Delegating responsibilities to suppliers |
| Davies & MacKenzie, 2014 | London Olympics 2012 and Paralympics Games | Design and implementation phases | • Co-location<br>• Encouraging suppliers to come up with innovative solutions<br>• Frequent progress review meetings<br>• Joint team events and social activities<br>• Prioritizing project challenges with a traffic light system |

| | | | |
|---|---|---|---|
| | | | • Protecting suppliers from outside interference (by external stakeholders)<br>• Setting up cross-organizational dedicated committees dedicated for integration<br>• Subjecting deadlines to public scrutiny by all project actors |
| Gosling et al., 2015 | Global construction company | Implementation phase | • Access to web-based systems<br>• Co-location<br>• Executive briefings (senior mgmt. involvement)<br>• Formal performance monitoring<br>• Framework agreements<br>• Risk analysis programmes<br>• Supplier training |
| Zhai et al., 2017 | Shanghai 2010 World Expo Project | Implementation phase | • Co-location<br>• Influencing allocation of supplier resources<br>• Promoting personal accountability<br>• Promoting societal importance of project |

A observation from the extant empirical research is that the integrative activities identified vary considerably among individual studies. Each study highlights a diverse set of activities, typically ranging from two to five, and no two studies have ended up with identical activities. The question is, why this is the case? One potential explanation may be that integration of suppliers is context-specific whereby some activities are more common in specific industries and/or organizational and national cultures than others. For example, informal interaction (at a personal level) is likely to be more typical in Russian and Chinese markets than what is the case in many European countries (Ling & Li, 2012). In addition to context, different managerial styles may play a role here. A SI that leads its projects with a relatively hierarchic and contract-based governance structure might resort to a different set of integrative activities as compared to a SI emphasizing de-centralized decision-making and responsibility in the project. For example, Ruuska et al. (2009) discuss a hierarchically led nuclear station delivery project whereas the approach adopted by the SI in the London Olympic games (Davies and MacKenzie, 2014) is much closer to the latter approach.

## 3. RESEARCH METHODS

To study integration across organisational boundaries, we conducted a qualitative single-case study focusing on a system delivery project referred to as 'project Åsgard' (according to the name of the oil and gas field in the Norwegian Sea operated by the customer). Case-study methodology seemed the logical choice since our research was explorative in nature, addressing contemporary and dynamic phenomena involving multiple organisations (Yin, 1994). For the purposes of our study, we selected a project in which the ABB subsidiary ABB Transformers, a global provider of power and automation solutions had signed a contract for the delivery of a subsea transformer solution with Statoil, a Norwegian-based energy company operating primarily in the oil and gas industry. The scope of project Åsgard consisted of nine subsea transformers to be used in productive activities in oil and gas field. The contracted transformer units were to be placed on the seabed, approximately 200m below the surface level. At the time of the focal project, subsea transformer technology was still in its infancy, posing considerable challenges for integrating development and manufacturing activities across the participating organisations. ABB Transformers acted in the role of SI in the project while relying on several suppliers which were technology leaders in technological domains required for producing subsea transformers including: rubber moulding, pressure testing, and machining of high-durability metal alloys. Due to the considerable technological novelty and involvement of multiple firms with complementary technological capabilities in the delivered solution, we regard project Åsgard as an ideal case for observing integrative activities across organisational boundaries. The following paragraph briefly introduces the technological challenge and the organisations involved in our study.

### 3.1 Subsea transformer technology

Offshore production assets, such as oil production wells, require substantial amounts of electric power to operate. This energy can either be produced on site or transferred to the site by means of electric cabling. The availability of physical space on offshore assets is always limited, and equipment for producing electricity and converting it to voltages suitable necessitate considerable space allowances. Thus, electricity is frequently relayed in from dedicated external sites or – when close to land -, fed in from the grid. When electricity is transferred over long distances, a considerable proportion of it is lost due to cabling resistance. To minimize this costly loss, electricity is transferred using very high voltages, typically exceeding 100kV. Such high voltages cannot be fed directly to production equipment but need to be converted by means of transformers. As transformers are heavy and bulky items, it is an advantage if they can be placed on the sea bottom, instead of the production platform where they typically reside. Furthermore, many of the power-consuming devices such as pumps and compressors are typically situated on the sea bottom, further reducing the need for cabling.

In industrial transformers where the durability and efficiency of the unit are paramount, the shape of the core and how the unit is cooled and insulated from its surrounding constitute highly important design factors. Specialized shapes and metal alloys are used for the core, and customized oils with a very low expansion coefficient provide cooling for the unit. In subsea applications where maintenance activities are extremely difficult and expensive, the importance of two additional features is emphasized: how the transformer is encased so that it will work without any maintenance in a highly corrosive environment, and how the transformer will cope with immense pressure that it is subjected to several hundred meters below the sea surface. To counter the effects of corrosive sea water, the transformer casing is manufactured from highly customized steel alloys. The processing of these bespoke materials into subassemblies demands specialized equipment and expertise possessed only by few firms. The immense pressure is compensated for using pressure accumulators relying on bellows made from compressible rubber materials. Similarly to the strict requirements for the metal casing of the transformer, also the bellows need to resist the corrosive properties of sea water for several decades, calling for considerable expertise in rubber production and moulding. Figure 1 illustrates a subsea transformer produced jointly by ABB and its suppliers. The figure highlights both the complicated structure of the orange metallic casing and the multiple black rubber bellows that are in direct contact with seawater.


