Integration of an ERP System

A case study on integration challenges with Microsoft Dynamics AX

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Integration av ett ERP-system
En fallstudie kring integrationsutmaningar med
Microsoft Dynamics AX

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Abstract

Historically, system integration of ERP system and other existing IT systems within an organization has always been a complex challenge, both technically and organizationally. In many cases, the budget for system integration corresponds 30-40% of the whole IT budget. Since system integration accounts for a large part of the cost during acquisitions and implementation of an ERP system, companies are interested in the challenges that exist during system integration, to simplify the integration process and hence reduce the costs. To understand the challenges, a case study at Company X has been performed. The ERP system investigated in the case study is Microsoft Dynamics AX.

The purpose with this study is to investigate challenges that exist in large organizations during system integration of ERP system and other IT systems that exist in the organization and thereby understand how integration can be developed in a more efficient way.

The study entails an extensive literature study and two rounds of data collection through qualitative interviews.

The results showed that the challenges that exist at Company X are mainly organizational. Technical challenges coexist but they have a much less significant impact than the organizational challenges. This can be explained by that there has been a heavier focus on solving the technical related problems and maybe to some extent neglected the impact organizational problems can have on system integration. Possible actions includes central strategy concerning how to work with Dynamics AX, it’s growth and future initiatives, policies and framework regarding working methods, increased authority and decision rights to the group working with AX as well as minimize customizations and own development.

Keywords: ERP system, system integration, Dynamics AX, integration challenges
**Sammanfattning**

Systemintegration av ERP-system och andra existerande IT-system inom en organisation har historiskt sett alltid varit en komplex utmaning, både tekniskt och organisatoriskt. I många fall har budgeten för systemintegration motsvarat 30-40% av hela organisationens IT-budget. Eftersom systemintegration står för en stor del av kostnaden vid införandet och implementeringen av ett ERP-system kan det vara intressant att förstå vilka utmaningar som existerar gällande systemintegration. På sikt kan det förenkla integrationsprocessen och därmed sänka kostnaderna. För att förstå utmaningarna har en studie utförts på företaget X. Det ERP-systemet som är i fråga i denna studie är Microsoft Dynamics AX.

Syftet med denna studie är att undersöka vilka utmaningar som finns inom stora organisationer gällande systemintegration av ett ERP-system och andra interna IT-system och därmed förstå hur integrationer kan utföras på ett mer effektivt sätt.

Arbetet innehåller en omfattande litteraturstudie samt två omgångar av kvalitativa datainsamlingar genom semi-strukturerade intervjuer.


**Nyckelord:** ERP-system, systemintegration, Dynamics AX, integrationsutmaningar
# Table of Contents

List of Figures ........................................................................................................ viii

List of Tables ......................................................................................................... ix

Foreword and acknowledgement ........................................................................... x

Abbreviations & Definitions .................................................................................. xi

1. Introduction ........................................................................................................ 1
   1.1 Background .................................................................................................. 1
   1.2 Company X ............................................................................................... 1
   1.3 Purpose and Research Questions ................................................................. 2
   1.4 Previous research ...................................................................................... 2
   1.5 Expected theoretical contribution ............................................................... 3
   1.6 Delimitations and limitations .................................................................... 4
   1.6 Disposition of the thesis ............................................................................ 4

2. Theory .................................................................................................................. 6
   2.1 Enterprise Resource Planning (ERP) Systems ............................................. 6
   2.2 The concept of integration ...................................................................... 8
   2.3 Enterprise Integration .............................................................................. 8
      2.3.1 System integration ........................................................................... 10
      2.3.2 Enterprise Application Integration (EAI) ........................................ 11
   2.4 Integration Standard ................................................................................. 12
   2.5 Customization of ERP systems ................................................................. 12
   2.6 Microsoft Dynamics AX ......................................................................... 13
   2.7 Service Oriented Architecture (SOA) ....................................................... 13
   2.8 Application Programming Interface (API) .............................................. 14
      2.8.1 API-management .......................................................................... 15
      2.8.2 APIs vs. SOA ................................................................................ 15
   2.9 Web services ............................................................................................ 16
   2.10 IT governance ......................................................................................... 16
   2.11 Organizational impact when introducing ERP systems ............................ 17

3. Methodology ....................................................................................................... 19
   3.1 Research Design and Method .................................................................. 19
   3.2 Literature study ......................................................................................... 20
   3.3 Theoretical model ..................................................................................... 20
   3.4 Qualitative data collection ....................................................................... 20
      3.4.1 Semi-structured interviews ............................................................. 21
      3.4.2 Documentation ............................................................................... 21
   3.5 Case study at Company X ......................................................................... 21
   3.6 Discussion regarding research design and methods ................................... 22
   3.7 Reliability, Validity and Generalizability .................................................. 23
   3.8 Research ethics ....................................................................................... 24

4. Obstacles ............................................................................................................. 26
   4.1 Technology ............................................................................................... 26
   4.2 Process ..................................................................................................... 30
5. Solutions................................................................................................................................. 34
5.1 Solutions related to technology .......................................................................................... 34
5.2 Solutions related to process ................................................................................................ 36
5.3 Summary .............................................................................................................................. 39

6. Conclusions & Future Work..................................................................................................... 41
6.1 Answer to sub research questions ..................................................................................... 41
   6.1.1 RQ1: What are the challenges of integrating an ERP system with other IT systems? 41
   6.1.2 RQ2: What are the possible solutions to these challenges? ........................................ 42
6.2 Answer to main research question .................................................................................... 42
6.3 Sustainability and Theoretical Implications ...................................................................... 43
6.4 Future Work ......................................................................................................................... 43

7. References ................................................................................................................................ 45

8. Appendix .................................................................................................................................. 48
List of Figures

Figure 1: Disposition of the thesis ................................................................. 5
Figure 2: Characteristics of ERP system (Uwizeyemungu & Raymond, 2004) .............. 7
Figure 3: Obstacles in Enterprise Integration (Venkatachalam, 2014) .......................... 9
Figure 4: Relation of integration type to integration obstacle (Venkatachalam, 2014) .... 10
Figure 5: EAI Integration vs. Traditional Integration (Lee et al., 2003) ....................... 12
Figure 6: API vs. SOA (De, 2017) .................................................................... 15
Figure 7: Theoretical model for this study .............................................................. 20
Figure 8: Conceptual figure over the integration architecture .................................... 27
List of Tables

Table 1: Summary of previous research and work.................................................................4
Table 2: Summary of the interviewed candidates....................................................................22
Foreword and acknowledgement

This report presents a master thesis project conducted during the spring 2017, at the department of Industrial Economics and Management at KTH Royal Institute of Technology in Stockholm, Sweden.

Firstly, I would like to express my gratitude to everyone at Company X for sparing time to provide me with valuable knowledge and personal experiences about the project area. Especially, I would like to thank my supervisors at Company X for their time, patience and guidance throughout this master thesis project.

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This project report could not be successfully achieved without the dedications from all involved persons. Thank you for sharing with me your expertise and personal experiences!

Annie Xu
Stockholm, June 2017
Abbreviations & Definitions

BoB systems – Best-of-Breed systems

Company X – the case company, which is an internal IT company, delivering IT services and solutions to its parent company, a global organization operating within the automotive industry.

AIF – An infrastructure within Microsoft Dynamics AX 2009, which exposes business logic or exchanges data with other systems.

Company Y – the parent company to Company X. In this report, Company Y will also be referred as “the business” since all business is performed and developed at Company Y.

DIXF – An extension used to import and export data in Microsoft Dynamics AX 2012

EAI – Enterprise Application Integration

ERP system – Enterprise Resource Planning system

ESB - Enterprise Service Bus

Internal integration platform – the enterprise integration platform in Company X, a middleware between different systems and applications that need to be integrated

IS – Information System
1. Introduction

This section will present the background, problem formulation, research questions and the purpose of this study. Relevant previous research, expected theoretical contribution as well as delimitations and limitations of this study are also presented.

1.1 Background

Nowadays many organizations, especially large organizations with a long history have a huge number of both modern and legacy IT systems. With emerging technologies, new possibilities and challenges arise when attempting to improve the current IT landscape.

One of the challenges is to integrate disparate systems to achieve greater automation of business processes. Isolation of systems and applications can raise problems such as inconsistency, redundancy, duplication of functional systems etc. However, these issues can be prevented with adequate system integration. The concept “system integration” describes the process of linking different systems and applications to function as a single coordinated system or application. (Marton & Paulová, 2014) Through system integration, disparate systems are integrated and can communicate with each other. Often, there are many obstacles when integrating different functionalities, business processes and data in an organization. (Nordheim & Päivärinta, 2004) Therefore, almost every organization needs to put major efforts into system integration (Marton & Paulová, 2014). In many cases, 40% of an organization’s IT budget is spent on integration, (Nordheim & Päivärinta, 2004) whereof more than 30% of IT investments are used for system integration. (Azevedo & Romão, 2014) In many cases, system integration is a complex task that involves both technical and business challenges (Moradi & et al., 2015). An example of business challenges that increases the complexity of system integration is customized business processes in different sectors of an organization (Özkarabacak & et al., 2014).

Enterprise Resources Planning (ERP) systems are enterprise-wide information systems (Lee, et al., 2003), which consist of a set of software modules and aims to automate core corporate activities, e.g. finance, supply and distribution, and manufacturing. The ERP solutions are designed to solve the issue of information fragmentation in large business organizations and integrate all information across an organization. (Themistocleous et al., 2001) One of the challenges with system integration includes integrating ERP systems with legacy IT systems in an organization. Since ERP systems consist of a set of internally integrated modules, they are not designed to collaborate with other autonomous applications. This results in many limitations when integrating business and cross enterprise business processes. (Themistocleous, 2006)

A critical success factor during implementation of ERP systems is minimal customization. (Nordheim & Päivärinta, 2004) Many customizations are developed as the need arises when integrating the ERP system with other IT systems. Since customization and integration account for a significant cost of the whole implementation process of ERP system, organizations are interested in understanding the challenges that exist during system integration to simplify the integration process.

1.2 Company X

In this report, the case company will be anonymous and denoted as “Company X”.
Company X is an internal IT company, delivering IT services and solutions solely to its parent company (from now on denoted as “Company Y”), a global organization operating within the automotive industry. This thesis is commissioned by the Microsoft Dynamics AX group at Company X and will therefore be performed and studied from the perspective of Company X and the Dynamics AX group.

The ERP system utilized in the company for this case study is Microsoft Dynamics AX, which is an ERP software product developed by Microsoft. Currently, different on-premise versions of Dynamics AX (AX 2009 and AX 2012) are used and installed on different servers around the world. The latest version of Dynamics AX, called Dynamics 365, is offered as a cloud-based service (Microsoft, 2017c).

1.3 Purpose and Research Questions
The purpose of this study is to understand the challenges large organizations can experience regarding system integration with ERP systems and other internal IT systems, and in turn understand how these challenges affect future ERP systems. Furthermore, the purpose is to investigate how the integration process can be performed in a more efficient way. In order to fulfill the purpose, a case study at Company X was conducted.

The main research question (MRQ) is defined as:

- What measures can be taken to reduce the required effort of integrating an ERP system with other internal IT systems in a large organization?

The MRQ will be answered with support from the sub research questions (RQ1, RQ2), which are defined as:

RQ1: What are the challenges of integrating an ERP system with other internal IT systems?

RQ2: What are the possible solutions to these challenges?

1.4 Previous research
A summary of previous research can be found in Table 1.

Several researchers have conducted studies on the issue of integrating an ERP system with other IT systems. This indicates that it is a complex issue both theoretically and practically, and is a topic worth investigating.

Hustad et al. (2016) investigated how different ERP tailoring types defined in the literature corresponded to the types of misfits identified in an ERP implementation project at a large public organization. The results showed that tailoring decisions are influenced by numerous social circumstances, such as resistance to the system, organizational knowledge about the ERP system and maturity of the organization.

Azevedo et al. (2014) performed a case study in the hospitality industry in Portugal and investigated critical factors for successful implementations of ERP systems and the relation to application integration. It was concluded that the lack of IT strategy, in regard to the
integration needs, resulted in absence of investments that would have made positive impact on the critical success factors.

Kahkonen et al. (2016) identified that integration challenges included local adaptations of the ERP strategy defined for the organization, as well as problems related to identifying integration needs and requirements. Some issues were due to the decentralized IT governance which allowed different organizational units to control the development as well as the current IT governance model that allowed facilities to make own decisions and use their own configurations. In conclusion, omitted integration governance was the root cause to the negative outcomes.

The research conducted by Usher (2009) studied the role of IT governance in relation to the post-implementation phase of the implementation of an ERP system. The components of IT governance that were examined were ownership, accountability and decision-making structures. The research showed that IT governance is a factor that has major impact in the outcomes.

