



Integration impediment during ERP Development

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ABSTRACT

ERP (Enterprise Resource Planning) systems have increasingly been developed and integrated with other internal and external systems. This paper contributes to the field of enterprise systems integration by clarifying the concept of integration in the context of ERP systems. We investigated integration obstacles during ERP development in 5 large organizations through theme-based interviews. Besides considering integration as purely technical challenge, our findings reveal the other perspectives of integration. In total 31 environmental, technical, managerial, and organizational integration obstacles were identified from empirical data and further mapped with 13 ERP challenge categories derived from the literature. Our findings reveal that integration barriers are related to all 13 categories of ERP challenges. This indicates that integration should not be a separate project from ERP development. Identifying the integration obstacles is necessary for practitioners to develop counteractions to enterprise integration problems.

1. INTRODUCTION

Companies must improve their business procedures and processes in order to remain competitive. They must also share their in-house information with their suppliers, distributors, and customers [27]. This information should be timely and accurate. Companies adopt Enterprise Resource Planning (ERP) systems to fulfill these objectives. ERP systems are information systems that integrate different business functions [5,11]. Companies spend significant amounts of their IT budget in ERP installations and upgrades [10,11]. However, ERP projects are associated with considerable problems and high failure rates [19,33]. Besides technical

aspects, ERP implementation imposes numerous social and organizational issues [10].

Implementing an ERP system does not guarantee the integration of the organization, as ERPs need to co-exist with other enterprise applications and systems.

2. Background

ERP systems are configurable Information System (IS) packages that aid in accomplishing the business[39]. Mainstream ERP studies in the realm of integration address the approaches to achieve integration [25,26] or implementing ERP as a way to achieve integration [16,18] However, it has been identified that integration in the context of enterprise systems is surrounded by confusion [6,17,25].

With this study, we aim to increase the understanding of the nature of integration in ERP development that is often overlooked in research. To achieve this, we employ both literature and empirical data from 52 interviews in 5 large enterprises. This paper addresses the following research questions:

RQ1: What issues hinder integration?

RQ2: How do issues hindering integration relate to general ERP development challenges?

In the remainder of this paper, we first review the literature for this research. After that, we explain the research approach and present the results. Before concluding the paper, we discuss about our contributions and lessons learned based on the findings goals by facilitating real-time planning, production, and customer response [20,32]. They

consist of different modules, such as sales, production, human resource, which are interconnected to enable the exchange of business data across different organizational units [12]. ERP systems offer a central repository for enterprise data and promise reduced data redundancy, increased supply chain efficiency, increased customer access to products and services, and reduced operating costs [13,29].

These benefits are not easily accomplished. It has been estimated that 90% of ERP implementations fail to provide all the desired business benefits [28]. Several distinct characteristics make ERP projects troublesome. The implementation involves multiple organizations and stakeholders that need to interact and communicate. This makes the implementation prone to errors and misunderstandings [35]. Moreover, there is the constant dilemma to decide, should the system be customized or should the existing ways of working be altered [4]. Due to the role of ERP systems as a backbone for enterprise integration, they need to co-exist with other enterprise systems [38]. Interconnections with internal and external systems is a necessity and a crucial part in ERP development [15]. When replacing the existing legacy systems with the ERP, usually the migration process involves the implementation of temporary interfaces between systems, which can be expensive and time consuming [40]. In general, ERP systems have limited capability in integrating with other systems [5].

Due to the challenging nature of ERP projects, a considerable amount of literature has focused on critical factors in these projects [2,9,14,28,30,31,36]. These studies have not widely addressed integration issues. Integration is mainly seen as something that is finished during the project phase of the system development, such as in terms of data management between legacy systems. However, instead of being an outcome or an activity occurring during a single phase, in the context of ERP systems, integration is a continuous activity conducted during the whole life cycle of the system [22].

Furthermore, the term *integration* is generally a concept surrounded by a fair amount of confusion [6,17,25]. For instance, some authors in the literature tends to consider integration as a project outcome or as a technical feature [6]. We understand ERP system integration as *a process during the ERP system life cycle, in which interfaces and interconnections between the ERP and other internal and external*

systems are built and managed as a collaborative effort conducted by different organizations and stakeholders involved in development. With this study, we want to better understand the nature of this activity by examining the issues that hinder it.