**Figure 1 – Subsea transformer unit**

**3.2 Organisations included in the study**

ABB Transformers is a subsidiary of ABB, a global provider of power and automation technologies. ABB Transformers is a Finland-based unit employing some 300 individuals, specialized in the production of industrial transformers for global markets. In addition to ABB Transformers, our study encompassed six ABB's suppliers possessing central capabilities and expertise in the technological areas required for the manufacturing of subsea transformers. More specifically, four suppliers were pertinent for the design and manufacturing of the transformer casing and pressure compensation technology described above whilst two suppliers represented technical service providers. The supplier roles ranged from being a technology and manufacturing partner (Cyan) to assuming design and manufacturing responsibilities (Magenta and Violet) to building to print (Crimson) and to developing and providing highly specialized technical services (Amber and Orange). From ABB's perspective, many of the involved suppliers possessed capabilities, expertise and know-how that was complementary to its own. Table 2 below describes the key business area, main tasks assumed, relevant capabilities and degree of previous collaboration between ABB and each supplier in project Åsgard and summarizes the empirical data collected for this study. Due to confidentiality reasons, the names of the supplier firms have been replaced with pseudonyms.

**Table 2 – Characteristics of organisations included in the study and details of empirical data collected**

**Involvement of studied organisations**

| **Organisation** | **ABB** | **Cyan** | **Magenta** | **Violet** | **Crimson** | **Amber** | **Orange** |
|---|---|---|---|---|---|---|---|
| **Key business area** | Delivery of industrial transformers (both customer-specific and standardized) | Welding technology expert | Manufacturing of bellows of all sizes and from different materials for industrial customers | Manufacturing of hoses and customer-specific components out of tailored industrial polymers | Producing complex metal constructs often from exceptionally hard metal alloys | Industrial maintenance services supporting the availability of customers' technical processes | Provision of technical research and testing services |
| **Main task in project Åsgard** | Operating as systems integrator | Manufacturing of transformer casing, assembly of pressure compensator parts and attachment to container | Design of pressure compensation system and manufacturing of metal structure for it | Design and manufacturing of customized rubber compound for pressure compensation system | Manufacturing of metallic frames for pressure compensators according to drawings received from customer | Verifying quality of welds, developing tailored helium-based testing protocol jointly with ABB | Pressure-resistance testing of subassemblies in liquid mediums, developing testing procedures and methods jointly with ABB |
| **Role in project** | System integrator | Technology partner, manufacturing supplier | Design partner and manufacturing supplier | Design partner and manufacturing supplier | Manufacturing supplier | Service provider | Service provider |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Most relevant supplier expertise for ABB** | | Know-how of welding of special metal alloys, underwater welding, ability to confer to high performance standards; knowledge of different materials | Jointly developed skills to operate with required materials and designs, special in-house machinery | Ability to produce customized solutions, flexible production, high degree of know-how and expertise | Ability to manufacture in small batches | Accumulated expertise and knowledge of special requirements of subsea industry | Possession of unique equipment and expertise for high pressure testing |
| **Previous collaboration with ABB** | NA | Existing relationship with ABB, first time supplier in sub-sea project | Existing relationship with ABB, several joint projects | Several joint projects with ABB and experience of joint NPD with ABB | New supplier in sub-sea project context | Several joint projects with ABB | Several joint projects with ABB |
| **Collected primary empirical data** | | | | | | | |
| **Number of interviews** | 9 | 1 | 1 | 3 | 1 | 1 | 1 |
| **Positions of informants** | Project manager, design specialist (2) senior manager, sourcing specialist, technical manager, financial manager, technical engineer (2) | Business development manager | Senior manager | Sourcing expert, structural designer, material designer | Senior manager | Engineer (with business responsibility) | Project manager |
| **Collected secondary empirical data** | | | | | | | |
| Five interviews with representatives of the customer organisation (understanding of the solution delivery business case), project plans, ABB quality manual, various progress reports, technical drawings | | | | | | | |

## 3.3. Collection of data

To obtain rich understanding of how the diverse supplier contributions were integrated in project Åsgard we interviewed 17 representatives of ABB and the six suppliers involved. In addition, we engaged in loosely structured discussions with six different representatives of the customer Statoil to achieve an overview of the solution delivery business case. The 17 interviews were semi-structured and began with a discussion on the progress made in project Åsgard, allowing us to develop a multifaceted overview of the project, its challenges and major milestones. We then asked each informant to elaborate crossorganisational integration in the focal project freely, in detail, and to provide examples of situations in which specific integrative activities had been used.

The length of the interviews varied between 49 and 97 minutes. Most interviews were carried out at the facilities of the studied organizations, providing our research team numerous opportunities to tour around the facilities and become acquainted with the equipment and techniques used in project Åsgard. Sixteen interviews were audio recorded and the recordings were later fully transcribed to facilitate analysis.

### 3.4. Analysis

Analysis of data consisted of three sequential phases. First, all the gathered material, including transcribed interviews, field notes, and documentation describing the focal project and its management was coded. We focused on identifying evidence of activities crossing organisational boundaries and assigned a descriptive code label for each activity. Consistent to Larson & Wikström (2007), coding was cyclical and iterative in nature. The initial coding round resulted in 37 first-level codes, some of which partially overlapped. We proceeded to merge codes that were highly similar in their content, ending up with the 13 integrative activities reported in the following section.