Nordheim & Päivärinta (2004) conducted a study concerning customization of Enterprise Content Management (ECM) systems. ECM systems and ERP systems are similar in the way that both systems enable users to manage different kind of information and data in one single system. While ECM systems are primarily used for storing documents and other content, ERP system solves administrative and operative transactions. Even though the study by Nordheim & Päivärinta (2004) is about ECM systems, it was found that many of the challenges that they identified are relevant to this study about ERP systems, and is therefore argued to be a relevant previous research study.

1.5 Expected theoretical contribution

At Company X, the previous and current developments of integration have been performed with a lack of long-term perspective, leading to loss of some of the most important characteristics of an ERP system, such as flexibility and standard functionality. Since Company X is a subsidiary to Company Y and is governed as a service provider to Company Y, Company X faces the difficulty of satisfying the needs of their customers while working strategically to reach their own vision. Furthermore, Company X has historically adapted the best-of-breed solution, meaning that the software or system that is best for each business function is used. Therefore, many systems are only used for small-scale purposes, which increase the complexity during system integration. Previous research has indicated that adapting an ERP system to best-of-breed solutions is an issue that also exists in other organizations as well. However, there is a gap in the literature regarding how system integration with ERP systems should be performed to reach the best outcome. Thus, this study will contribute by describing how large organizations such as Company X should think and work regarding system integration to have efficient working methods and sustainable solutions in the future.
<table>
<thead>
<tr>
<th>Author(s), year</th>
<th>Title</th>
<th>Conclusion</th>
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<tr>
<td>Hustad et al. (2016)</td>
<td>ERP and organizational misfits: An ERP customization journey</td>
<td>Tailoring affected by: resistance to the system, the transition from legacy systems, organizational knowledge about the ERP system and maturity of the organization</td>
</tr>
<tr>
<td>Kakhonen et al. (2016)</td>
<td>Lack of integration governance in ERP development: a case study on causes and effects</td>
<td>Lack of integration governance was the root cause to the negative outcomes.</td>
</tr>
<tr>
<td>Usher (2009)</td>
<td>An examination of the role of IT governance in the ERP post-implementation phase</td>
<td>IT governance has a critical role during the post-implementation phase.</td>
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Table 1: Summary of previous research and work

1.6 Delimitations and limitations
This study was commissioned by the Dynamics AX group at Company X, and will mainly investigate the challenges of the integration between Dynamics AX and other internal IT systems that currently exist at Company X. The study is delimited to investigate the ERP system Microsoft Dynamics AX and the different versions (AX 2009 and AX 2012) that are currently being utilized.

The foundation of this study was based on the current situation at Company X and the study is limited to investigate only one organization. Furthermore, this study was performed from the perspective of Company X and not the business (Company Y) and may therefore be biased. Because the study is performed from the perspective of Company X combined with time constraints, only one interview with a representative from the business was performed. To enhance the reliability and quality of the results, it would have been optimal to include more subjects to the study.

1.6 Disposition of the thesis
The rest of the report is structured as follow: Chapter 2 will present relevant background and theory about ERP systems, enterprise integration, customization of ERP systems, different integration technologies as well as IT governance and the organizational impact when an ERP
system is introduced to an organization. Chapter 3 describes the research design and methodology for the study as well as how the empirical data will be collected and analyzed. Subsequently, chapter 4 discusses the obstacles that have been identified in this study. Chapter 5 presents possible solutions to the obstacles that were identified in chapter 4. In addition, both chapter 4 and 5 includes the discussion and analysis connected to the literature study. Finally, conclusions and suggestions for future work are presented in chapter 6.

![Figure 1: Disposition of the thesis](image)
2. Theory

In this chapter, relevant theoretical concepts and frameworks to the research questions will be presented.

2.1 Enterprise Resource Planning (ERP) Systems

ERP systems contain a comprehensive set of modules and aim to integrate all business processes of the company (Peng & Gala, 2014). With the help of ERP systems, an organization can move into new markets and maintain visibility into the organization’s operations and standardize the business processes (Microsoft, 2017a), build accurate and trouble-free databases, and minimize data complexity (Lee et al., 2003). ERP systems can be offered by third parties providers through either on-premise, i.e. installed on local servers, or in cloud platforms. A cloud-based ERP system is a solution that is becoming more popular (Microsoft, 2017a). The benefits of implementing an ERP system includes cost reduction, better customer services, improved productivity and enhanced resource management (Johansson et al., 2014). An ERP system can be beneficial to decision-making in strategic, tactical and operational dimensions. Due to these benefits, the majority of large organizations have implemented at least one ERP system. (Özkarabacak et al., 2014) However, it is also accompanied with risks, time and costly IT investments (Johansson et al., 2014).

Özkarabacak et al. (2014) mentions that the barriers of ERP systems can be grouped into five categories: operational, managerial, technical, strategic and organizational. The main issue related to the operational and managerial barriers are software modifications (also called customizations). The issue mainly concerns the degree of modifications that is acceptable for an ERP system. System integration is a problem related to the technical, strategic and organizational barriers. Both issues regarding software modifications and system integration lead to difficulties during integration and maintenance of the ERP system. Consequently, support and adaption of ERP systems are costly operations. On the other hand, it is worth knowing that ERP systems quickly lose value when companies try to link external systems and other services to the ERP system despite the technology being used. (Özkarabacak et al., 2014)

The characteristics of ERP systems can be categorized under three dimensions: technical, organizational and informational (see figure 2). The dimension “technical” refers to capabilities or facilities for application development offered by ERP systems. The “organizational” dimension reflects the impact an ERP system can have on the organization, including integration, completeness (generic function) and transversality (process-oriented view). The dimension “informational” describes characteristics related to quality and usefulness of the information provided by the system, i.e. real-time updates and simulation of business processes. (Uwizeyemungu & Raymond, 2004)

Uwizeyemungu & Raymond (2004) argues that flexibility is very important in the case of ERP systems, due to the size and breadth of investment and organizational coverage. Since an ERP system integrates various functions of an organization, integration is perceived as important. In fact, the literature study performed by Uwizeyemungu & Raymond (2004) showed that integration is without a doubt the most important characteristic of an ERP system. Several authors emphasize this characteristic since this is what distinguishes ERP systems from traditional systems. However, the relationship between flexibility and integration can be opposing but also complementary. The more an organization adopts integration techniques, the less flexibility remains. Decreased flexibility can be perceived as problematic since flexibility is an important character of ERP systems. However, integration can enable more efficient information sharing, thus increasing the organization’s flexibility and ability to
response to change. Uwizeyemungu & Raymond (2004) argues that theoretically, integration and flexibility are inter-related and inter-dependent by enabling the links between the various organizational functions and levels. Nevertheless, this theoretical relationship is not necessarily confirmed in practice. (Uwizeyemungu & Raymond, 2004)

Figure 2: Characteristics of ERP system (Uwizeyemungu & Raymond, 2004)

An organization’s business processes are often misaligned when an ERP system is implemented and therefore requires reengineering. However, it is often impossible to request the business to change its processes to fit the ERP system; instead the information architecture should be aligned with the business. (Hasselbring, 2000) Hasselbring (2000) argues that applications need to understand the exchanged data. In this context, standardization of message format and content is important.

Integration and compatibility among systems are very important for ERP systems to be considered successful. Absence of these contributes to efficiency problems and higher implementation costs. (Azevedo et al., 2014) Historically, companies have experienced difficulties of finding the right integration architecture for integrating the ERP system with other niched systems, so called best-of-breed (BoB) systems. BoB systems are limited to one or a few functions and have difficulties handling new requirements when an organization expands. Experts say that many complexities regarding point-to-point integration between ERP systems and BoB-systems have been solved with emerging technologies, e.g. web services. “If you do integration right and make use of underlying technologies like service-oriented architecture, web services and using standard business objects, it makes it much easier to integrate than it ever used to be.” (Techtarget, 2013)

Despite the progressive innovative technologies, the complexity around integration of ERP systems still increase as the requirements of not just integrating with internal applications but also with core systems of suppliers and customers grows. Furthermore, the ERP system needs to be synchronized with multiple sources, often multiple vendors, each with different upgrade schedules. “The more connections and integration, the more complex the whole picture is.” (Techtarget, 2013)
2.2 The concept of integration
The term “integration” can be ambiguous and has different meanings. The confusion around this term can be because it is used in many different areas and refers to different things depending on the area. Without putting the term in a context, it is hard to interpret the meaning of the word “integration”. In this study, the following three contexts will be considered (Kahkonen et al., 2016):

1. Integration as the interoperability of systems
2. Integration as establishing communication between systems
3. Integration as interorganizational process reengineering

When referring to integration of enterprise information systems or enterprise applications, it is often seen from the technical perspective, where two or more systems or applications are combined to communicate through data exchange, whereof standardized data formats and standardized products can facilitate integration. Therefore, some definitions of integration also include standardization as one aspect or prerequisite. (Kahkonen et al., 2016)

Different technological solutions have been introduced to overcome integration difficulties. However, it is often forgotten that not only technical challenges exist during integration. Because social, managerial and organizational challenges coexist with technical challenges, there is no single approach that can solve the integration issues. A combination of different approaches is necessary. (Kahkonen et al., 2016) Social integration challenges are related to communication and coordination among stakeholders. The term social integration has been defined by Elbanna (2007) as “the ability and willingness of different individuals, work groups, business units or organizations to work together in order to develop, establish, and carry out operationally integrated processes and to be part of the same integrated organization technically supported by the ERP system”. Organizational and managerial challenges include power and political issues as well as organizational units having different goals (Kahkonen et al., 2016).

2.3 Enterprise Integration
Enterprise integration refers to the capability of an organization to integrate different functionalities, business processes and data. (Lee et al., 2003) The term enterprise integration refers to the strategic concept of integrating technology, processes and people for the purpose of facilitating better flow of information and effective decision-making across the enterprise, whereas ERP systems is one solution. (Venkatachalam, 2014)

There is a higher demand by organizations to overcome integration obstacles and to become more competitive. (Themistocleous, 2006) When both technical and behavioral integration are at place, integration can enable organizations to achieve agility and flexibility. Technical integration is referred as integrating software and hardware, whereas behavioral integration indicates redistribution of roles and responsibilities. (Lee et al., 2003) Lee et al. (2003) argues that behavioral integration is the biggest challenge as well as the most critical factor for successful implementation of enterprise integration.

The problems with enterprise integration can be defined by three levels (Hasselbring, 2000):

1. Business level: business to business integration
2. Application level: application to application integration
3. Software platform level (i.e. integration of different software platforms)

Venkatachalam (2014) identified six integration types: system integration, information integration, application integration, knowledge integration, human capital integration and
functional domain integration (ERP, CRM, SCM etc.). Enterprise integration comprises all of these methods, each best suited to their primary focus – people, processes or technology. System, information and application relates primarily to technology while the other three integration types are related primarily to people and business processes.

Furthermore, there are three obstacles involved in enterprise integration; process, people and technology (see figure 3). People related obstacles refer to the ability of the employees to meet what’s needed, change management, training and resource allocation. Obstacles related to process include systems migration, reengineering and management. Obstacles related to technology include management of systems and applications, the functionality of hardware and software and the integrity of data. The six integration types mentioned above can affect these obstacles (process, people and technology) at different levels. The relation of integration type to integration obstacle is visualized in figure 4. (Venkatachalam, 2014)

No single type of integration can overcome all of these obstacles. Therefore, enterprises need to adopt different integration initiatives to achieve their goals rather than pursuing a “one-size-fits-all” approach. The right combination of human and information integration can help a company succeed with overall enterprise integration. (Venkatachalam, 2014)

The underlying type of integration is often system integration when it comes to ERP systems. It can be viewed as creating strong links between different information systems and databases and can be regarded as the major technical problem when it comes to implementations of ERP systems. (Themistocleous et al., 2001) According to the study by Themistocleous et al. (2001), 82% of the participants in the study found integration with existing systems as the most serious problem, while integration with other applications came on third place, with a result of 46%.

Application level and software platform level are the levels that will be studied deeper in this study. According to the definitions of these levels provided by Hasselbring (2000), they can be categorized as system integration. Therefore, system integration will be presented in more detail later in this chapter.

Figure 3: Obstacles in Enterprise Integration (Venkatachalam, 2014)
Application and system integration requires financial investment by the organization. At least 40% of an organization’s IT budget is spent on integration (Puschmann & Alt, 2004). If it is desirable, an evaluation of used technologies in integration projects can reduce the costs significantly. However, the evaluation and selection of right technology is difficult due to the wide variety that exists on the market. (Moradi et al., 2015; Mosawi et al., 2006) This puts pressure on organizations to have a clear understanding of their future IS architecture and choose the right integration approach (Puschmann & Alt, 2004).

According to (Özkarabacak et al., 2014), there are several business drivers for integration efforts, including the need to

- Decrease application migration costs during transition to new systems or applications
- Improve visibility of information across the organization by linking disparate systems without developing custom interfaces
- Reduce data entry time, costs and errors

For Company X and the AX-group, these are also the driving factors for the interest of this study.