3. Research process

This research was designed as a qualitative, thematic study. We deemed this approach to be suitable when approaching the research problem of enterprise system integration because besides its technical nature, it includes organizational and managerial issues [3]. The main instrument in the data collection was theme-based interviews in five companies. The companies were large – their sizes ranged 1000 to 30000 employees. To analyze the data we employed a qualitative inductive analysis, in which we identified new kind of occurrences in the data and classified them with codes. This is also called “open coding” [7] in grounded theory. According to [34]

“qualitative inductive analysis generates new concepts, explanations, results, and/or theories from the specific data of a qualitative study.”

3.1. Data collection

To conduct this study, both literature and empirical data were employed. We carried out two rounds of theme-based interviews. In the first round, we gathered data from three organizations (Case A, B, and C) in the period from February 2013 to May 2014. These interviewees included stakeholders from client organizations, the vendors and third parties, such as a middleware vendor and offshore departments. No strict interview protocol was used, but instead, the questions focused on general challenges in ERP development. More detailed questions were asked based on the answers. Total of 45 interviews with an average duration of one hour were made in the first round. In the second round, we gathered data from three organizations (Case A, D, and E) in May and June 2014. In total, 9 experts were interviewed, with the average duration of the interviews being 1 hour and 15 minutes. The question set included technologies, standards, organizations and stakeholders dealing with integration issues. We consider second round as our main dataset in this study since its focus was on integration issues while the first round data served more as supportive material. Table 1 lists the case organizations and the roles of interviewees.

Table 1 Information about Case organizations and interviewees

Cases	Size and industry	ERP systems	No. of interviews	Role of interviewees
1st Round				
A	Large & global manufacturing enterprise with 30000 employees	Tailored system for sales and logistics SAP ERP for administrative processes	17	Different roles representing the client organization, the vendor and third party organizations
B	Large & global service provider in retail business with 1000 employees	Tailored ERP system for retail business processes	16	
C	Large and global manufacturing enterprise with 20000 employees	Tailored ERP system for the raw material procurement	10	Different roles representing the client organization
2nd Round				
A	Large & global manufacturing enterprise with 30000 employees	Tailored system for sales and logistics SAP ERP for administrative processes	6	Business-IT negotiator IT manager of business area Manager of E-business and integration Head of E-business and integration Business support manager of a business area Director of business process development
D	Large and global manufacturing and service provider enterprise with 5000 employees	Tailored ERP system	2	Head of IT department Manager of IT and enterprise engineering
E	Large and global manufacturing and service provider enterprise with 1600 employees	A system based on Oracle products	1	Head of systems analyze & design

The ERP systems in case organizations were in different phases in their life cycle. In Case A, the tailored system had been in use and development for 20 years. During the interviews the retirement phase of the system had begun as the company was considering replacing it with a SAP ERP. The ERP system in Case B was in the middle of the implementation phase. The system in Case C was in the post-implementation phase, currently being deployed to a new business location in another country. Case D started the implementation of a new ERP system in 2012 and has been since improving the

business processes and enhancing the system. Case E was about to change their ERP system from Informix to Oracle. Most of the transition had been done but few systems were needed to be changed to Oracle.

3.2. Data analysis

We extracted and identified integration obstacles from the transcribed interviews. Three researchers used the principles of open coding [8] to label the data and to find the integration obstacles from the primary data set. Due to the fact that each researcher makes his/her

own interpretations from the data, it was necessary to discuss and compare the identified obstacles. After several brainstorming sessions, a list of 31 integration obstacles was constructed, with six obstacles not previously mentioned in the literature.

To have a comprehensive view on the integration obstacles and their relationships to general ERP development challenges studied in the literature, we used the classification of ERP development challenges by [1]. In addition, we reviewed seven literature reviews on ERP development challenges [2,9,14,28,30,31,36] and modified the original classification. This comparison produced in total 13 categories of ERP development challenges. For

example, in the literature category “Network and communication” concerned with “boundary crossing activities” and issues related to “consultant and vendor companies” was divided into “Inter-organizational environment” and “Communication and coordination”.

Inspired by Themistocleus [37] and Shaul & Tauber, [36] we further classified the 13 categories into four main themes: Environmental, Technical, Managerial, and Organizational obstacles. Table 2 presents this categorization. We then mapped the integration obstacles extracted from the data to the general categories of ERP challenges found from literature.