Second, to uncover how the use of the activities varied across the seven organisations, we proceeded to derive organisation-specific accounts of their use. In this phase, we discovered that many of our informants provided evidence of the use of integrative activities by more than one organisation. For example, representatives of suppliers often described activities used by ABB and then continued to discuss activities that their respective organization had used in the project. In this way the use of an integrative activity in a specific situation was often discussed by more than one informant allowing triangulation (Jick, 1979).

In the third stage of analysis, we focused on uncovering similarities and differences in the use of the integrative activities across the organisations in our study. This evaluation resulted in a categorization of the activities into three distinct groups: the integrative activities used by the systems integrator ABB, the integrative activities used by the suppliers, and the joint integrative activities involving both of the aforementioned organisations. Parallel to identifying integrative activities we also developed a chronological timeline of all distinct project events, such as design freeze, and delivery of the first transformer that were mentioned by the informants. To address challenges related to the reliability of our data and the validity of its analysis, we resorted to the following techniques. First, we obtained evidence from informants representing multiple organisations, thus reducing the risk of single-actor bias. Second, we complemented the interview data with project documentation and internal process descriptions that were made available to us by the participating organisations. This material allowed us to verify the time and scope of specific events mentioned by our informants and provided additional detail regarding activities uncovered in our analysis. Third, to reduce bias in analysis the data were analysed by all three authors of this paper. During the analysis, we frequently discussed alternative strategies for coding specific activities until a consensus was reached. Fourth, the core results of the analysis were discussed together with multiple representatives of ABB to verify that our informants considered them to accurately describe what had occurred during the focal project.

## 4. RESULTS

### 4.1 Historical background of Project Åsgard – commercialization of subsea transformer technology

ABB Transformers had developed the first functional prototype transformers that could operate in underwater environments in-house by late 1990s These prototypes resulted from intensive and collaborative research efforts and testing how various technologies perform in underwater conditions. ABB involved some of its suppliers in further developing the technology towards a more refined and marketable solution later. In 2007, Statoil began to explore the suitability of various technological alternatives – including subsea transformers - for subsea production operations. This initiative involved ABB and a number of its key suppliers that delivered the necessary equipment and other resources for prototyping the novel technology. The proposed subsea transformer technology was thoroughly tested and prototyped by the customer at its own technology laboratory called K-Lab, at Karstø, Norway. After four years of testing and intensive discussions with ABB, Statoil was convinced of the reliability and commercial viability of subsea transformer technology. Thus, in 2011, Statoil decided to purchase a subsea transfer solution consisting of nine transformer units from ABB and project Åsgard was initiated.

### 4.2. Progress of Project Åsgard

Project Åsgard was the first external delivery project of ABB that involved the new subsea transformer technology to a significant degree. ABB began by subcontracting various components and subsystems of the delivery mainly to those suppliers that had been involved in the commercialization of the technology. From mid-2011 to the first quarter of 2012, the focus was on determining the exact functional and technical requirements for the delivered transformers. For this purpose, the customer involved an external consultant that interacted directly with ABB when necessary. Later in 2012, project Åsgard entered into manufacturing stage. As the SI, ABB was responsible for coordinating the manufacturing process, involving the manufacture of various subassemblies and ensuring that all the components and subassemblies were adequately tested so that their long-term functionality in underwater conditions could be guaranteed. ABB and its suppliers encountered several problems with ensuring the water tightness welds in transformer containers manufactured of a bespoke corrosion-resistant steel alloy. After intensive problem-solving efforts and supplier training provided by ABB these problems were finally solved near the end of 2012. While many of the components required for the transformers were manufactured at the suppliers' facilities, the final assembly of the transformer units was completed at ABB's manufacturing plant in the city of Vaasa. The first transformer was delivered to Statoil in late 2013 and the deliveries continued until 2015 when the final transformer had been received, tested and accepted by the customer. Figure 2 below highlights the main milestones and events of the focal project. Following this brief chronological overview of the project, we now proceed to discuss the integrative coordinating activities across the organizational boundaries in the focal project.