### 2.3.1 System integration

System integration is the process of joining different subsystems into one large system and ensuring that each integrated subsystem functions as required. (Technopedia, n.d.)

Commonly, new functionality must be integrated with existing applications, other packages and data sources without replacing legacy systems due to lack of time. The purpose of system integration is to build applications that are adaptable to business and technology changes while retaining legacy technology and systems. To achieve rapid response and protect existing investments, dealing with changes on the organizational level, group collaboration level and system level in a coherent manner is needed. (Hasselbring, 2000)

### Integration Methods

Enterprise Service Bus (ESB), sometimes also called horizontal integration utilizes a dedicated subsystem to communicate between other systems. The benefit is reduced number
of interfaces (connectors) to only one per subsystem, which are directly connected to the ESB. The ESB can be translated from one interface to another and can provide flexibility as changes at one side does not affect the other side. When a subsystem is replaced with another subsystem with similar functionality but exports different interfaces, only the new interface need to be implemented between the ESB and the new subsystem. (Gold-Bernstein et al., 2005)

When a subsystem is interconnected to each of the remaining subsystems, it is called spaghetti integration, also known as star integration (Gold-Bernstein et al., 2005) or traditional integration (Lee et al. 2013). In some cases, spaghetti integration can be preferable due to the simplicity of creating a direct integration between two systems. However, the required costs and time increases exponentially when adding new systems. This kind of integration architecture occurs due to developments of point-to-point integration. (Gold-Bernstein et al., 2005) When you only have a few systems, point-to-point integration can be seen as a light weighted way. However, as the number of systems grows, an infrastructure based on point-to-point integration quickly becomes unmanageable, damaging both the IT budget as well as the capability to respond quickly to business demands. (MuleSoft, n.d.) When one system is changed, every connection to that system must also be changed.

Another integration method is the common data format. This method avoids every adapter having to convert data from and to every other systems’ format. Usually, a data transformation service is provided to help convert between application and system specific formats to common data format. In other cases, systems that use this method can also set up a common or application independent format. (Gold-Bernstein et al., 2005)

2.3.2 Enterprise Application Integration (EAI)

The integration of different applications and systems is a great challenge for many organizations. In the past, the choice of applications or systems was decided based on the need of the department. Consequently, it led to different vendors using different technologies and interfaces, which usually could not communicate with each other. Therefore, many companies have a collection of many isolated systems. As companies grow, additional non-compatible systems are added to the existing structure and only a modest level of integration can be achieved through customized and often in-house developed middleware. Many integration problems could have been minimized or avoided if it was not due to the lack of long-term perspective and foresight. The need for EAI as well as the role of enterprise architect has been created to address this issue.

The concept of EAI refers to using existing applications for enterprise integration to enable lower costs and less programming. If enterprises want to add or migrate a new set of applications while using the existing legacy applications and databases, EAI may involve developing and determining how existing applications fit with the new applications and then devise paths to efficiently re-use what already exists, while adding new data and systems or applications. (Lee et al., 2003) It can be defined as an activity that integrates and harmonizes an organization’s isolated business applications, processes and functions. (Mosawi et al., 2006) EAI uses a middleware to serve as a bridge between the different systems and applications in system integration. (Lee et al., 2003) It combines different integration technologies, such as message brokers, adapters and application servers to build a centralized integration infrastructure. (Themistocleous, 2006) All applications communicate freely through a common interface layer, rather than through point-to-point integration, which is the way of communication in a traditional integration. (Lee et al., 2003) The benefits of EAI is increased flexibility of an organization’s IS, prolongs lifecycle of many applications and enables more efficient operations and flexible delivery of business services. (Özkarabacak et al., 2014) It
could also reduce the costs of integration from 10%–60% of the license price of the ERP software, depending on the industry and specific functions (Lee et al., 2003).

However, in many cases, a combination of integration technologies and EAI packages are needed to meet the organization’s demand since no single EAI package can provide all the functionality needed by the organization. (Themistocleous, 2006) EAI involves both technological and business challenges. From the technological aspect, EAI integrates incompatible and heterogeneous technologies. From the business aspect, EAI integrates disparate business processes and functions. EAI is a challenge that every enterprise needs to face due to rapid changes of business as well as the need for an enterprise to communicate internally and externally. (Mosawi et al., 2006)

![Figure 5: EAI Integration vs. Traditional Integration (Lee et al., 2003)](image)

### 2.4 Integration Standard
Integration standard defines common languages, file formats and communication protocols that are essential for coexistence and interoperability of the different systems, enabling the connection of systems with different vendors and origins. According to Azevedo et al. (2014), the need of integration standards has increased due to the following aspects:

- Growing complexity of the integration technologies
- Decrease costs for IS integration
- The need to integrate either external or internal processes
- The need to integrate all applications in an organization
- Expose services outside an organization

In large organizations, many legacy systems, including proprietary systems exist. These systems complicate the integration process due to several reasons; the communication between these systems may be inadequate, different technologies are not compatible or many systems are characterized by a very traditional governance model (Hedman et al., 2009)

The need of integration standard has increased as the executives realize the benefits as well as the need to perceive integration as a long-term strategy for an organization. Hence, in a study conducted by Delphi group, 31% perceived standards as very relevant since it can increase the value of current and future investment on IT. (Azevedo et al., 2014)

### 2.5 Customization of ERP systems
The definition of customization may vary. In this report, the definition of customization follows the meaning of Nordheim & Päivärinta’s work (2004):
“Customization is a socio-technical activity of modifying the properties of packaged software, so that the resulting information system converges with the requirements of the target organization.”

A challenge with customizations in larger organizations is to satisfy all the different needs of information that exists in the organization, both on business level and functional level in a coordinated manner. (Hedman et al., 2009) Sometimes, the organization needs to adapt itself to the software. In that case, customization does not necessarily imply total adaption of the software to the organization’s needs. This is a well-known phenomenon in implementation of ERP systems and is referred as mutual adaption. Integration is one aspect of non-functional customization and is the most common form of customization (Nordheim & Päivärinta, 2004). In cases where companies need to customize the ERP system to fit with the organization’s existing processes, high costs are always accompanied and it is a trade-off between functionality and convenience. (Lee et al., 2003) For example, the cost for customization in a large SAP-installation may be 10 times higher than the license cost. Furthermore, updating all the unique customizations to future versions of the ERP system entails another large financial investment. (Hedman et al., 2009)

2.6 Microsoft Dynamics AX

Microsoft Dynamics AX is one of Microsoft’s ERP systems, targeting mostly middle-sized and large-sized organizations.

Microsoft Dynamics AX 2009 was released in 2008 and is the eight major release of Axapta, the name of the first version of the ERP system. To this version, improvement on user interface (UI), role-based concepts to both the Enterprise Portal and windows clients, support for time zones, new site inventory dimension and Enterprise Portal development through Visual Studio was added. (Microsoft Dynamics AX Users, n.d.) In 2011, the version Microsoft Dynamics AX 2012 was released and made available and supported in more than 30 countries and 25 languages. Additional improvements on UI were added and application enhancements focus on specific industries, e.g. retail, media & entertainment and public sector. (Microsoft Dynamics AX Users, n.d.)

In 2016, Microsoft Dynamics 365 (D365), which differs from the other versions by being offered as a cloud service, was released. Essentially, D365 aims to combine Microsoft’s Customer Relationship Management (CRM) and ERP cloud services into a single cloud service package. (Sheridan, 2016) D365 aims to help the management of specific business functions, e.g. D365 for Sales, D365 for Customer Service, D365 for Operations etc. (Bridgwater, 2016)

2.7 Service Oriented Architecture (SOA)

The basic idea of SOA is addressing systems as services and abstracts those services into single domains where they are formed into solutions. SOA can be described as “representing a set of design principles that enable units of functionality to be provided and consumed as services”. (Lankhorst, 2009) With a SOA, software and IT infrastructure can be designed to allow applications and systems communicate and exchange data regardless of the operating systems or programming languages. The fundamental building block of SOA is a service. A SOA is composed by a set of services that communicates through a communication protocol. (Lundkvist & Persson, 2015) A service is a program that interacts through well-defined message-exchanges. An application’s functionality is exposed through a collection of services. Through a contract that defines their interchanges and a defined policy of how they should be exchanged, the services are interconnected. The services must be built to enable stability and
availability, which can be achieved by using standards-based interfaces and well-defined messages. (Microsoft, 2017b)

The concept of SOA has captured interest by the emergence of web services and service-oriented computing. (Lankhorst, 2009) Loose coupling is the fundamental principle and the architectural concept associated with SOA, whereas the benefits with SOA can be described with the word agility. The idea of loosely coupled systems can result in loosely coupled business processes, as the business processes are not constrained by the underlying infrastructure. To achieve this, the interfaces associated with the services must remain stable and be able to re-configure to meet the ever-changing needs of the business. (Microsoft, 2017b)

The aim of SOA services is to design re-usability and interoperability between systems and platforms. (Microsoft, 2017b) In traditional systems that do not rely on services, the function that is provided by services need to be built into the systems. The issue with this is that the functions have to be coded or recoded every time it is needed. (Maurizio et al., 2008) Consequently, different organizational units might need to build functionality from scratch, e.g. point-to-point integration need to be built, making the architecture fragmented since new integration is built for each case. (Lundkvist & Persson, 2015) However, a SOA could be a possible solution to overcome this kind of issue. A SOA can provide the mechanism whereby a function is written as a stand-alone service that is called when needed. (Maurizio et al., 2008)

Standardized protocols and formats are used to enable the interfaces to be loosely coupled to the system providing the service, meaning that the rest of the IT landscape is not affected when a change in a particular system is made. Furthermore, SOA is an architectural philosophy that promises to help IT respond to market conditions in time and enable agile business processes through open, standards-based interoperability. However, describing SOA can be a challenge for organizations due to different business needs and strategies that affect the requirements and expectations of SOA. To ensure that SOA will provide a value, alignment of SOA with an organization’s business drivers are required. The organizational benefits are assumed that the organization has implemented a well-designed architecture. (Microsoft, 2017b) This is for many organizations difficult due to lack of experience and knowledge of how to do it or how to manage and control the processes. (Marton & Paulová, 2014) Microsoft (2017b) suggests that the first step should be to identify the critical business problems and challenges.

**2.8 Application Programming Interface (API)**

The term “API” can have different meanings depending on the context. There are APIs for applications, operating systems and the Web. Nowadays when API is mentioned, it is often referred to web APIs. (De, 2017) In this report, it is referred to web APIs when talking about API. According to De (2017), the definition of an API is as follows:

> “An API defines the contract of a software component in terms of the protocol, data format, and the endpoint for two computer applications to communicate with each other over a network.”

Through APIs, services and assets are exposed and can easily be consumed by another application over the Web. When cloud computing emerged and cloud-based solutions and software were introduced to organizations and industries, APIs moved from being only used for social interaction to running real business and the need for APIs has ever since grown in a rapid pace. When applications want to use an API, the applications are dependent on a
contract that defines the API. The contract describes how two applications communicate with each other. (De, 2017)

2.8.1 API-management

API-management can be defined as (Techtarget, 2016a):

“API-management is the process of publishing, documenting and overseeing APIs in a secure, scalable environment.”

For an organization that publishes an API, API management aims to monitor the interfaces’ lifecycle and ensure that the needs of the ones using the API are met (Techtarget, 2016a). An API management platform provides with capabilities for an organization to successfully receive business insights, analyze, manage and protect APIs in a scalable environment. (De, 2017)

2.8.2 APIs vs. SOA

There is a huge confusion regarding the difference between APIs and SOA. APIs can be considered as an evolution of SOA, advocating for a lot of the same concepts and principles of creating and exposing re-usable services. Figure 6 briefly presents the main differences between SOA and APIs. SOA has an extensive and well-defined description language and focuses on control while APIs focuses on easy consumption. (De, 2017)

Compared to SOA, APIs are more open, developer centric, easier to consume and also supports human-readable formats, e.g. JSON. From a technical perspective, the major difference between SOA and APIs is the objective behind them. While SOA focuses on re-usability, agility and helps in the pace of the delivery of a service, APIs helps in the pace of innovation of building applications (De, 2017), rapid development, time-to-market and support for cloud-based solutions and services. (HCL, 2014)

A service, which is the fundamental building block of a SOA can be defined as the capability while APIs define how that capability can be repackaged, productized and shared in an easy consumable format. In that sense, APIs and services are complementary rather than contradictory. When applied together, the overall effectiveness of enterprise innovation can be dramatically increased. (De, 2017)

Seen from governance perspective, SOA focuses on re-usability of enterprise services that enable integration within the enterprise. Access to the services is controlled and only available for trusted and well-known partners, whereas APIs are open services for developers and can be accessed on the Web.