Table 2 Main themes, literature categories and integration obstacles

Main themes	Categories of general ERP challenges from the literature [2,9,14,28,30,31,36]	Integration obstacles derived from data	Cases
Environmental obstacles	Intra-organizational environment Issues related to organizational culture as well as organization’s experience on ERP projects	Complicated end product	A
		Inexperience on integration projects	A, E
		Heterogeneous operating environment	C
		Different strategic interests of business units	A
	Inter-organizational environment Issues related to external environment such as conflicts between the organizations, poor management of partnerships with these organizations and underperformance of either vendor or consultant	Sanctions in licensing	E
		Competitors taking new technologies into use	A, C, E
		Failing to commit customers in integration projects	A, D
		Discovering a way to satisfy customers by integration	A, E
Technical obstacles	ERP-product selection & implementation strategy Issues regarding selecting and comparing different ERP products	Selecting unsuitable integration technologies	A
		Troublesome management of integration product licenses	A, E
	ERP system characteristics Issues related to the lack of ERP system’s quality	Design flaws in ERP system	A
		ERP system’s incompatibility	A
	IT-infrastructure & legacy systems Problems in integrating the ERP system with other systems and converting the data between the systems as well as managing the master data	Characteristics of integrative systems	A, B
		Complex systems landscape	A, D
		Troublesome migration	A, B

	ERP software development & configuration Issues dealing with requirement specifications definition and changes, system configuration, and software development tools and methods. Also, issues related to troubleshooting and functional testing of the software	Poor evaluation of integration requirements	A
		Slow development process	A, B, C
		Inadequate testing of integration	A
		Lack of knowledge on integration	A, E
Managerial obstacles	Business visioning & planning Issues in creation of the business case for the system, setting up business goals and justifying the ERP acquisition financially	Cost cutting hindering integration projects	A
		Insufficient identification of business needs & evaluating the benefits of integration	A
	Organizational management & leadership Issues related to top level management's involvement, capabilities and actions in the project	Top management does not understand Integration	A, C, D
		Top management does not support integration	A, D, E
		Lack of company-wide policies for integration	A, D
	Project management Issues regarding the project scope, responsibilities, and resources. Also issues related to crisis and expectations management	Troublesome management of integration Projects	A
	Project team & human resources Challenges related to structure and composition, and skills of the people in the project team. Also issues related to empowerment, motivation and incentives	Lack of integration experts	D
		No dedicated persons for integration	D
Quality management & evaluation Challenges related to measuring the performance and acceptance of the system	Not measuring integration projects	A	
Organizational obstacles	Change management Issues related to business process re-engineering, training and education. Also factors related to misunderstanding of the change caused by the system and its implication to organizational culture, personal factors and political issues	The need for comprehensive training	A, C, D
		Personnel change resistance	A
	Communication & coordination Factors related to communication style, coverage and planning. In addition, issues related to knowledge management and unsuitable communication tools	Lack of collaboration	A, D, E

4. Results

We mapped the identified 31 integration obstacles into the ERP challenges found from literature. Table 2 shows the categorization. The next sections explain the integration obstacles derived from data.

4.1. Environmental obstacles

In Case A, because of the complicated product of the company, complex structures were needed to store product information in the ERP systems. This made some of the integration projects difficult. For instance, customers faced difficulties when defining the product variables in their systems, as mappings and conversions between different ERP systems required significant efforts. In Cases A and E facilities **inexperience on integration projects** and low maturity level of organization hindered integration. In Case A, some facilities did not have previous experience on ERP system deployments, which hindered the roll-outs. On the other hand in Case E, organizational immaturity was seen as a major barrier for integration. The differing readiness for integration in organizational units was highlighted: *“We have 75% integration in our supply and distribution department but we only achieved 30% integration in after sale service department because the maturity level of this section was very low”* –Case E, Head of systems analyze & design

Case C encountered difficulties due to the **heterogeneous operating environments**. The misfit between the ERP system and the new operating environment was learnt the hard way. As the ERP system was to be deployed to a new business location in another country, the drastic differences between the business processes and practices forced the company to consider implementing a new instance of the system which would then have to be integrated with the ERP system currently in use. Initiating the deployment project to this environment was eventually cancelled.

The environment was characterized as being *“20 years behind”* the focal country and being a *“conservative, old-fashioned field”*.