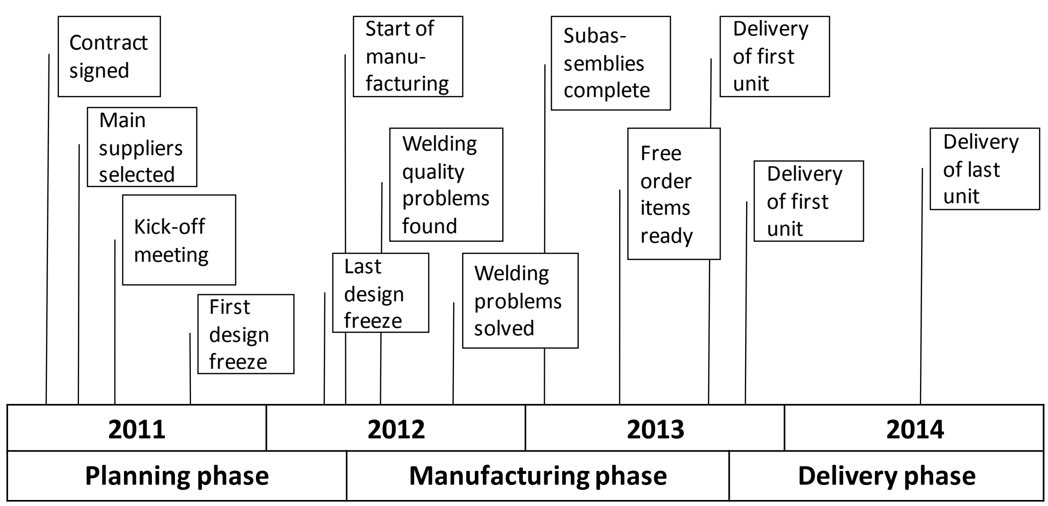


**Figure 2 – Major milestones and events in project Åsgard**

### 4.2 Overview of integrative activities in project Åsgard

Our analysis revealed three distinct groups of integrative activities that were used in project Åsgard: the systems integrator's integrative activities, supplier-led integrative activities, and joint integrative activities. Table 3 summarizes the 13 integrative activities identified in this study. Table 3 also indicates whether an activity was planned a priori by the SI or if it emerged during the focal project in a reactive manner. In addition, the contribution of activities to project management emphasis areas (time, cost, and scope) is elaborated. In the following, we proceed to discuss each individual activity in detail.

**Table 3 – Integrative activities in project Åsgard**

| | Nature of activity | Contribution to project management emphasis areas | | | Contribution to long-term collaboration | Activity identified in relationship between system integrator and supplier | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Systems integrator's integrative activities** | | **Cost** | **Scope/ quality** | **Time** | | **Cyan** | **Amber** | **Orange** | **Crimson** | **Violet** | **Magenta** |
| Frequent coordination meetings | P | - | + | + | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Using a heavyweight project leader | P | - | + | + | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Early supplier involvement | P | - | + | | + | | ✓ | ✓ | ✓ | ✓ | ✓ |
| Motivating suppliers to innovate | E | | + | | | ✓ | | ✓ | ✓ | ✓ | ✓ |
| Supplier training | E | - | + | | + | ✓ | ✓ | | ✓ | | ✓ |
| Providing suppliers with physical assets | E | - | + | + | + | | ✓ | | ✓ | | ✓ |
| **Supplier-led integrative activities** | | | | | | | | | | | |
| Relation-specific investments | E | - | + | | + | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Future-oriented support | E | - | + | | + | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Dedicating resources to project | E | - | + | + | + | ✓ | | ✓ | | | ✓ |
| Fast-pacing the project | E | - | | + | + | | | ✓ | | ✓ | ✓ |
| **Joint integrative activities** | | | | | | | | | | | |
| Frequent co-location | E | - | + | + | + | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Joint problem solving | E | | + | + | + | ✓ | ✓ | | | ✓ | ✓ |
| Joint efficiency seeking | E | - | | | + | | ✓ | ✓ | ✓ | | |

P planned activity
E emergent activity
- negative contribution
+ positive contribution
✓ activity identified in relationship

#### 4.2.1 Systems integrator’s integrative activities

We identified a total of six distinct types of integrative activities used by the SI to coordinate work carried out by its suppliers during the focal project. The planned practices, including frequent co-ordination meetings, using a heavyweight project leader, and early supplier involvement were used across all involved suppliers (with exception of Cyan). In general, these activities were not associated to long-term orientation and focused on the effective and timely management of the project. The three emergent practices, motivating suppliers to innovate, supplier training, and providing suppliers with physical assets were employed more selectively on ad hoc basis, depending on the suppliers’ technological capabilities and progress in project Åsgard. As can be observed in Table 3, none of the SI’s integrative activities were targeted at cost reduction but instead, at enhancing the quality and the scope of the delivered solution. Moreover, the activities were employed selectively to speedup time-to-market and to foster long-term collaboration with the suppliers.

***Frequent co-ordination meetings***

ABB set up a practice of meeting regularly with suppliers participating in the project. The purpose of these meetings was to review the status of the project from the perspective of each supplier. ABB put significant efforts to ensuring that the meetings were informal in nature, e.g. by emphasizing that the meetings were held on factory floor and not in dedicated meetings rooms. ABB also benefited from these meetings by collecting feedback and improvement ideas for manufacturing activities implemented during the project. The frequency of the coordination meetings varied according to the project progress, e.g. when the delivery of several subassemblies was evident, the meeting intervals were shortened by ABB.

*"Every Friday we reported to ABB what is the status now, what is ready, what we are working on and what phase we are at".* (Violet)

*"We had not agreed on a specific day for meeting every month. The project progressed in intervals … we would have lots of contact during one month, and then during the next six months there was hardly any communication at all. And then ABB would approach us again informing that they have a case at hand." (*Magenta)

***Using a heavyweight project leader***

ABB's internal core project team consisted of a project manager, three R&D engineers, and a senior R&D manager. Frank (name altered for confidentiality), the senior R&D manager, soon assumed the role of project champion, whose expertise and dedication to the project was known and respected throughout the supplier network. The role of the project champion was pivotal in creating commitment towards ABB amongst the suppliers. The active support and advice provided by the project champion as well as his commitment were also recognized internally within ABB. Frank became the primary person to represent project Åsgard:

*"Frank has created this. He is the main driver for creating commitment (towards our top management)* (ABB)