![Figure 6: API vs. SOA (De, 2017)](image-url)
2.9 Web services

“A web service, in very broad terms, is a method of communication between two applications or electronic devices over the World Wide Web (WWW).” (Techtarget, 2016b)

Word Wide Web Consortium (W3C, 2004) defines web services as “a software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine processable format. Other systems interact with the web service in a manner prescribed by its description using messages, typically conveyed using HTTP with an XML serialization in conjunction with other web-related standards.” (W3C, 2004)

An API (web API) can be regarded as a subset of web services. It is a special kind of web service that uses different architectural patterns to communicate, compared to other web services. (De, 2017)

2.10 IT governance

IT governance is considered as the process by which firms align IT actions with their business performance goals and assign accountability for those actions and the corresponding outcomes. (Usher, 2010) The aim with IT governance is to have proper strategic alignment of business and IT strategies of the company to improve the organization’s performance. (Kahkonen et al., 2016) This is especially important in ERP system implementations to achieve mutual expectations of what the system should deliver and what can be delivered in the reality. Research has shown that firms with superior IT governance have at least 20% higher profits compared with firms with poor governance given the same strategic objectives. (Usher, 2010):

Decision-making

According to Usher (2010), decision-making is an essential component of IT governance and defines how decisions are made as well as what people are involved in the decision-making process. It has been identified as one of the driver for successful ERP projects. Existing research showed that the business and IT should collaborate on business oriented IT decisions, which can be accomplished by establishing joint committees and business- or process teams with IT membership. (Usher, 2010; Kahkonen et al., 2016)

Integration is an important area for IT decision makers as it spans through different organizational units and systems that interact with the ERP system, introducing organizational and managerial issues to be dealt with. It is an issue that calls for both strategic and non-strategic decision-making, which are carried out by stakeholders representing different organization units that are involved in the development of the ERP system. The role of IT governance becomes even more important as the ERP system is used by many heterogeneous business units, e.g. when deciding on developing new features. When the number of systems grows in an organization, the need to manage the IT portfolio grows as well. (Kahkonen et al., 2016)

Power issues

From a study conducted by Kahkonen et al. (2016), it was showed that the system landscape became unmanageable when power issues existed. Cited from one of the participants in the study: “When constantly reacting to the needs of business without evaluating the impacts rigorously enough, the systems landscape evolved to an undesired direction in an unmanaged way”. It was suggested that IT should be emphasized, not only during early system acquisition but also during the entire life cycle of the system. Hence, IT experts should not just be consulted, but also have authority to make decisions during development and system
acquisitions. Furthermore, the potential of new technologies can be further realized when IT experts have a more central role in decision-making.

**Enterprise architecture**
Enterprise architecture can be defined as describing the high-level integration and standardization needs of the organization (Ross et al., 2006). As a result from the research conducted by Kahkonen et al. (2016), it was recommended to establish a high-level enterprise architecture to expose the organizational goals for affected systems and technologies. This is to ensure that integration needs, requirements and impacts are evaluated and aligned with organizational goals. It is especially important in organizations where individual business and functional units can make decisions that may not necessarily be aligned with the organization’s global strategy for its ERP systems.

**Formalize actions**
The strength with formalizing actions, e.g. allowing the ERP system reinforce organizational structures, is that it reduces variations as well as simplifies the ability to control and predict actions. A structure could be the process for buying in supplies or planning a production. Furthermore, organizations that can balance formalized actions with human creativity and spontaneous actions is likely to be more successful than other organizations that can only manage either one of them. (Hedman et al., 2009)

**2.11 Organizational impact when introducing ERP systems**
When a standard ERP system is introduced, it is important to not regard the system as a pure technical issue. In order to reach success, an ERP system is in a high degree dependent upon organizational solutions to act as support for the system, including organizational changes, e.g. change of structure, processes and culture. The aim with these changes is to reach the full potential of the ERP system and create a higher value. At the same time, there are other challenges that need to be considered to successfully introduce an ERP system in the organization. Some of these challenges are to a large extent mental, e.g. a new and different mind-set regarding the management of the organization. Therefore, acquisition as well as adaption of an ERP system should be regarded not only as a technical project but also as a business project and a change project. Organizational development in the form of reformed governance model is essential, often with a focus on strategic development, implementations and follow-up. The strategic focus is about increasing the rate of coordination in the organization and predictability in the business. (Hedman et al., 2009)

Choosing a standard system entails many compromises, e.g. the extent to which systems should be adapted to the unique business logic that exists in the organization or whether the organization should change. When relinquishing from the system vendor’s standard, what need to be considered is which processes to change as well as a good foundation and support for decision-making. Customizations of either the organization or the ERP system have both costs and benefits. What needs to be remembered is that the ERP system is not a design of how the organization’s processes should be in the future but rather a suggestion on what the system vendors believes to be excellent processes. Therefore, it is essential to balance the benefits and drawbacks of each compromise and decision. (Hedman et al., 2009)

Deviations between an organization’s processes and the acquired ERP system can be regarded as an opportunity to organize the business in a more competitive way in the future. The deviation can be seen as a problem from either the technical perspective or from the organizational perspective. Seeing the problem from the organizational perspective results in a broader picture and the ability to view the interaction of organization and ERP system from
different angles. It also decreases the risk of appointing the system as the problem when the acquisition consumes more time and money than expected. Instead, the organization (e.g., resistance from users) should be appointed as the problem. This is proven to be an issue that is well reported in the IT industry. (Hedman et al., 2009)

An important circumstance to enable positive contribution from the ERP system is a thorough strategic analysis. The ERP system contributes with increased possibilities of modern management accounting, characterized by wider width (multidimensional management) and greater depth (more employees affected). It strengthens the possibilities of increased transparency, responsibility and expectations regarding deliveries and actions. (Hedman et al., 2009)
3. Methodology

In this chapter, the methodology and design of the research will be presented. Furthermore, the reliability, validity and generalizability of the research will be analyzed.

3.1 Research Design and Method

To answer the research questions, a case study was performed at Company X, which is described in more detail in section 3.4. Based on the results and empirics from the case study, combined with the literature study, the aim of this study was to draw general conclusions on how large organizations should work with integration and ERP systems after understanding the challenges that exist.

According to Yin (2009), if the research questions are dealing with operational links that need to be traced over time, rather than mere incidences, case study is the preferred research strategy. A case is a phenomenon that has occurred naturally, which exists prior to the research study and still exists when the study has finished (Denscombe, 2010). Since the problem situation that was investigated in this study is a consequence of several actions and decisions made over time at the case company, it was decided that case study would be the most appropriate research methodology.

The study consisted of a literature study and two rounds of qualitative data collection through both formal and informal interviews. The interviews performed during the first round of data collected, the so-called pre-study phase, were conducted in an informal and unstructured approach while the second round of interviews were designed in a semi-structured approach and performed in formal way. This study applied an inductive research approach (Blomkvist & Hallin, 2014).

A pre-study was conducted to receive an understanding of the current situation and the experienced issues at the Dynamics AX group. Informal interviews were decided to be the best option, as it is difficult to formulate appropriate interview questions without an overview and understanding of the situation. Despite informal interviews, the pre-study also included looking through the documentation for an overview of what integration techniques are used today in Company X, as well as how the ERP system is integrated with other internal systems at Company X. A small literature study about e.g. ERP systems, Dynamics AX and enterprise integration was conducted in parallel. The purpose of this literature study was to get a basic understanding of ERP systems and enterprise integration to easier understand the issue at the case study company. Another purpose with the smaller literature study was to understand whether there had been similar case studies or if a similar issue had been experienced in other organizations.

After the pre-study, a more extensive literature study was conducted. The design of the second-round interview questions as was formulated in parallel with the literature study. Afterwards, the second-round of interviews were performed. During this phase, the literature study was still an ongoing process and was updated after the findings from the interviews. The findings from the data collection were analyzed with the findings from the literature study and conclusions were drawn upon these findings.
3.2 Literature study
As mentioned earlier, a small literature study was already conducted during the pre-study phase. This is coherent with Collis & Hussey (2014), which mentioned that the literature search can already start when initial ideas on the research topic have been formed. However, the search of literature has been performed throughout the whole process of the study, starting from a broader searching scope and scaling down the scope later on when the research questions and result of the findings became clearer.

The aim of the literature study was partially to identify and gain knowledge within the research topic (Collis & Hussey, 2014), including enterprise integration and system integration, ERP systems, IT governance and other relevant areas to the research questions. It was also conducted to understand how this study could contribute to the research as well as find academic connections to the findings from the data collection. Since the results of the interviews were analyzed with the findings from the literature study, the academic findings have a significant role for the conclusions of this study.

All sources of secondary data that was relevant for the study is referred as literature (Collis & Hussey, 2014). Different sources for collecting literature were used during the study, whereof the main sources were the database KTH Primo and Google Scholar. The keywords for searching the literature included: “enterprise integration”, “system integration”, “Dynamics AX”, “ERP systems”, “integration”, “SOA” etc. In addition, the ambition was to study mainly research articles that were published during the recent years in order to receive knowledge about the latest research.

3.3 Theoretical model
The theoretical model that was used for this study was the model presented by Venkatachalam (2014), which describes the three obstacles that exist in enterprise integration: technology, process and people. A more detailed presentation of this model was described in section 2.3. However, it was decided in an early stage that only the obstacles related to technology and process was going to be investigated in this study. The reason is because it was identified during the pre-study phase that the obstacles that had a major impact on the problem situation at Company X are mainly related to the technology and the processes. Therefore, it was decided to only focus on these two aspects in this study.

![Figure 7: Theoretical model for this study](image)

3.4 Qualitative data collection
This section will present the qualitative data collection methods used in this study and describes briefly some decisions taken during the data collection phase.
3.4.1 Semi-structured interviews
The interviews were conducted in a semi-structured approach. The benefits of semi-structured interviews were that the interviewees were given the opportunity to express their opinions and ideas based on their own experience.

Interviews with employees that have varied roles and backgrounds at the case company were performed. Table 2 shows all the interviewees participated in the second round of the formal, semi-structured interviews. It was decided to interview people with different occupations in order to receive a broader understanding and perspective of the issue. The participants of the second round were not the same as the participants during the first round of data collection (the pre-study). The reason for not choosing the same persons as those during the pre-study was to prevent the answers of being biased or influenced from the informal interviews.

During the interview process, only written notes were taken. Recording of the interviews were not performed, as some of the interviewees were not comfortable with it. According to Denscombe (2010), only taking notes during the interviews can be a compromise in situations where the interviews could touch upon sensitive issues, e.g. political issues. The written notes are also a form of permanent record. However, the disadvantage of only taking notes and not audio or video recording is that the researcher might misinterpret some points. (Denscombe, 2010) Regarding misinterpretation and the affect on the results, in cases where there has been a possibility of misinterpretation, the researcher has always assured with the interviewees whether the interpretation made by the researcher is accurate. Therefore, it is argued that there is a very low chance that information can be misinterpreted in this study.

3.4.2 Documentation
Documentation is a source of data and also an alternative to questionnaires, interviews or observation (Denscombe, 2010). In this study, documentation is referred as internal, written documents. The purpose with studying and reading the internal documents was to receive more information about the ERP system, previously developed integration, the organizational structure etc.

3.5 Case study at Company X
To answer the research questions and fulfill the purpose, a case study at Company X with focus on the ERP system Microsoft Dynamics AX was conducted. The executives of Company X experienced that the current way of working with integration with AX and other IT systems is neither economically beneficial nor flexible and scalable. Therefore, they were interested in understanding how they should address the issues concerning integration in the future. Since the study was performed from the perspective of Company X, nearly all data have been collected from Company X, except for one interviews with interviewee 16 that works within Company Y but runs the consolidation program; a program intended to extend the use of standard software to support wholesale and retail processes.
<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Role</th>
<th>Organization/functional unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interviewee 1</td>
<td>AX Solution Architect</td>
<td>Company X, AX</td>
</tr>
<tr>
<td>Interviewee 2</td>
<td>AX Solution Architect</td>
<td>Company X, AX</td>
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<tr>
<td>Interviewee 3</td>
<td>AX Technical Lead</td>
<td>Company X, AX</td>
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<td>Interviewee 4</td>
<td>AX Developer</td>
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<td>Interviewee 5</td>
<td>AX Developer</td>
<td>Company X, AX</td>
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<tr>
<td>Interviewee 6</td>
<td>Manager</td>
<td>Company X, Integration, standardized interfaces</td>
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<tr>
<td>Interviewee 7</td>
<td>Integration Technical Lead</td>
<td>Company X, Integration, standardized interfaces</td>
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<td>Interviewee 8</td>
<td>Manager</td>
<td>Company X, Integration, interconnectivity services</td>
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<tr>
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<td>Manager of Enterprise and business architect</td>
<td>Company X, Enterprise Architecture</td>
</tr>
<tr>
<td>Interviewee 16</td>
<td>Consolidation Program Manager</td>
<td>Company Y, Commercial Operations: Business support unit</td>
</tr>
</tbody>
</table>

*Table 2: Summary of the interviewed candidates*

### 3.6 Discussion regarding research design and methods

As previously mentioned, the methods used for this study contained a literature study and two rounds of data collection, both unstructured and semi-structured interviews. The data that were collected during the first round were through unstructured interviews. It fulfilled the purpose of understanding the problem situation at the case company as well as receiving a basic understanding of the integration architecture and the elements that are involved and affects the situation. The data received from the unstructured interviews laid the foundation of the purpose of this study and as well as the research questions. Furthermore, it fulfilled the purpose of gaining knowledge about the area and the kind of literature review that was needed for this study.