In Case A, **different strategic interests of business units** introduced conflicts in ERP development. A development need that other unit considered important might not be an interest for the other. As a consequence, integration projects were prioritized

differently, which increased the development time, causing the other units to wait for the needed features.

Besides the intra-organizational environment, integration can also be hindered by external forces. For example, in Case E due to the **political sanctions**, licensing caused problems. An ERP provider refused to sell the required licenses to the company. Therefore, the company bore financial loss, having already trained and prepared to adapt the specific ERP system. Eventually, the company was forced to change the ERP provider.

In Case A, the possibility of **competitors taking new technologies into use** might cause them to re-consider their existing integration solutions. Similarly in Case C, competitors were planning to take a new domain standard into use. This caused pressures for the company. Possibly it had to abandon the application logic developed in-house and re-develop the system interfaces to comply with the new standard:

“If we get involved in [the standardization project], it would mean that part of the ERP system would be outsourced to an external service, which would be integrated with the system” –Case C, Client organization representative

Also in Case E, **the pace of environmental change** was mentioned as a matter setting pressures on integration. It was mentioned that it is difficult to *“attune with those changes”*.

In Cases A and D **customers’ loyalty and commitment in integration projects** were considered as an obstacle. Customers facing organizational changes could stop the ongoing integration initiatives in Case A. On the other hand, in Case D, small customers sometimes lacked the needed knowledge on integration, which made it more difficult to cooperate with them. In Case B, it was mentioned that as several business partners are involved in the ERP project, sometimes coordination issues emerge as it is necessary to wait partners to complete certain operations before the development can continue.

Cases A and E looked for tighter integration with customers. Instead of responding to customers’ needs, companies were **discovering ways to better satisfy their customers**, trying to *“make it easy to buy from us”* and implement new solutions *“even before they come to us and ask for it”*. This was considered

difficult. For instance, in Case A, mobile applications for customers were considered in order to achieve tighter integration with customers.

4.2. Technical obstacles

In Case A, **selecting unsuitable integration technologies** caused the system architecture to be redesigned in the early phases of implementation. According to the middleware provider, not enough attention was paid on the selection of the base technologies of the system. In addition, **troublesome management of integration product licenses** turned out to be an obstacle in Case A and E. Knowing the limitations of licenses and avoiding getting fines or sued by the product providers was emphasized, “*as huge costs are always involved in license management*”.

In Case A, certain architectural decisions caused that the facilities used different codes in system messages sent from the facility systems to the ERP system. This later led to problems when trying to collect the same information from all the facility systems:

“Because all [facilities are using] different codes and that's a nightmare [...] when you want to report something or when for example our sales offices who are using [the ERP system], for all the [facilities]. They actually see very different data for them, because of the different codes which we have allowed in our

ERP.” –Case A, Business support manager

This was identified as one of the **design flaws** in the customized ERP system that would not be able to be fixed during the life cycle of the system. In addition, by having a vendor specific message format in the system, integrating the ERP system with external systems was considered challenging. Because of different levels of standards being used internally and externally, the **ERP system incompatibility** challenged integration with external systems.

In Case B, **characteristics of integrative systems** introduced a fundamental obstacle of integration. The data formats of two systems were different and the older system could not handle specific data types. Similarly in Case A, the factor affecting the easiness of rollouts was said to be dependent on the characteristics of the facility system in question.

Complex systems landscape where integration takes place was one aspect that made integration difficult. In Case A, the organization was dealing with a huge number of different systems. Business-IT Negotiator of Case A stated that it is difficult to “*reach the ideal world*” as the landscape of system “*evolves constantly*” due to the organizational changes. An integration project that required exchanging of messages between three ERP systems, was considered as “*a mission impossible*”. A project in which an invoice was to be sent from one office to another through several system, had been initiated four years ago but was still ongoing during the interviews. Furthermore, the increased complexity hindered the information retrieval from the logistics systems:

“[When getting information from logistics systems] there are not only delays, there are total black outs. We don't always get the information. [Then we] get the customer calls: ‘Where is my order? It should be here now’” –Case A, Director of business process development

Troublesome migration was encountered in Cases A and B. During migration, data conversions from legacy systems, master data management and parallel run of systems are needed. In Case A, migration from the old system to the new one took years. In Case B, using two systems simultaneously was considered too difficult from the end-user’s viewpoint and because of this, the new ERP system was not deployed to all the sales offices. Major technical problems were encountered when running the two ERP systems in parallel. The data transfer between the two systems was unreliable, due to insufficiently designed interfaces:

“The problems emerged because the interface was the problem. The data might have been accurate in the new system [...] but they did not manage to make the logic between two of their applications bullet proof. [...] the data that came to our system was somehow corrupted” –Case B, Representative of Finance

Transferring the master data from the old system to the new one was seen problematic in Cases A and B. In Case B, it was claimed that the parent company “*did not have a capability for master data*”. Moreover, different policies for master data were used in group and national levels of the company.