***Early supplier involvement***

ABB involved five out of the six suppliers included in the scope of our study early in project Åsgard as it expected the planning phase to benefit significantly from their advanced capabilities in their technological domains. Following this rationale, the selection of suppliers to be involved in project Åsgard was carried out by the R&D function instead of the purchasing function, which typically manages supplier selection for ABB's delivery projects. In supplier selection, ABB emphasized manufacturability feedback on early plans and designs, and active search for technologically superior alternatives:

> *"We have been investigating together, what kind of part should be designed that the suppliers would then be able to manufacture it at their production facility. Suppliers have then told us that for example this rounding is really difficult manufacture with our set of tools. Then we have started to think whether (the design) can be changed, and what is be the right material strength. Collaboration (with suppliers) in this phase has been very intense."* (ABB)

***Motivating suppliers to innovate***

The scope of Project Åsgard required the involved firms to overcome several manufacturing-related technical challenges. ABB was aware that their suppliers were the most likely actors on global scale to solve these problems and put active efforts to persuading their suppliers into a mode where they would focus on solving challenges instead of considering how much everything costs. This was achieved largely by downplaying the importance of costs and highlighting the importance of quality and technological progress. Also, the contracts towards the suppliers supported this as described by a representative of Crimson.

> *"The main thing is to get the job done, and everything else comes after that. There is no need for the customer to ask for costs, hour by hour. In this case, ABB has not done this." (*Crimson)

By purposefully setting demanding challenges, ABB fostered supplier ambition to innovate and exceed all expectations:

> *"ABB came by during manufacturing and when the product was ready, to see how it looked. So we decided to split up a huge bellow in half after it had been tested to check the functional*

> *properties of our bespoke rubber compound. Jerry from ABB was almost terrified when we actually split the whole [expensive] bellow up…"* (Violet)

***Supplier training***

While all suppliers involved in project Åsgard were leaders in their specific technological domains, ABB was more advanced in several competencies required by many of the suppliers. To facilitate project progress, ABB chose to share its expertise with all the suppliers which could benefit from it. Specifically, ABB's expertise in two distinct areas - measuring and welding - was openly shared with the suppliers. Supplier training took different forms in the project. In the case of measuring, a supplier was physically present during ABB's pilot assemblies to observe and learn on site, which provided an important learning opportunity that served as the foundation for later collaboration in the project:

> *"I travelled to Norway a couple of times to see pilot assemblies personally. During these pilots we have learnt the most concerning testing processes and in particular testing methods.*" (Amber)

In welding technology and techniques, ABB arranged specific training events focused on the topic area and actively communicated their interest in developing the capabilities of their suppliers:

> *"I tried to tell (Cyan) what works and what doesn't [in this welding technology], as they had experienced exactly the same difficulties and challenges as we did in the very beginning. They told me that they can handle this, but I tried to give them advice and point them the right direction."* (ABB)

> *"During our first production runs we had problems in welding. We just weren't able to get it working (as it should). Both [the customer] and ABB were on our case, and tried to come up with a solution. ABB then suggested us a new kind of welding technology on which we had no previous experience of." (*Magenta)

***Providing suppliers with physical assets***

During project Åsgard, ABB provided suppliers with specialized equipment and materials that the suppliers could not purchase due to prohibitive costs or extensive payback times. ABB also acquired expensive testing equipment and purchased the operation of that equipment as a service from Amber.

> "*ABB has acquired a newer and a more precise piece of equipment and then they purchase expert services from us. They buy the service from us since we have such high expertise concerning sub-sea applications."* (Amber)

In terms of materials, ABB purchased a batch of special metal alloy on behalf of their suppliers and allowed suppliers to hold it in their inventories, as the material in question could only be ordered in a batch size that was significantly larger than any of the suppliers involved in project Åsgard could use in the focal project. Furthermore, as ABB still owned the material, the suppliers only needed to pay for the exact amount they needed for the components and assemblies manufactured for the project as elaborated by the representative of Magenta.

> "*ABB purchased the materials, so it is their asset. They also paid for it. We use it to manufacture the next lot. This is the way to ensure the availability of this material.*" (Magenta)

**4.2.2 Supplier-led integrative activities**

We identified four distinct categories of integrative activities that were used by the suppliers to support the coordination of tasks in the focal project. The common denominator of the supplier-led practices is that they were emergent and exceeded the written project specifications set by the SI. In this sense, the supplier-led practices can be seen as gratuitous services to support not only the project but also to enhance collaborative relationships between ABB and its suppliers over the long run. From the perspective of the focal project, the purpose of supplier-led practices is to enhance the scope and quality of the project outcome and to ensure that the schedule agreed with the customer could be maintained.

***Relation-specific investments***

During project Åsgard, all six suppliers made considerable investments in technological capabilities. The capabilities were relation-specific in the sense that they supported the achievement of the project goals but there was no guarantee that they would be in demand in future projects with ABB or in other customer relationships. As an example, the metal alloys used in the project proved to be extremely complicated to weld, and thus, several suppliers needed to upgrade their welding competencies:

> *"Only one or two persons here had the required competences…so we needed to start from scratch with developing our capabilities in welding, this really has required a lot of effort".* (Cyan)

> "*Welding (at the assembly) is far from simple. We needed to find the right technique first. Then we needed to get a quality welder, and get him certified".* (Violet)

In terms of developing technological resources, service provider Orange invested in the physical restoration of existing but un-used equipment that was utilized solely in project Åsgard. In addition, a considerable number of working hours were invested in planning the first round of testing procedure and setting up the equipment. Also Magenta prepared various prototypes of expansion chamber and invested in developing their manufacturing technology.