The second round of data collection with semi-structured interviews was conducted after having an overview of the case. The interview questions that were given to the interviewees
varied depending on the functional role of the interviewee. However, the direction and purpose of the study changed in the middle of the second round of data collection. This was because the initially proposed research focus was no longer relevant for the commissioner after understanding that the integration group had increased their focus on API-management. This resulted in a change of research direction and research purpose. Consequently, much of the received data from the first half of the second round of data collection were not applicable to the new research purpose, even though some input still had some significant contribution to the understanding of the situation and the issue. At the same time, it means that the number of conducted interviews that were useful to this study was not really 16, but fewer. Ideally, more semi-structured interviews should be performed to increase the quality of the results. However, due to time constraints, this could not be accomplished. Along with the second round of data collection, the literature study was performed and adjusted after the empirics. The initial understanding of the problem formulation at the case company was that it was more of a technical issue rather than non-technical issues. Therefore, the initial focus on the literature review had a heavier focus on the technical aspects. This was adjusted after realizing from the empirics that the factors behind the problem were in fact due to non-technical factors, rather than the technical factors.

3.7 Reliability, Validity and Generalizability

In this section, reliability, validity and generalizability will be discussed to understand the quality of the research methods and thereby the quality of the results.

Reliability

Reliability refers to the accuracy and precision of a research. If a research has high reliability, the same results should be obtained if the study was performed under the same circumstances by another researcher (Collis & Hussey, 2014). The reliability can be discussed in terms of the literature study and the data collection, which were the performed interviews and documentations. The reliability of the literature study is relatively high, as most of the sources were published data from research articles, even though some sources were also websites from the Internet. According to Denscombe (2010), website pages can be treated as online documents, a form of data. The issue with websites is that it is hard to evaluate the credibility, i.e. if the information is accurate. Hence, the used websites need to be considered carefully. (Denscombe, 2010) In this study, many of the judgment criteria for evaluation of websites mentioned by Denscombe (2010) have been considered. Furthermore, the information retrieved from the websites has been compared with other websites to assure that the information is accurate.

Since the interviews were performed in a semi-structured approach, the reliability in this part of the study is of a lower degree (Collis & Hussey, 2014). This is due to the nature of the interview questions in a semi-structured interview, where the answers could be very open and varied, leading to different follow-up questions as well as different answers from the interviewee from occasion to occasion.

Validity

Validity refers to the extent to which the research findings accurately reflect the studied phenomena. The validity of a research study is considered high if the research studied what it was intended to study (Blomkvist & Hallin, 2014). According to Collis & Hussey (2014), qualitative data are associated with an interpretivism method that gives the findings high degree of validity.
Most of the chosen sources in the literature study were published research articles or published books, collected or published from known databases and is argued to have high validity. While some sources were websites, these do not have any significant impact on the validity as the websites have been chosen with care and evaluated carefully according to Denscombe (2010). A few of the sources were industry reports, written by consulting firms or vendors. It can be argued that these articles may be subjective or biased in order for them to sell their expertise within the area. However, the overall validity of the literature study is considered high since the majority of the chosen sources were published research articles. Several sources that focus on the same research area have also been compared to ensure the validity of the obtained theory and information.

To ensure validity of the interviews, at least two interviewees with the same role or adjacent working areas were interviewed and they received the same interview questions. However, it is most likely that the interviewees had their own perspective on the problem, and might therefore differentiate from other interviewees, despite same role and working area.

**Generalizability**

Generalizability refers to the extent that the study can be applicable in other cases under similar circumstances. In most qualitative studies, the intention is to study a specific issue in a certain population. Hence, generalizability of a qualitative research study is often not expected. (Leung, 2015)

The case study that was performed in this study evaluates a company-specific situation. This means that the finding might be hard to apply in other cases, as the situation in this study is company-specific and have not been studied in other contexts. Furthermore, the findings obtained from the interviews might be biased, as the interviewees have a perspective from their current role at the case study company. However, it is reasoned that the findings could be generalizable to other large organizations within the same industry.

Blomkvist & Hallin (2014) mentioned the concept “analytical generalizability”, which discusses how the results from the case study could be applicable in other similar cases. The disadvantage is that a case study needs to be presented detailed enough for the reader to judge whether the reasoning holds in another case. In large organizations such as Company X, with a huge number of different internal IT systems, it might be difficult to obtain a relative broad view on the issue by just reading a report. Therefore, this report tries to simplify the situation to make it understandable for the reader.

**3.8 Research ethics**

This study followed and fulfilled the Swedish Research Council’s four principal requirements, cited from Blomkvist (2016):

- The people studied are informed about the purpose of the study (i.e. the information requirement)
- The studied individuals agrees upon being studied (i.e. the consent requirement)
- The material collected during the study will be treated confidential and involved companies and informants are made anonymous (i.e. the confidentially requirement)
- The material collected may only be used for the purpose that was stated when collecting the material (i.e. the good use requirement).

All interviewed candidates were before the interviews informed about the purpose of the study through email and have all agreed upon being studied. With exception of the functional role of the interviewees, all other information about the interviewees was kept anonymous.
They were also not referred to during the presentation of the empirics, in order to ensure that there are no assumptions on who said what.
4. Obstacles

In this chapter, the obstacles that were identified from the case study will be presented. The obstacles will be presented according to the theoretical model that was described in section 3.3. Firstly, the technology related obstacles will be presented, followed by the process related obstacles.

Company X is an IT organization consisting of 10 different functional departments. Each department has a number of units and each unit has a number of subgroups. This main focus of this case study has been performed at the unit level “AX” and the belonging four subgroups. However, interviews have also been conducted with representatives from the units “integration”, and “enterprise architecture” Each unit works within different areas and have different responsibilities, e.g. one group works with SOA and standardized interfaces, one group works with establishing and creating integration, another group works with enterprise architect etc. The current organizational structure at Company X is fragmented in the sense that there is no cross-functional collaboration between the different units. As Company X delivers solutions to Company Y, the structure of the organization and the business at Company Y affects how IT solutions are built. Company Y is a multinational company with a decentralized organizational structure. This means that the executives of each country have authority to make their own business decisions. Consequently, the structure of the same business processes can be different in different countries. For example, the layout of an invoice used in the Swedish market can be different in comparison with the invoice used in the Indian market. This is problematic when using an ERP system that has its own standard on the layout of an invoice.

The type of integration that has been investigated at Company X is system integration. This is also the most common type of integration issue related to ERP systems (Themistocleous et al., 2001). While Themistocleous et al. (2001) distinguished systems from applications in their research, integration of both systems and applications have in this study been interchangeable. In this research, the systems and applications are those that are currently used at the headquarters of Company X, called central systems as well as systems and applications that are used at the local markets, in some cases called local systems. If one would follow the model showed in figure 4, by Ventakatachalum (2014), the integration types that would be relevant are “system integration” and “application integration”. From that model, it is showed that the relation of system integration to technology related obstacles are high, while process obstacles are of medium level. On the contrary, for application integration, process related obstacles are higher than technology related obstacles, as showed in figure 4. It can be concluded that Company X has treated the integration between Dynamics AX and other IT systems as system integration, rather than application integration. This conclusion is drawn from the collected data, which showed that process related obstacles have received much less attention than technology related obstacles, which will be presented further in chapter 4.2.

4.1 Technology

This subsection will present the obstacles related to technology that Company X experience. Based on the findings, the technological aspects have a much less significant impact than the process related obstacles.

Current integration architecture

During the recent years, the usage area of AX has increased and AX has been used in a larger scale. AX has grown rapidly and to some extent uncontrolled. While the number of users have increased, the number of systems as well as the number of required integration between the ERP systems and other IT systems have increased as well. During the first few years, point-
to-point integration may have been the most optimal, flexible and cost efficient approach, in line with what has been mentioned by Gold-Bernstein et al. (2005). However, the required costs and time has also increased rapidly when new systems need to be integrated, which is in coherent with the theory.

The integration of all systems and application (including Dynamics AX) at Company X is through an internal integration platform (denoted as EIP in figure 8) that acts as a middleware between different systems and applications. In other words, Company X is already adopting an EAI technology. Over the years, different integration technologies have been used, which increases the complexity of the integration with other IT systems and AX along with the point-to-point integration. Consequently, this way of working with integration has led to large financial investments, reduced possibility to re-use already developed integration as well as difficulties of keeping the ERP system at standard.

There are nine development environments of Dynamics AX at Company X, some in version 2009, some in version 2012. These development environments are distinguished by function/module, business area and geographic location. The majority of integration between Dynamics AX and other systems are built with an EAI-technology, with an integration platform acting as a middleware, denoted as EIP (Enterprise Integration Platform) in figure 8. However, there are also some point-to-point integration that are directly connected without involving the integration platform. As can be seen in figure 8, unique integration for different countries have been built even though the same system is used. This is one of the reasons for the unnecessary complexity of the overall integration architecture.

The conceptual figure (figure 8) can be found below. For the simplicity, only two development environments of Dynamics AX are illustrated in the figure.

![Figure 8: Conceptual figure over the integration architecture](image)

**Lead times**

As the AX group relies on the integration group when creating either a mirror setup (a similar integration setup that has been performed before but with a new system in another country) or a completely new integration, long lead times follows. The AX group cannot proceed with their work until the integration group has accomplished their work. Furthermore, there are
several steps in the process, which also contributes to the lead time, e.g. creating a change request, setup an initial meeting, fill in information- and data forms etc. During mirror setups, you could assume that some steps could be reduced as you have experience from the work before. However, because the integration group is not aware of what kind of data AX requires and whether the data and information is the same for different countries, the same procedure need to be performed for every kind of integration.

The reason for why point-to-point integration has been developed in some cases may be due to the long lead times at the integration group. In practice, the needed integration may be quite simple and it could save a lot of time by just doing a point-to-point integration and hence not involving the internal integration platform and the integration group. The lead times prevent the AX group from performing continuous integration and results in extended time of delivery. This is also one of the reasons why the AX group considered of introducing another integration platform developed by Microsoft, BizTalk to have more control over the integration work and be less dependent on the internal integration platform and the integration group.

Integration Technique
A main issue with current integration is that they have been developed with different techniques. Depending on the version of the ERP system and historical decisions, two different integration technologies, AIF and DIXF have been used. AIF is an infrastructure within AX 2009, which exposes business logic or exchanges data with other systems. It is a framework that enables integration with external applications. (Microsoft, n.d.) DIXF is an extension in AX 2012 that helps to import and export data. (Microsoft TechNet, 2014) Compared to AIF, DIXF has the capability of processing large quantities of data. The different technologies reduce the possibility to re-use an already developed integration, especially if it is an integration that was built with AIF. Since AIF is deprecated in future versions of Dynamics AX, these integration cannot be re-used.

The current major challenge related to the integration techniques is how to work with the integration that was developed with AIF. This is currently the biggest workload and it is unsure whether the most optimal choice would be to upgrade the integration to DIXF or wait until upgrading to the future version, the cloud-based ERP system (Dynamics 365).

Standardized interfaces and generic middleware
The standardized interfaces that are used today at the AX-group are called “Financial transactions” (FT) and “Information format” (IF). There are several versions of these interfaces, e.g. FT 2.0, FT 2.1, FT 5.0 etc. Even though these standardized interfaces exist, it is hard to accomplish high rate of re-usability because different integration uses different versions of these interfaces. Version 5.0 is the latest version of FT and IF. The issue of different markets having different business processes, which complicated the integration architecture can be solved by using version 5.0 and in turn reduce the overall complexity of the integration architecture. However, this is something that was recently developed and utilized. The development of version 5.0 can be seen as a strategic measure towards making upgrades of the ERP system and integration smoother in the future.

The internal integration platform that currently exists at Company X only handles a fixed number of patterns and has its own standards, which will be denoted as “X standard” from now on. Since the Microsoft/AX standard deviates from the “X standard”, leading to many customizations and constraints of using full functionality of AX, there is a need to investigate
and analyze whether the Microsoft standard could be added as one of the design patterns to the integration platform. In that case, what needs to be investigated in detail is what requirements AX have that the integration platform cannot provide at the moment as well as the benefits and drawbacks of adding Microsoft standard to the “X standard”.