The **slow development process** turned out to make integration more difficult. In order to cut down the development costs caused by a customized system, in

Cases A and C the vendor had offshored the development to remote locations. Because of this, it took a long time until new feature requests would realize as new features in a system:

“If the development on our side is something which is then related to [our ERP], then it takes time [...] then we are really talking about six seven eight months.” – Case A, Manager of e-business and integration

The slow development process was also highlighted by a representative of Case C, who emphasized that the development process should be made faster.

Poor evaluation of integration requirements was sometimes hindering integration projects. In Case A, it was specifically highlighted that the need for integration and testing of it may appear suddenly, if the development is done without establishing separate projects and the requirements for integration are not comprehensively investigated. Similarly, **inadequate testing of integration** was mentioned as a major obstacle in integration projects. In Case A, a sudden need for testing appeared due to the lack of inappropriate planning. Resources that were not initially allocated for the project were needed:

“It is not realized that [integration] requires a lot of testing [...] the resources that are then used, are not specifically allocated for the project but instead internal resources. But then, what are their skills and motivation? How it is being documented that something has been tested?” –Case A, Business-IT Negotiator

Lack of knowledge mentioned as an obstacle for integration. Integration projects that were performed for the first time with no previous experience on similar projects were considered challenging in Case A. For example, having a customer using SAP involved for the first time was considered painful. Similarly, if integration would require an implementation of a totally new business process with new messages, needed more effort than the projects in which already existing knowledge could be utilized. In Case E on the other hand, the lack of documentation about integration frameworks and technologies caused a big halt in the project as the needed information was gathered from different places.

4.3. Managerial obstacles

Another issue hindering integration in Case A was the constant development **cost cutting**. Because of this, fewer resources were available for developing and extending the system further. This caused some of the integration projects to be postponed. According to the current trends and the changed role of the ERP system from a back-end tool to a tool of salesmen that interact with customers on the field, the company was planning to build mobile applications to enable end users and customers to access the ERP system from remote locations. This was, however, considered too expensive, and the initiative was dropped out due to the cost saving:

“We have been talking about [the mobile interfaces of the system] and made some pilots, but they haven't gone further [...] they are probably the first thing to drop out when cutting down the development costs.” –

Case A, vendor, Lead software developer

Cost cutting was also considered as a major barrier when developing the business processes further through integration, it was said that there is *“a lot of unattached potential but no willingness to invest”*.

Identification of business needs and evaluating the benefits of integration was mentioned to be burdensome to integration projects. According to the Enterprise Architect in Case A, the challenging phase in some of the integration projects was the evaluation of costs and the business benefits. The business-IT negotiator stated that evaluating the size and the complexity of integration projects were difficult, and the significance of integration was *“mainly underestimated”*. This led to resource allocation problems in these projects. Due to the lack of internal collaboration and organizational silos, certain cross-checking and verification (i.e., by finding out which part of the system the development would have an impact) was sometimes omitted when developing new functionality. This also led to wasted resources.

In cases A, C and D, the **top management sometimes lacked the understanding of integration**. In Case A, the management had too high expectations what could be achieved by integration. Similarly in Case D, management lacked the understanding on integration:

“The high management cannot really realize the benefits of integration. It is hard to convince them how an integration project can benefit the organization. In words they say ‘Ok, let's do the integration project’ but when it comes to practice and

reality they withdraw” –Case D, Manager of IT department and organizational engineering

Also, sometimes management was unwilling to participate in integration projects which caused the project to lack the management support. In Case C, as the system was deployed to the new operating environment in different nation, local manager’s attitude was not supportive and the project lacked leadership.

The **lack of top management’s support in integration projects** came up in Case A and D. The constant changes of top management terminated the on-going customer integration projects in Case A and it took years to re-establish them. Similarly in Case E, changes in top management “*brought chaos and even terminated the existing integration projects*”. The extent to which the top management prioritizes integration was seen crucial in Cases A and E.