***Future-oriented support***

The suppliers engaged in many future-oriented activities which aimed at supporting ABB in the successful delivery of the customer solution, even though these activities were not specified in the contracts between ABB and its suppliers. Cyan provided significant consultative advice to support ABB in integrating Cyan's deliverable to the customer solution. Amber made significant efforts to ensure that ABB's key decision makers were constantly up-to-date in the area of measuring capabilities and knowledge, even if the supplier could have performed some of these measurement activities during the project and charged ABB for them. Based on the information exchanged between Orange and ABB, Orange developed its resource planning so that project Åsgard and potential joint future projects could be executed more efficiently. Crimson served as a one-stop-shop for solutions, indicating that they would provide the customer with a solution even if the expertise did not reside within their own walls:

> *"I am used to finding a solution one way or the other. If I cannot do that, I will get someone else to make (that part). But I will always try to find (a solution for the customer) so that they will get what they ordered in the first place." (Crimson)*

***Dedicating resources to project***

Suppliers dedicated resources such as key personnel and equipment solely to project Åsgard, which caused challenges for maintaining schedules in deliveries made to other customers. Early in the project, each supplier nominated a dedicated single point of contact, who acted as ABB's main interface towards the supplier company.

> "*We have a dedicated testing engineer reserved just for ABB requirements during our joint projects*" (Orange)

This commitment towards the relationship with ABB was evident in a case where Magenta's dedicated contact person was unwilling to delegate the project responsibility forward, even when the organisational structure and his responsibilities had changed:

> *"This (managing ABB as customer) is not actually my responsibility any more, as we now have sales people in a separate organisation. I see a major risk in giving this customer management away, since I possess so much knowledge that I have been gathering during these years…so it would be very difficult to delegate this to others" (Magenta)*

In addition to personnel resources, suppliers dedicated scarce equipment and facilities to project Åsgard, which in some cases resulted in internal disputes within the supplier organisations.

> "*Others tried to do real production there…as we took up the welding place (for ABB project) there were some internal discussions. At one point we needed to take up a valuable welding spot for two months, in this case it was complicated because normal production needed to be ran as well. In this occasion, we had a tough time here internally*." (Magenta)

***Fast-pacing the project***

We observed how some suppliers expedited project decisions to make sure that project-related work could continue uninterrupted. By acting this way, the suppliers effectively chose to carry some of the project risks on behalf of ABB. For example, in order to respond more quickly to ABB's requests, Orange decided to streamline its sales process so that they no longer required a confirmed specification from ABB to provide a binding offer:

> *"We can state in our offer that we will conduct this test according to ABB specification, even if we don't have the exact specification at the time of doing the offer. We can trust ABB not to send us any specifications that we could never fulfil as stated in our offer". (Orange)*

Orange also initiated further testing procedures without official kick-off meetings with the customer. Violet initiated production activities at their own risk before ABB had signed a formal contract with its customer. On their part, Magenta invested considerable resources in terms of man-hours in planning and revising the offer during the early stages of collaboration to ensure that it meets the customer specifications, but chose not to invoice for the work conducted during the pre-contract phase:

> *We had to do quite a lot of planning, since this was a new product (application) for us. This was more like prototyping, for which we did not have experience. We engaged in active discussions with ABB, doing calculations and sketches, and for quite a long time we worked without invoicing. But it is always hard to draw the line (where the offering phase stops and actual project starts)." (Magenta)*

#### 4.2.3 Joint integration activities

Our analysis revealed three kinds of integrative activities conducted jointly by the SI and its suppliers. All three types of activities, frequent co-location, joint problem solving, and joint efficiency seeking emerged reactively during the project. Furthermore, all of these activities, in addition to supporting the project objectives over a short-term period, also included a clear orientation for long-term collaboration.

***Frequent co-location***

Our interviews revealed that ABB's employees frequently visited the facilities of the involved suppliers. The purpose of these visits varied from formal quality checks and instructing, learning the supplier's technologies to more informal and unplanned visits like popping in to greet the project partner and discuss any daily concerns. In a similar vein, the suppliers made frequent visits to ABB's production sites to get updates regarding project progress and to help ABB in integrating the supplier's deliverables as a fully functional system. Some to the suppliers worked for significant periods of time at ABBs facilities in Finland and in Norway in completing installations or running tests. Co-location practises- that were cultivated extensively in project Åsgard allowed project-related tasks to be conducted relationally and informally through face-to-face discussions. In particular, these practises strengthened the inter-organisational teamwork between the SI and the suppliers.

> "*Usually when the testing procedure started we had a meeting here with ABB and we checked together that the test was running well."* (Orange)
>
> *"When we were figuring out various methods of manufacturing, ABB came to visit us and wanted to see the end-product"* (Violet)
>
> *"The project champion of project came then personally for a visit shaking hands and saying that you guys have done excellent work here" (Crimson)*

***Joint problem-solving***

We observed multiple occurrences of joint problem solving involving ABB and its suppliers. During the project, ABB and many of its suppliers encountered technical challenges that would have been very difficult to solve by the SI or the supplier alone. In such situations, the firms engaged in joint problem solving, the efficiency of which was based on the complementarity of the technical skills and knowledge of the individual experts. Engagement in joint problem solving was based on mutual trust and expectations of supportive behaviour by each party and it did not require special contractual agreements. Open, direct and informal communication was characteristic to the joint problem-solving activities, which also fostered social cohesion between the individuals across the firms.