If the markets do not accept changing processes and adapting to the ERP system, then the middleware have to be more generic than it currently is. Interviewees mentioned that the main issue is that the middleware is not generic enough, which means that AX cannot receive standardized data formats. Consequently, customizations are needed and integration are rebuilt each time a new integration is needed. The mind-set that exists today is how to communicate with currently used system rather than how to communicate with the future system. Also, the way of thinking is integrate system A and B rather than what kind of information and data the systems need to exchange between each other. Without consideration to what data and information is sent between the systems, the middleware is not generic enough to handle the situation at Company Y, where local markets defines their own processes and sends or receives different format of data. When the middleware is not generic, too many connections and integration need to be built, resulting in unique integration that only a particular system or country can take advantage of. Furthermore, if the middleware is not generic enough, issues arise when systems do not follow the “X standard” (many systems usually have external and local vendors). For example, a standardized interface called “financial transactions” (FT) follows the “X standard””. However, some system vendors experience complications when supporting the “X standard”. In that case, if the middleware was generic, the local systems would send its data without much modification. The middleware would transform the data to fit AXs standard and AX could retrieve the data after the transformation in the same way like any other system.

**Customization and AX Standard**

When buying and introducing a standard system, e.g. an ERP system, the usage of the system should be in the areas where the system can contribute with its full potential to the users. For a standard system, using its core functionality and using the standard is the only way to obtain the full advantage.

During the interviews, it was mentioned that from the perspective of integration, AX might not be the best choice of system since Microsoft is quite immature with open source, exposure to other platforms and compatibility with other standards. This is the main reason why some of the interviewees argue that you should not use Microsoft standard when it comes to integration issues, as many systems are not compatible with Microsoft. However, within the domain of AX, standards should be used. This also means that you should not make any customizations in the kernel of AX.

The interviewees seemed to have different opinions regarding following AX standard or “X standard”. Some argue that following the standard implementation of AX is wrong due to the fact that Company Y does not have standardized processes throughout the different markets. Following AX standard would only be beneficial if the different markets had the same processes, otherwise spaghetti integration architecture will emerge. For example, another ERP system that is used at Company X called SAP follows the “X standard", i.e. designs after what already exists at Company X.

Company X has a history of developing everything internally, resulting in customized solutions and increased costs. The benefit for the AX group when keeping to the Microsoft
standard is that developments can be kept at minimum. Many functionalities and services can be bought, instead of developed, which also simplifies the process when moving towards the cloud platform and buying software as a service (SaaS).

**SOA and API-management**

At Company X, there is a SOA center and a functional unit that works with SOA. However, the data showed that in some cases, a SOA has not been used, either because the traditional systems has technical limitations and cannot rely on services or due to historical decisions. As Maurizio et al. (2008) mentioned in their research, the consequence is that the integration functions is built into the systems, which means that the functions have to be hard-coded or recoded each time a system needs to be integrated with the ERP system. The data showed that this was one of the reasons for the occurrence of point-to-point integration as well as why the management of the AX-group experienced that the development of integration were inefficient.

The case company has the vision of moving the majority of current systems and applications to a cloud platform. Hence, there has been an increased focus on API-management at the integration group. It was reflected during the interviews that many issues that have occurred with integration is partly because SOA is too tight coupled to the systems or applications, partly because the implementation of the SOA did not work out as expected. Some interviewees argue that API can solve many of the integration issues that the AX group experiences, while other argue that API is just another technology.

### 4.2 Process

*This subsection will present the process related obstacles that Company X experience.*

From an overall perspective, many issues with the integration complexity that has arisen can be categorized under the concept “IT governance” (Usher, 2010; Kakhonen et al., 2016). This has also been reflected by the interviewees, experiencing that there has been a lack of central strategy regarding the future of Dynamics AX, its growth, integration and future initiatives. In other words, IT actions have not been aligned with the business strategies.

**Decision-making**

Decision-making is one component of IT governance (Usher, 2010), which defines how decisions are made and who makes the decision. From the empirics, it is clearly showed that the process of decision-making has been lacking or is insufficient. It is not clearly defined how decisions are made and who makes the decisions since different employees can make their own decisions based on what they believe would be most beneficial for Company X and the situation. The consequences are that Company X lacks control and governance over what kind of integration are developed and how they are developed. Because every IT project is financed by the business, i.e. Company Y, Company X is dependent on Company Y. Thus, Company X has less power in decision-making in relation to Company Y. Additionally, each local market has the authority and final decision right to decide what’s most optimal for the specific market.

In some occasions, formal authority at Company X can be limited during decision-making as Company Y can overrule them. When a project is formed and a solution is going to be developed, Company X can give recommendations for how the project should be performed but the business has the final decision as Company Y finances the project. As economic benefits are at stake, receiving the requested functionality in time and within budget may be perceived as more important than the quality of the deliveries. Consequently, issues regarding
the quality of the solutions, standards and policies as well as governance can arise. This also indicates that IT-project members are forced to disregard policies and standards in order to stay within the timeframe and budget. Consequently, in some cases, Company X must provide a point-to-point integration or create an integration that may not fulfill the requirements of reusability. At the same time, this decision-making structure can with a high probability create misalignment between the business and IT.

From the perspective of Company X, another concern regarding decision-making is the issue where decisions are made on a functional unit-level or local market level. Each local market has their own authority and formal right to make decisions that they believe is most beneficial for their specific market. Besides, there is no formal authority that can make decisions on a level above the local markets. For an ERP system, which is a standard and centralized system, this is a costly structure and also increases the complexity of each integration project, in the sense that each local market request unique solutions that are only compatible in their market, rather than for all the markets that Company Y operates in.

**Working methodologies and policies**

Many of the issues that the AX group experiences now are due to the lack of standardized working methodologies and policies. Currently, there are no defined standards and policies regarding how an integration should be designed, developed, implemented, documented, what aspects need to be taken in account and which best practices should be used or which technology should be deployed.

As the use of Dynamics AX has been growing rapidly, the created and needed integration with other systems within the organization has also been growing. This has led to the awareness of striving for re-use of the already developed integration. However, the design of the integration as well as the quality of the implementations can vary in a broad scale depending on several factors, e.g. experience and knowledge of the developers and solution architect, requirement from the customer (the business), timeframe etc. The consequences are limited possibility of re-use, unstable integration, difficulties in keeping consistency and flexibility etc. The main reasons for this are lack of standardized working methodologies and policies. Employees with more experience and deeper knowledge of Company X’s integration architecture may develop an integration that has a higher chance of being re-usable while others, e.g. new employees with limited understanding of Company X may develop a solution that is not fully adaptable with the rest of Company X’s goals in the longer perspective. This leads to the scenario where each project group and employee works in a way they think would be most optimal. For example, when a decision of developing a point-to-point integration between AX and the receiving and sending systems has been made, this integration cannot be re-used as this goes against the policy, which states that each integration needs to involve the integration platform. Since the goal is to achieve re-use and consistency of the integration, the lack of standardized working methods may not be the most optimal working structure. The lack of standardization can also result into technical issues that lead to some integration being more expensive when trying to re-use the integration in the future.

It appears that some subgroups within AX have come much further with the work of keeping the ERP system at standard and not adapting and customizing after the requests from Company Y. Also, there is no unified strategy on which integration technology should be used. For example, the management of the “financial service” group has decided to work with DIXF and upgrade previous integration to use DIXF while the management of “commercial operations” have decided to let previously built integration that used AIF remain the same. Even though the decision at “commercial operations” may be due to the big amount of
integration that is built on AIF, the lack of unified and standardized working methodologies is present. The management of each subgroup of AX can decide for themselves without any clearer directive from the management above.

**Expectations and collaboration between business & IT**
The lack of collaboration between different business units have led to limited possibility of developing generic solutions that can be applicable to several business units. As decisions are made independently at different functional and business units, the required IT-solutions from the different business units are also requested separately regardless from each other. Besides, the different business units have also different budgets for the requested IT solutions. The issue with this decision structure and the separate budgets is that Company X have in many cases been constrained of developing a solution that is unique to a specific system or customer, rather than developing a solution that is generalizable and scalable, i.e. the solutions does not acquire the flexibility to easily add a new system that is in need of the same or similar integration. The consequence is that Company X is building an integration that may not be reusable in the future and consequently spaghetti integration architecture arises. In other words, a similar integration with minor modifications to the future customer will be rebuilt from scratch. Obviously, building small-scaled and specific solutions are cheaper from the perspective of each individual business unit compared to building large-scaled, generic and standard solutions. However, it is more expensive from the perspective of whole Company Y as well as seen from the longer perspective. Since this way of building integration increases the complexity of the overall integration architecture, building new integration or updating to newer versions may be more expensive and inefficient.

Normally, employees from Company X do not encounter the employees from Company Y on a regular basis. As both parties lack understanding of each other’s operations, there are difficulties of receiving mutual understandings of the specifications, expectations etc. Except the formal meetings that usually exist between the business and IT during project initialization, there are no formal follow-up meetings or other information channels that enable both parties to interact.

It happens that IT project groups tries to deliver something even though they know it is nearly impossible based on the current circumstances. The main reason is because Company Y (the business) has a stronger position as they are financing for the deliverables. It is possible that they could actually communicate their difficulties of delivering in time but this is not performed in reality, either because of lack of authority or because of the mental belief of lack of authority. In these cases, project members may feel the pressure of developing solutions in a fast pace to satisfy the needs of their customers (the business). Consequently, the mind-set of “delivering in time is more important than quality” can occur. At the end, it is not to any advantages for the business. However, this may not be realized for the business, as they often do not have the whole picture or understanding of the technical aspects.

From the perspective of the business, Company X is regarded as an organization separated from Company Y, with the purpose of delivering IT solutions to Company Y. This means that Company X and Company Y are working towards their separate goals as two separate organizations without any intersection rather than working together. Hence, a gap is created, which complicates the collaboration between the business and IT.

**Customized business processes for the local markets**
As mentioned earlier, Company Y has businesses all around the world, with each country having the formal right and authority to decide on their own business processes, meaning that the same business process may be entirely different in for example Taiwan compared to
Indonesia. In other words, every local market has unique and customized business processes. This is a challenge and increases the integration complexity radically when working with standard systems such as ERP-systems. The business processes that do not contribute to any competitiveness, e.g. the finance processes could be standardized. In this context, it is important to distinguish from legal requirements and process change. The customized business processes may have evolved from the lack of business and IT governance on the horizontal dimension, i.e. between different regions and municipalities. Even though this business structure has made Company Y successful globally, it is an issue from the perspective of Company X.

Organizational structure
Both Company Y and Company X has a decentralized organizational structure. The current organization structure that exists at Company X separates each functional unit from each other. For example, the solely communication and collaboration between the integration group and the AX-group is when a customer has ordered an integration. Further communication and collaboration occurs only if one of the parties has taken the initiative to formalize a meeting or interaction. However, as the integration between AX and other IT systems requires involvement from different parties, this kind of organizational structure enhances the difficulties when developing and implementing the integration.

Parallel Projects
Since a huge number of integration are executed through different projects, successful project execution can also lead to simpler integration architecture and affect the quality of integration in a positive way. Previously, usually one project at a time was performed. To increase efficiency it was decided to run several projects in parallel. Currently, around 12 integration projects are run in parallel. Many of these projects often run over the time frame or budget, affecting the other projects as well as future projects in several ways since some resources are common. Empirics showed that this is less efficient as there are several factors that the employees cannot influence, for example longer lead times as many projects collides during e.g. the testing phase. Project members often have several roles due to participants in several parallel projects. Often, they have to prioritize between different projects, leading to delays and other negative influences in other projects. Also, many projects are not closed because there are still a few problems that hinder the project leader from closing the project. At the same time, new assignments need to be started. Therefore, you move on to the next project without closing existing projects as the next project has begun.

Furthermore, estimating the time and budget for each project is also a challenge. In many cases, integration projects are unique, meaning that the system that needs to be integrated with AX is a new kind of system, often a local system that has not been integrated with AX before in any other country. Therefore, it is hard to estimate in the prestudy phase how much time is needed, predict what kind of problems can occur etc. In many times, you are “learning by doing”. Furthermore, this also affects the ability to question whether an integration is developed in the most optimal way.

Moreover, the AX-group currently started working with agile project methodologies, from previously more traditional methods. However, they have not completely succeeded with the transition, which means that both agile and traditional projects methods exist.
5. Solutions

In this chapter, the possible solutions of the obstacles that were presented in the previous chapter will be presented. The solutions will be presented in the same structure as in chapter 4, i.e. technology related solutions will be presented first, followed by process related solutions.

5.1 Solutions related to technology

When it comes to technology, one can argue that even though it exists some minor issues with the technology, the technology related obstacles are not the main issues. Rather, the root cause behind the challenges related to integration with the ERP system and other systems at Company X are the lack of IT governance, lack of policies, organizational structure etc., which can be categorized as process related obstacles.

Standardized interfaces

According to Hasselbring (2000), standardization of message format and context is necessary for applications to understand the data that is exchanged. One of the integration methods, common data format takes advantage of this kind of data exchange. When it comes to the case at Company X, there are standardized message formats for FT and IF, which have proven to be more efficient and entails many benefits. The empirics showed that they are working more and more towards this direction.