Due to the **Lack of companywide policies for integration**, difficult integration scenarios were encountered in Case A. When the ERP system was under the busiest implementation, the policies of individual facilities had an impact on how the integration between the ERP system and a manufacturing execution system in question was done. This led to a problem when querying information from the facilities as the quality of the retrieved information was varying. It was suggested that the common rules should have been decided in advance to prevent this, and there should be “*a dictator*”, when defining these rules. Similarly in Case D, due to the fact that different enterprise systems were developed separately, the end users had to separately log in to each system. It was suggested that there should be a single sign in option instead to avoid the manual work and redundancy. **Difficulties in integration project management** were experienced. Allocating resources for these projects and keeping them in budget and schedule were not easy. Some of the development projects were not done in a systematic manner as projects. Instead, “*the one who has the money*” could initiate development activities, without negotiating with other parties. These projects encountered unexpected issues with resources. A representative of Case A highlighted the attitude towards integration:

“The biggest challenge is to evaluate the size and complexity of the project. I state that the significance of integration is mainly underestimated [...] is it just

stated that the technology and tools are clear, ‘this cannot be a big issue’” –Case A, Business-IT Negotiator

Convincing the top management and developers about the value and importance of software testing in integration projects was mentioned as a considerable challenge for project managers.

Case D faced resourcing issues due to the **lack of integration experts**. Lack of personnel with skills on middleware and SOA (Service-Oriented Architecture) hindered integration projects. It was stated that suppliers familiar with specific technologies, such as BizTalk or Oracle “*can’t really implement anything themselves*”. Similarly, selecting of the supplier was said to be “*risky because of their limited knowledge*”. In addition the company had no dedicated persons responsible for integration. Instead, managing the IT architecture and doing integration were considered as additional works which reduce the pace of integration:

“When you are integrating systems using middleware, we should unify some architectural basics. Sometimes you need to re-engineer the tasks. This work conflicts with our routine work. We cannot stop this ‘moving train’ to do integration.” –Case D, Manager of IT department and organizational engineering

Not measuring integration projects to evaluate whether or not the desired business goals are met, was considered problematic. Case A was using measurement to evaluate how much the certain business integration solutions were used by different business units. However, in integration projects, measurements were not established. Also, if an integration project was carried out in a non-systematic way, there were no proper quality management practices in place. Measuring the performance of integration project on customers’ side and evaluate the value of customers’ satisfaction was considered “*difficult if not impossible*” since there were no similar access to customer’s resources and systems in a similar fashion as own internal systems.

4.4. Organizational obstacles

Personnel resistance to change was described as an obstacle that comes with integration in Cases A and D. The interviewees highlighted the need to carefully explain to the related personnel what the change means in practice:

“You should assure them that changes that have come up with integration does not mean that you are going to lose your job” –Case D, Head of IT department

Case C also faced personnel resistance to change and their unwillingness to take the new system into use when deploying the system to a new geographical location:

“They didn’t really want to have that system [...] or even willing to develop it to fit their needs in general.” –Case C, Client organization representative

In addition, in Case A, change resistance was identified as a major barrier that terminated the attempts trying to simplify the complex systems landscape:

“System-specific groups have been established there [...] they do not have the desire to make this (ERP system landscape) any simpler. And all the external players who enter this field, are excluded in one way or another.” –Case A, Business-IT Negotiator

The importance of the **need for comprehensive training programs** were considered essential when trying to mitigate the change resistance caused by integration. The interviewee from Case A mentioned the necessity of training when deploying new systems, considering it as a *“major part of the ERP project”*. Similarly, integration with customers created a need for training due to the changed roles of the persons dealing with customers.

Lack of collaboration made the coordination of integration activities more difficult in various ways. In Case D, lack of teamwork was said to be a major inhibitor of integration. In Case A, despite the fact that the business units had different strategic interests, the representative of Sales noted that the services needed from the ERP system can still be the same. Because of lack of cooperation, duplicate development was sometimes done, which led to increased costs:

“Better tools for sales prediction may be an essential development requirement for both of these big business areas, and still these things may not be handled together. [...] Instead of doing one joint project, we may do two in parallel.” –Case A, representative of Sales

The lack of inter-departmental cooperation caused that certain parts of the organization could not

benefits from the services already developed in the other parts of the ERP system. Similarly in Case E, the communication between branches in different cities was considered as limited. Using improper tools added manual work, suggesting that the communication was not carried out in the desirable manner.