*"ABB called me up and asks me to visit them, and then we looked at the drawings and discussed whether the part can be tested and whether it will fit. We then discussed potential challenges related to the assembly together. Since we know each other well, we just give each other a call [when a problem arises]." (Amber)*

*"ABB is very solution-oriented. In case there are problems, they are not asking whose fault it is, but instead, what should be done to fix it." (Magenta)*

***Joint efficiency-seeking***

ABB and its suppliers engaged in joint activities directed at improving the efficiency of processes that crossed organizational boundaries. In practice, the joint process development was manifested in two specific areas. In the area of technical testing, which played a central role during all stages of the design and the manufacturing of the transformer units, ABB and its suppliers worked in collaboration to develop testing procedures and improve the efficiency of the project planning process. In addition to testing, efficiencies were also sought by developing flexible and agile working practices and by taking deliberate efforts to avoid unnecessary bureaucracy during the project.

*"We had to figure out testing processes, and we worked together with ABB on those as partners. We planned the testing procedure together and worked towards a common goal. We embarked on an area, where no ready-made procedures existed, so we had to come up with them jointly." (*Orange)

*"In case there is [a measurement} result that I can't explain, then we sit down together with ABB to investigate. Then I tried various different methods for to solving this problem. When we figured out the reason why the part was behaving this way we modified and developed our testing methods at the same time. This helped us to catch similar instances later on". (Amber)*

*"We never had a one official meeting with ABB. We never discussed at table but somewhere on the floor…we did not have any teams either...in our case we had perfect trust (Crimson)*

## 5. DISCUSSION AND CONCLUSIONS

In this final section, we discuss the results of our research in light of earlier literature and derive three propositions which highlight the main theoretical implications of our study. We also elaborate the implications of this study for managerial practice and highlight avenues for further research.

### 5.1 Theoretical implications

Earlier research on integrated solution provisioning has stressed the importance of integrative capabilities of the systems integrator firm, both in terms of managing the system-level integration of a number of complementary technologies and the organisation-level integration of supplier firms specialized in specific technological domains (Prencipe 1997, Hobday 2000). The findings of this study elucidate on the nature and diversity of integrative activities used by a SI in order to integrate suppliers and their technological expertise with the client solution. More specifically, we found that the focal SI relied on six distinct activities targeted at improving task coordination across the supplier-SI boundary. Two of these integrative activities, frequent coordination meetings and use of heavyweight project leader, were implemented across all the involved suppliers alike. All suppliers were also involved early in the project, which is an activity that has been linked with various benefits in terms of product development outcomes (see e.g. Zsidisin and Smith, 2005). In addition to these activities deployed across all suppliers, the SI implemented certain activities, for example supplier training, with only a limited number of suppliers, with the aim to develop and tap their specialized technological capabilities. Training arranged by the SI helped suppliers to connect their outer-core technologies, e.g. advanced machining of alloy components efficiently into the customer solution.

This finding supplements the earlier notion by Brusoni et al. (2001) in that SIs know more than they make with the notion of openly sharing their knowledge with the participating suppliers for the benefit of the project delivery. The SI was also active in motivating suppliers and challenging them to come up with innovative solutions during the project. Motivating suppliers to participate and share their proprietary knowledge has been identified as a major challenge in manufacturer-supplier networks (see e.g. Dyer and Nobeoka, 2000), however, in the context of solutions provisioning, the need to motivate suppliers has been rarely addressed, as the assumption is that suppliers are readily motivated and willing to share their technological knowledge.

Consistent to earlier research (Davies & Brady, 2000; Brady et al. 2005), our findings highlight the role of the SI as the main integrative actor in IS provisioning. However, we found that the involved suppliers –manufacturing and service suppliers alike - also played active roles in supporting task coordination across organisational boundaries. While earlier research on integrated solutions provisioning has accentuated the coordinative role of the customer (Biggemann et al., 2013; Prior, 2013), and strong technological expertise of suppliers (Prencipe, 1997; Ahola et al. 2008; Davies et al., 2007), we are unaware of any earlier empirical observations of activities that have been initiated by the suppliers in order to integrate tasks across organisational boundaries. Indeed, extant literature tends to treat suppliers more as passive recipients of tasks and targets of coordination efforts by the SI. Specifically, we identified four supplier-led activities through which the suppliers actively contributed to overcoming integrative challenges in the focal project. An observation in the context of the supplier-led integrative activities in, for example, relation-specific investments and ramping up client-specific testing procedures and refurbishing equipment, is that these were voluntary, instead of being stipulated by legal contracts. It has been suggested that the willingness of suppliers to invest in their customer's new product development has a long-term orientation which is driven by technological knowledge and the reputation that the supplier obtains from their relationship with the buyer (Smals and Smits, 2011). Our study also pointed to three joint integrative activities including co-locating, problem solving, and identifying efficiencies that were implemented by the SI and the suppliers in collaboration. This finding is new to the ongoing discourse on systems integration and suggests that while the primary responsibility for achieving integration lies within the SI (Hobday, 2000), integration can be achieved through activities that are mutually carried out by the SI and the suppliers participating in the project. Thus, we propose the following:

> *Proposition 1: While the systems integrator holds the primary responsibility for integration in integrated solution deliveries, suppliers actively participate in integration when motived by prospects of long-term collaboration with the systems integrator.*

Co-locating was instrumental in allowing individuals to work together temporarily for the focal project either at the SI's or suppliers' premises. Co-locating has been previously categorized as a formal co-ordination mechanism, however it could be observed that in our case, co-locating contributed to facilitating more informal face-to-face discussions and team interaction during the project, supporting the notion of Lawson et al. (2009) in that formal mechanisms may provide the needed structure that facilitates more informal interaction, contributing to knowledge sharing between the participants. The system integrator and suppliers also engaged in problem solving and efficiency seeking efforts with the aim of improved task coordination and integration across organisational boundaries. These findings align with earlier research that stresses joint problem solving as an important integrative activity (Uzzi, 1997). Our observations underline the importance of establishing trust-based inter-organisational relationships between the SI and suppliers, as earlier research has established a link between SI - supplier relationships and the performance of the production systems (Prencipe, 2011). While not empirically verified, the three joint integration activities identified in our study may act as mechanisms contributing to this relation by emphasizing the inherently dyadic nature of integration.

In our focal project, the performance and long-term reliability of the delivered solution was considered paramount to its cost. This is understandable, as the costs of repairing failed transformers in the seabed is prohibitively expensive. Thus, in terms of the three core objectives time, cost, and scope emphasized in project management research and practice (e.g. Atkinson, 1999), the scope and time were given priority, while cost was noticeably de-prioritized. This emphasis was clearly reflected in the integrative activities identified in our study. Most of the activities (including e.g. early supplier involvement, and supplier training) contributed to ensuring the performance and functionality of the delivered solution. In addition, several activities (e.g. frequent coordination meetings, and fast-pacing the project) were targeted at ensuring that the project schedule would be maintained. Regarding the third objective, cost, we did not identify a single integrative activity that would have directly contributed towards reducing project costs. On the contrary, the findings suggest that most of the integrative activities increased the costs incurred by the SI, suppliers or both. During our interviews, several of our informants characterized the focal project as a unique setting where the suppliers were allowed to be creative and really emphasize the quality of their deliverables, instead of finding ways to reduce cost. For example, the discussion of how a finished and fully functional rubber bellow was split (destroying the bellow) in half just to check its functional consistency illustrates the priorities in project management in the focal project. Thus, we propose:

> *Proposition 2: The use of integrative activities in integrated solution deliveries reflects the priorities between project objectives in terms of cost, time, and scope.*

We observed that while many integrative activities used by the SI had been planned in advance, all integrative activities used by the suppliers and all joint integrative activities were emergent, i.e. they were used to reactively respond to conditions and challenges that arose during the focal project. For example, after understanding that manufacturing suppliers experienced significant challenges related to processing the extremely hard metal alloy that was required in the transformers, ABB responded by providing additional training to suppliers. These observations contribute to the ongoing discourse regarding the nature of integrative activities in complex project (Errasti et al., 2007; Martinsuo & Ahola, 2010, Jaakkola & Hakonen, 2013). Hence, we propose:

*Proposition 3: While the integrative activities used by systems integrators include activities of both planned and emergent nature, all integrative activities used by suppliers are emergent.*

**5.2 Implications for managerial practice**

The findings of this study offer two main implications for practitioners involved in IS provisioning. First, the identification and description of the integrative activities has value for both SIs and supplier firms as the findings complement and expand prior knowledge on the practical approaches for facilitating integration in complex delivery project settings. Firms operating in this domain may use this information to further develop the integrative capabilities of their organizations and evaluate the contribution of individual activities to the project goals in terms of cost, scope and time. Second, our observations contribute to the description of actor roles in IS deliveries by emphasizing that while the responsibility for achieving organisational integration lies primarily within the SI, also suppliers may assume an active role in integration of tasks by initiating specific activities towards the SI. Finally, integration is, to an extent, shared between the two parties, as some activities are joint and require active participation and commitment from both organisational actors. This highlights the notion that integration is indeed a two-way street, requiring resources and considerable continuous effort at both sides of the dyad.

### 5.3 Limitations and avenues for further research

An important limitation of our study stems from single case focus. Thus, the findings cannot be directly generalized outside the observed context. From the perspective of generalizability, additional research addressing the extent to which the activities identified in the present study are applied in other geographical and industrial contexts would be highly important. Furthermore, our empirical investigation was conducted during a period when the oil price was significantly higher than what it is now in early 2017. It is possible that as the focal project was not under high pressure for cost efficiency, the conditions for developing collaboration across organisational boundaries were more favourable as compared to the current situation in the industry. Similarly to previous empirical studies focusing on integrative activities (Errasti et al., 2007; Söderlund et al., 2007; Ruuska et al., 2009; Lenferink et al., 2013), our observation revealed that while most of the integrative activities identified in our study have been reported in earlier studies, each study – including this one – has resulted in a unique pattern of activities. One potential explanation for this tendency might be that inter-organizational integration is highly context-specific. Thus, it may be that a very different set of integrative activities would be used in a project with limited pressure for cost control as opposed to a project with emphasis primarily on schedule (e.g. Davies & MacKenzie, 2014) or primarily on costs (most construction projects). Thus, additional research linking distinct integrative activities to contextual factors would be highly warranted.

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