Even though different markets have different business processes and sends and receives different output or input, there is a possibility to accomplish simpler integration architecture than what exists today through standardized interfaces. From AX’s side, the process for processing the data could be the same; independent of what kind of data AX receives. This could be accomplished by having standardized interfaces. At Company X, there is a unit that is fully dedicated with creating standardized interfaces. However, the empirics showed that the AX group has not completely taken advantage of it. Therefore, it is suggested that standardized interfaces should be used at a higher extent.

Integration technique and methods

Finding the right integration architecture for integrating the ERP systems with best-of-breed-systems have historically been difficult. According to the findings in the literature study, experts believe that many complexities around point-to-point integration of ERP systems and best-of-breed-systems have been mitigated with technologies such as web services, SOA and standard business objects, making it easier to integrate. At the case company, web services and SOA have been used to a certain extent, when it has been possible. There is the goal of extending the usage of web services and SOA. However, there are many limitations at the other IT systems since AX need to be integrated with many legacy systems, which are not built for using modern technology, e.g. web services.

Regarding standard business objects, Company X is aware of the advantages they can obtain with standard business objects. However, this is hard to achieve in practice due to several reasons including varied business processes and political issues. These kinds of obstacles have been presented in section 4.2 and will also be discussed further in section 5.2.

Since Company X has the goal of upgrading to the cloud-based ERP system, and it is a big workload to upgrade the integration built with AIF to DIXF, it is recommended to not upgrade to DIXF but rather build from scratch when it is time to move to the cloud. As the empirics showed, it is unclear whether the integration developed with AIF is of high quality
and satisfies the requirements of re-usability and consistency. This means that it is uncertain whether the integration can be re-used in the future. Therefore, it is believed to be optimal to rebuild from scratch.

**Customizations and AX standard**

Özkarabacak et al. (2014) mentioned that the main problems with ERP systems are customizations and problems with system integration, making maintenance and integration of the ERP system difficult. According to another research, standardized data formats as well as standardized products can facilitate integration (Kahkonen et al., 2016). Nevertheless, customizations of the ERP system have both a cost and a benefit (Hedman et al., 2009). In coherence with the research empirics, many interviewees reflected that the customizations that they are building are expensive but are needed due to several reasons, e.g. the business processes. Strive to minimize customizations as well as increase the usage of standard functionality and standard business objects of AX could be a solution. However, the theory also states that the ERP system is not a drawing on how the business processes should look in the future but is rather a suggestion to the user. (Hedman et al., 2009) Therefore, actions and decisions regarding these areas should be evaluated, which is also in coherence to the theory. A possible solution could be mutual adaption, which was introduced by Nordheim & Päivärinta (2004), meaning that the business and IT could compromise and meet halfway.

The issue of AX standard not compatible with other systems is still an urgent issue. According to Azevedo et al. (2014), absence of this issue may result in efficiency problems as well higher implementation costs. On the other hand, interviewees believe that Microsoft is working towards open source and increasing compatibility and integrability with other systems and platforms. It is hard to believe that they have not moved away from the mindset of keeping everything in-house. To remain successful, they have probably come to the conclusion that companies will not just use or buy Microsoft products, resulting in that they are forced to work toward openness and increase compatibility with other systems if they want to keep their leading position on the market.

**API-management**

Currently, SOA and traditional integration methods are the architectural concept and technologies that are used for integration at the internal integration platform. It was mentioned during the interviews that SOA might have not been successfully implemented. As mentioned in the theory, SOA is an architectural philosophy, which entails many challenges. The different needs and strategies from the business as well as requirements and expectations are all factors that can contribute to the implementation complexity. If SOA was not successfully implemented, many applications are affected and this could be one of the reasons for the challenges around integration that the AX group has experienced. As APIs have heavier focus on time-to-market (HCL, 2014) and are consumer-friendly (De, 2017), building APIs on top of the SOA services could be beneficial for integrating the ERP system with internal applications and systems. It could be easier for developers as well as consumers to discover and consume services (De, 2017). Furthermore, since the AX group at the case company has the goal of upgrading to D365 (the cloud-based Dynamics AX), API-management could facilitate the future integration work. Some interviewees also reflected that this is what the ERP system as well as the AX-group might be in need of in the future.

**External tools (to replace the need of customizations)**

It might be hard to reach the vision of not performing any customizations due to customer requests and the variety of business processes that exists in different markets at Company Y. Using external tools could be a way to overcome this issue. For example, printout
functionality often causes a lot of adjustments in AX with several customized documents. If exporting the printouts to external tools and print them there, the printouts could be transferred to the markets and AX only need to supply with one common export functionality for different printouts.

External tools could be a compromise – the local markets can keep their business process the way they are, while AX do not need to perform any customizations. However, when deciding to introduce new tools, deeper analysis regarding the benefits and drawbacks are needed to understand whether it is optimal to introduce another tool to Company X’s landscape.

5.2 Solutions related to process
In this study, it is concluded that the main obstacles that have had an impact on the integration issues and the integration architecture are process related according to the definition defined by Venkatachalam (2014), which was presented in chapter 2. The foundation of the currently experienced issues of the integration with the ERP system and other IT systems at Company X can be regarded as the consequences of mainly focusing and solving the technology related obstacles, neglecting the negative impact process related obstacles can cause. Historically, there has been a heavier focus on solving the technical challenges, rather than the organizational and social challenges. This can also be connected to the theory. Both Kahkonen et al. (2016) and Venkatachalam (2014) mentioned that enterprises need to adopt different initiatives rather than pursuing a “one-size-fits-all” approach. Hence, only focusing on e.g. system integration, which is related primarily to technology and neglecting e.g. knowledge integration, which is related to people and business processes, will not work in the long run.

The research conducted by Kahkonen et al. (2016) showed that social, managerial and organizational challenges coexists with technical challenges during integration. The empirics collected for this current study showed that the social integration challenges, i.e. communication and coordination among stakeholders have not successfully been managed. Furthermore, there are organizational and managerial challenges such as power and political issues, as well as variation of strategic goals at the different markets. While this may not be regarded as issues from the business perspective (Company Y), both the theory and the real world case study has proven that this not a favorable situation for Company X.

Decision-making - increased power to the IT project groups
The situation where Company X has less power and decision right than Company Y can hinder development of business oriented IT solutions. This kind of structure also diffuses roles and responsibilities. Who should be responsible for the deliverables as well as the functionality and quality of these deliveries? If Company X has no power to make a decision while they are responsible for the development of IT solutions, there is a high risk of creating dissatisfaction and confusion both for employees at Company X as well as for other stakeholders. This finding appeared also in the research conducted by Kahkonen et al. (2016). Constantly reacting to business needs combined with limited decision-making for IT experts lead to an undesired system landscape and a state where it gets unmanageable. It is important to understand and focus on the needs of the business rather than what they want. Since the integration and the ERP system affects corresponding systems and applications of related business processes, it is important that IT does not just have a consulting role, but also some authority and decision rights. Kahkonen et al. (2016) mentioned that establishing joint committees and business- or process teams with IT membership could facilitate the development of business oriented IT solutions. In that case, there should be an equal and balanced decision right between all committee members to reach any kind of success.
Rather than focusing on the pure functionality that the customer (i.e. Company Y) requires, there should be a deeper focus on their processes. This might require more management commitment from the customer, e.g. demand that the managing director is present during the pre-study of the project. Furthermore, the IT project group need to have more power to ensure that it is not the business that steers the project, but rather the IT-group since they have the bigger picture of the IT landscape and deeper knowledge regarding the best IT solution. Moreover, a more open dialog between the steering group and the project group needs to exist.

**Working methodologies and policies**

It is recommended to create working methodologies and policies to ensure that the implementation and design of the integration fulfills the standard. Striving for consistency, re-usability and flexibility should be the primary focus when establishing the working methodologies and policies.

The lack of standardized working methodologies can be due to the corporate culture at Company X, where employees can decide on their own depending on what is believed to be the best solution. However, in order to reach the vision of re-using as many integration as possible and reduce the customized solutions, the individual decision rights have to be limited to that ensure everyone is working towards the same direction. Of course, this also requires collaboration from Company Y since, as mentioned earlier, employees are sometimes forced to disregard or avoid the policies to ensure delivering in time. At the same time, what needs to be remembered is the balance between policies and autonomy. As long as the standards and policies add values, they should be followed. Otherwise, you could be flexible on how strict the policies should be followed when there are no additional values and the employees should in those cases not be afraid of disregarding the policies.

The lack of standardized working methods and policies can also increase the difficulty of knowledge management. Even though this has not been perceived as an issue during the interviews, this could be a futuristic issue. If employees are building unique solutions, complications will arise when that particular employee leaves the company. Also, unique solutions increase the complexity when you want to do a modification to the current solution. The risk of having to rebuild from scratch is much higher when the employee that has built the integration is no longer working at the company.

**Cross-functional collaboration and cross-functional teams**

Özkarabacak et al. (2014) mentioned that the role of enterprise architect was created to address many integration issues that have arisen due to the lack of architectural foresight. Previous research has showed that successful integration governance demands presence and use of high-level enterprise architecture. It can be used as a tool to identify interconnections and dependencies between systems and to evaluate the needs and impacts of integration. Furthermore, the theory also mentions that organizations have experienced increased difficulties due to the situation where departments can decide on the choice of applications and systems based on their own needs. Both of these issues have been identified from the collected empirics. The research result showed that there is a need for the AX group to communicate and collaborate closer with the enterprise architects in order to perceive an architectural foresight, evaluate the overall impact of their integration work and eventually build integration in a more strategically way. Furthermore, the empirics proved that Company X is also an organization that suffers from the situation where decision can be made on a departmental level. As this is one of the major reasons for the complex integration
architecture, the need to collaborate with other units, e.g. enterprise architects is even stronger. Cross-functional teams could be a solution to accomplish cross-functional collaboration.

Moreover, it would benefit all the involved units if there were formal communication channels or continuous updates that could contribute to awareness of what the involved parties are doing and what the future plans or actions are. In the case of AX, the involved parties would be the units working with e.g. enterprise architect, integration, business etc.

To work towards a more cross-organizational structure, new roles and responsibilities need to be created. To fill the gap that exists between the business and IT, these two units should share the responsibility that the delivered integration are of high quality and reaches the requirement for re-use. It is also necessary to create new roles that addresses the issues related to governance, i.e. have an overall view and govern integration related to AX. These roles should for example ensure that all integration holds the standard, set policies regarding evaluation of when to build new integration, when to re-use existing ones, how the integration should be designed and implemented etc. Furthermore, there has to be a role that keeps track over all previously built integration, current integration as well as future integration. It would be favorably that the person is involved at least at the beginning of each integration project to assure that the AX-group is working in the most optimal way. Also, there should be roles that can assure that separate functional units are working towards the same direction.

**Change of business processes**

There are several authors that have mentioned that customized business processes in different sectors of an organization or misaligned business processes are costly and increases the complexity of integrating with other IT systems (Özkarabacak et al., 2014; Hasselbring, 2000; Hedman et al., 2009) When introducing a standard system, such as an ERP system, there need to be compromises (Hedman et al., 2009). In the case of Company X, the compromises would mainly be about which business processes and organizational structures to change, as well to what extent the business and organization should adapt to the standard of Dynamics AX. According to the theory by Hedman et al. (2009), formalizing some actions or structures could enhance human creativity in other areas, resulting in success and competitiveness in other areas. This is in line with the results – as the areas where Dynamics AX is used within are not where Company Y has their competitive advantage, these processes could be adapted to the standard of Dynamics AX. As cited from one of the interviewees: “*When working with standard systems, e.g. ERP systems, the full potential and benefits of the systems cannot be reached if different markets are defining their own unique processes.*”

**Mutual expectations and collaboration between business and IT**

According to Usher (2010), existing research has showed that the business and IT should collaborate on business oriented IT decisions. Since integration is an area that involves different business units and systems, collaboration is even more essential. At Company X, the number of information systems has grown rapidly since the introduction of Dynamics AX. Therefore, IT governance and manage of the IT portfolio is needed, which is in coherence with the theory.

Moreover, it is important that different business units collaborate, communicate and synchronize with each other together with Company X in cases where they have the need of same integration or functionality. This gives the possibility to avoid building unique integration for each project, and in turn building a non-future proof integration architecture.
According to theory, IT governance is especially important in ERP system implementations to achieve mutual expectations of the deliverables. According to the empirics, the mutual expectations need to be communicated and shared among the different involved stakeholders. Mutual understanding and agreement on the expectations and deliveries also affects the choice of whether to strive for functionality or quality. Therefore the drawbacks with striving for delivery before quality need to be communicated. Mutual expectations and understanding of both parties’ tasks has to be reached to ensure that both business and IT are working towards the same direction and goal.

Project management
Focusing on a few projects at the same time with shorter timeframe, compared to running over 10 projects in parallel with longer time frame would be much more efficient. This might give a higher chance of closing existing projects, which also benefits the governance of all integration projects as well as documentation and re-usability in the future. Furthermore, focusing on a few projects and actually closing them can also motivate the employees, as they can experience completion of their work.