5. Discussion

The main contribution of this study is to increase understanding of integration in the context of ERP systems. The current literature on ERP challenges mainly focuses on the challenges encountered during the main ERP project and mostly highlight the technical issues when interfacing with legacy systems [2], incompatible existing systems [30], and data management and conversion [36]. Besides considering integration as purely technical challenge, our findings reveal the other (environmental, managerial and organizational) perspectives of integration. The identified integration obstacles are interrelated with all the 13 categories of ERP challenges derived from literature. This shows that integration should not be viewed as a separate task that is finished during an ERP project. Instead, integration is tightly coupled with ERP development and it is a continuous effort requiring attention during the entire life cycle of the system. We found some integration obstacles that have not been widely covered in the ERP literature before, such as political sanctions, management of product licenses, lack of measurements for integration projects, discovering a way to satisfy customers by integration, lack of previous experience on integration projects and lack of company-wide policies for integration.

Integration challenges and barriers in enterprise application integration and in e-government have been studied, e.g. in [21,23,37]. Themistocleus (2004) identified 12 application integration barriers. Our findings can be considered as an extension of this list. Similarly, we found that resistance to change, training, and lack of technical skills as barriers for integration. However, we did not see the costs as a major barrier. Another study about critical factors of adopting EAI revealed technical, organizational and environmental dimensions that majorly impact integration in a health care environment [21]. The authors found out that the top management support did not have a high impact on the EAI integration. We, however, found top management support as a critical barrier in three of our case organizations in

manufacturing domain. Similar to healthcare domain, the external pressure from competitors appeared to introduce integration challenges in three of our case organizations in manufacturing domain.

5.1. Lessons learned

It is possible to derive from the findings some important considerations for practitioners to overcome the obstacles in integration:

Integration should be regarded as a systematic and well planned activity that involves multiple systems, and stakeholders. Separate programs or projects are always needed to be established.

Dedicated expertise is needed. There should be stakeholders with a full-time responsibility of integration issues. Coordination and communication among the stakeholders is crucial.

Integration projects need to be managed from different levels. Besides the top management support, project and quality managers as well as change management is needed

Due to the complex nature of integration, it is important to maintain the architectural descriptions of the interconnected systems to facilitate the identification of integration needs and requirements.

Corporate-level integration strategies are needed to ensure that integration is aligned with organizational goals

5.2. Limitations

This study has its limitations. As in all qualitative studies, it is also impossible to make direct statistical generalizations from these five companies. We, however, believe that the classification of integration obstacles is valuable information to other researchers with similar objectives and also to practitioners that wish to manage integration in their organizations. Instead of statistical generalization we consider our generalization as theoretical [24], where we formed abstract categories out of specific and concrete observations. Another limitation is that at the time of data collection each enterprise was in a different phase of their ERP development life-cycle. Their challenges and problems were slightly different from each other. For instance, Case B faced challenges regarding parallel run and migration, because they were in the middle of implementation. Being at the beginning of the retirement phase, these challenges

were not considered as the main problems in Case A. This difference is not only a limitation, but also enables richer categorization with variation in observation.

6. Conclusion and future work

With this study we increase the understanding of the concept of integration in ERP development by examining its obstacles. As a result of the analysis of empirical data, we identified 31 integration obstacles. Issues in intra-organizational environment, such as complicated end product and inexperience are the barriers for integration. The pressure from competitors and customer commitment in integration projects impose challenges. Technical barriers are related to integration product selection, and system development and configuration. In addition, the characteristics of the existing systems and the complexity of the IT infrastructure can further complicate the integration efforts. Integration requires management in order to be realized. Management from four levels, organizational, project, quality, and change management is needed to overcome the barriers of integration. We also identified the common categories of ERP challenges from the literature. Our findings suggest that integration is tightly coupled with ERP development, and it should not be regarded as a single project activity, but rather as a continuous effort during the system life cycle. Finally, we provided practitioners with recommendations based on the lessons learned from our findings.

The future research on integration obstacles should consider different domains and include also other organizations involved in ERP development besides the ERP adopters, such as vendors, consultants and business partners. In the future we aim to investigate the solutions to overcome the integration obstacles in different settings.

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