Evaluate the need for customization
Currently, there is a vision and goal to make AX “future proof”, meaning that it should be easy to upgrade the ERP system, easy to use new functions and increase the rate of using standard functionality, i.e. decrease the rate of customizations. To work towards that goal, evaluation on what is reasonable to accept for change should be performed. Even a change of e.g. a logo that is on the right side instead of the left side is currently being accepted. More strict evaluation guidelines are needed to understand what should be customized at AX and what should be changed at the customers’ side. The general rule of thumb should be that legal requirements (which are not provided by AX) should be the only case where customizations are developed. In other cases, change of process should be applied instead of change of system. All changes cannot be made within AX, the other involved parties need also be prepared to take initiatives and take responsibility of making changes on their side if it is proven to be the best option.

Sell the gain of using AX and centralized solutions at all levels
Since local markets have unique processes, there is a need to explain and promote the benefits by having common solutions to the local users. Furthermore, the gain of having centralized and standardized solutions should be recognized and understood at all levels, including the managing director of every business unit. The benefits of using AX and its functionality should also be transparent at all levels, especially for those without any understanding of AX and its technology. The vision of using the pure functionality of a standard system, i.e. AX as well as standardized solutions can be more reachable if the markets are familiar with the benefits of changing to AX and adapting to the functionality already provided.

5.3 Summary
To conclude the discussion related to the technology aspects, what Company X needs to consider is in line with the theory by Puschmann & Alt (2004). It is essential for companies to have a clear vision and understanding of their future architecture and choose the right integration approach. Furthermore, as Hedman et al. (2009) mentioned, many challenges are mental. A prerequisite is that there is a change of mind-set in order for future measures to contribute with positive impact.
To conclude both the process as well as the technology related aspects, the major underlying issue is the lack of integration standards. Azevedo et al. (2014) define integration standards as common languages, file formats and communication protocols, which are rather on a technical level. However, one can argue that integration standards can also be defined on an organizational and managerial level. That would include standards for decision-making, support for evaluation of customizations, policies, and collaboration with different functional units. Furthermore, what needs to be remembered is that standards are important and integration should be regarded as a long-term strategy (Azevedo et al., 2014).
6. Conclusions & Future Work

This chapter will present the answers to the research questions and suggestions for future work. Firstly, the answer to the sub research questions will be presented. Secondly, main research question will be answered. This chapter ends by presenting the topics on possible future work.

6.1 Answer to sub research questions

The purpose of this research was to investigate and understand challenges that large organizations can experience regarding integrating an ERP system with other internal IT systems. Moreover, the purpose was to investigate how the integration process can be performed in a more efficient way. The purpose was to be fulfilled by answering the main research question (MRQ) that was formulated as:

- *What measures can be taken to reduce the required effort of integrating an ERP system with other internal IT systems in a large organization?*

From the MRQ, two sub research questions (RQ1, RQ2) were derived, with the aim of supporting and answering the main research question.

6.1.1 RQ1: What are the challenges of integrating an ERP system with other IT systems?

For large global organizations with a decentralized organizational structure and varied business processes in varied markets, the major challenges are mostly organizational and process related. For organizations that have an internal IT-department and relies on internal resources for IT services and solutions, a decentralized organizational structure results in difficulties to achieve flexibility and re-usability. It also hampers the possibility of building generic and standard solutions that are applicable across the whole organization. In the long perspective, the complexity of the overall IT landscape increases. Furthermore, if the IT-department is also fragmented and decentralized, it is highly possible that there is a lack of cross-functional collaboration between different functional units at the IT-department. As the work with integration of ERP systems and other IT systems spans different functional units, the absence of cross-functional teams complicates the process of working towards strategically solutions.

The political issue that can arise when having an internal IT-department is that the business units often have a stronger position, meaning that employees from the IT-department have less authority and decision rights in relation to the employees from the business units. This is because an internal IT-department relies on the business units to receive financial compensations and investments. Hence, it puts a psychological pressure on the IT unit to constantly react to the requirements from the business. A consequence is that the vision and actions of the IT-department is not aligned with the strategy and vision of the business units. This stresses the need to understand the importance of IT governance and understand the need of equal authority between the IT-department and the business units.

Organizations that have existed for a long time often also have a long history and habit of performing own development. Therefore, there is a challenge to change the mindset of not developing in-house and resist the requests of changing a purchased standard ERP system. Otherwise, the full potential of an ERP system is not taken in advantage and large financial costs occurs as customizations are being performed. Furthermore, large organizations also experience the issue that many legacy systems are still kept and utilized in the organization. This means that there are many restrictions and limitations when wanting to use emerging technologies.
6.1.2 RQ2: What are the possible solutions to these challenges?

Based on the research results, there are a number of possible solutions that could be considered to address the challenges that were mentioned above and facilitate future work regarding integration.

One of the possible solutions to the identified challenges are increased IT governance, including increased authority for the IT department, a strategy for how to work with Microsoft Dynamics AX and the integration with internal IT systems as well as future initiatives such as upgrading to newer versions of the ERP system. Policies and standards regarding working methodologies, development, design and quality of the integration are deemed important. The policies should also deal with helping employees at the IT-department decide when they can accept customizations being performed at the ERP system, and when the business units should adapt to the ERP system. However, changing business processes may require conducting business cases and deeper analysis to understand the benefits and drawbacks.

The psychological distance between the IT-department and the business units has to be minimized. As the IT-department receives increased authority and decision rights, it is believed that this distance will also be minimized. Only when this distance is minimized can mutual expectations regarding the deliveries be achieved. Eventually, more focus will be put on quality rather than functionality, resulting in less complicated integration architecture. It can also decrease the required effort in the future when for example upgrading to a cloud-based ERP system.

When introducing a standard ERP system, the gain of using centralized and standardized solutions should be transparent at all levels of the organization. This is especially important in organizations that have varied business process in varied markets.

According to the literature study, acquiring a standard ERP system also requires organizational changes and adaption. In an organization that deploys a decentralized organizational structure, closer cross-functional communication and collaboration, including the need to establish cross-functional teams are needed. For example, a cross-functional team that is working with integrating Microsoft Dynamics AX with other IT systems could be members that have expertise within the ERP system, integration, enterprise architect etc.

6.2 Answer to main research question

The main research question is defined as:

- *What measures can be taken to reduce the required effort of integrating an ERP system with other existing IT systems in a large organization?*

Firstly, in order to facilitate future work, there has to be a mutual agreement and understanding that customizations and performing own development have to be minimized. When an organization acquires a standard ERP system, the benefits of adapting after the standard system should be promoted at all levels of the organization. All units that are in need of utilizing the ERP system should be prepared to adapt to the system and make some changes, rather than relying on the IT-department to customize the ERP system after their needs. This requires a mental change for all involved stakeholders.
Often, an internal IT-department always delivers IT services and solutions after the request from their customers, which are different business units in the organization. What needs to be remembered is that they should work in line with the IT strategy, integration standards and working methodologies and policies. It is extremely important to have a simple integration architecture with as few connections as possible. To accomplish this, the primary focus when defining the standards and working policies can be described with the words re-usability, flexibility and consistency. Only when this is fulfilled can the required effort of integrating an ERP system with other internal IT systems be reduced.

It is argued that after having a clear understanding of current challenges described in RQ1 and performing the measures presented in RQ2, integration can be built in a more strategic and efficient way. Eventually, it can facilitate future tasks with the ERP system, e.g. the upgrade path to newer versions of the ERP system.

### 6.3 Sustainability and Theoretical Implications

When referring to sustainability, there are three main dimensions: economy, social and environmental. The fourth dimension, human is rarely discussed (Penzenstadler et al., 2012) and will no be discussed in this study either. In this research, one can argue that it is hard to concretize the impact on the environmental dimension and will therefore not be discussed further.

As previous research has showed, integration accounts for a large part of an organization’s IT-budget. Working and developing integration from a life cycle perspective contributes with many benefits, including financial benefits. Furthermore, good integration architecture can facilitate the process when creating new integration, resulting in shorter delivery time and shorter lead times. This also gives the IT-department possibility to evaluate and utilize emerging technologies that can benefit stakeholders at all levels. When IT goals are aligned with the business goals, not only does it benefit the IT-department but also the whole organization, thus considering both the economical as well as the social dimensions.

Many of the obstacles and recommendations affect the employees’ daily work with AX, which can be considered is the social dimension. It was mentioned during the interviews that how projects are managed at the moment is not a good working environment for the project members. They are often switching roles and many projects are not closed, resulting in no closure. Furthermore, the lack of working methodologies can have a big impact on especially new employees as many rules and policies are unknown for a person that have no understanding of how the working culture is in an organization.

This study has contributed to the theoretical field by concretizing what kind of process- and technology related obstacles can exist in large organizations that relies on their internal IT-department for IT solutions, when it comes to the issue of integrating an ERP system with other internal IT systems. This study has also contributed by showing the importance of understanding that integrating an ERP system with other systems is not just an issue for the IT-department but rather for the whole organization. Moreover, many theoretical findings have been confirmed, such as the importance of IT governance during implementation of ERP systems, the need of several integration initiatives, organizational challenges are as important as technical challenges etc.

### 6.4 Future Work

Even though the research questions and the purpose of this study treat a technological issue, the results showed that the problems are not necessarily technical. Rather, the obstacles are organizational and process related, whereof lack of processes is one of the identified issues.
Therefore, future work should focus on the process related obstacles that were identified in this study. A suggestion for future work could be to choose one or several appropriate business process and analyze the benefits and drawbacks with standardizing business processes based on the current structure of Company Y. Another suggestion on future work could be to investigate what elements or components are essential to include in the policy and the framework regarding working methodologies and integration standards. It can also be worth investigating what kind of organizational change could be performed, e.g. whether it is a good option to restructure the subgroups, other communication channels etc.

In this study, obstacles related to people were not investigated, as it was found during the pre-study that this kind of obstacles were not the main issues. However, since the pre-study was performed through informal semi-structured interviews, the result of the pre-study could have been different if different employees were interviewed. Therefore, it is not absolutely certain that people related obstacles do not have an impact on the complex integration architecture. Investigating whether people related obstacles affects the integration process in organizations as Company X could be another possible future work.

As mentioned earlier, Company X is currently performing a transition from traditional project management to agile project management. To the author’s awareness, they are experiencing some difficulties concerning this transition, which can also affect the effectiveness of the integration projects. Therefore, another possible future work could be within this area.

For the future, the final goal is to use a cloud-based version of Dynamics AX. Due to limitations of this study, the cloud-based ERP system was not a focus area. Therefore, studying integration related to the cloud version of Dynamics AX with a focus on e.g. API management could be of interest to the AX group at Company X. Also, investigating topics related to the future strategy and IT governance when the ERP system is cloud-based could also be another possible investigation topic.
7. References

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8. Appendix

The interview questions that were asked during the second-round of data collection are attached in this appendix. The interview questions are divided in “interview foundation A” and “interview foundation B”, whereof “interview foundation A” was those questions that were asked during the interviews before the research focus was changed. “Interview foundation B” has mainly been used for interviews with representatives from the AX-group. Small modifications have been performed for interviews with employees from other units.

**Interview foundation A**

1. Have you participated at an early stage of the implementation of Dynamics AX and the integration with other internal IT systems?
2. Have you been involved in an integration project?
3. Did you participate in any project when Dynamics AX was upgraded from AX 2009 to AX 2012?
4. How has the decision to upgrade from AX 2009 to AX 2012 affected the business?
5. Has the change of integration technique had any impact or consequences? (technical/organizational/business-oriented)
6. What is your opinion or view regarding developing integration within the AX systems in term of flexibility, efficiency, re-usability etc.?
7. What do you think about the suggestion to implement BizTalk between AX and the current internal integration platform?
8. It has been discussed to upgrade a part of the current implementations of AX to the cloud while keeping the rest on-premise. What do you think are the benefits and drawbacks with this action?
9. What do you think should be focused on in the future when it comes to preparing for future versions of Dynamics AX? What should be considered regarding the integration architecture to have sustainable solutions in the future?

**Interview foundation B**

1. What are the reasons for the customizations and the need to redevelop integration?
2. How well does the standard of Dynamics AX fit with the organization’s business processes and structures?
3. What is the impact of customizations as well as continuously redeveloping integration due to the organizational structure as well as requirements from the business?
4. How has the developed customizations and integration affected the usage of AX seen from a business perspective?
5. Has the collaboration with other functional units affected the integration work? If yes, how?
6. What are the challenges with integrating AX with other systems today?
7. How does the current integration architecture affect your daily work regarding integration?
8. Is there something that could be improved at the integration platform (technical issues as well as non-technical issue)?
9. What do you think could be performed in the future to make the work and development of integration more efficient?
10. What should be considered in the future when it comes to facilitating the upgrade path to newer versions ERP system?