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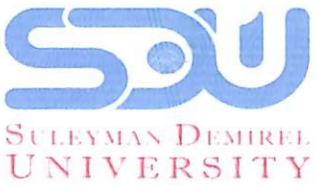

Department of Computer Engineering

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General Framework for implementation of Open Source ERP system in Kazakhstan's SME's

6M070400– «Computing systems and software» speciality

Kaskelen, 2013

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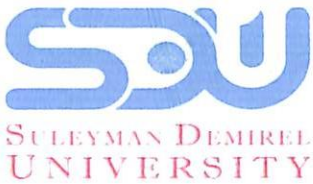

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Master dissertation

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Master student _____ Altynbek Zhunussov

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ABSTRACT

This research has been divided into six main parts. Listed below are the chapters with a brief description of each.

Introduction to study chapter gives an introduction to this research. The history of ERP, as a background to the research and introduction to the OS ERP systems, is given as a key target of this study. All the necessary points of research, such as the problem statement, aim, and objectives, are each briefly described. Finally, the methodology, limitations and definition of terms are also given.

The purpose of literature review chapter is to provide and review the available literature on ERP. A brief definition and benefits of ERP will be given in this chapter. As the focus of this research is OS ERP systems, this chapter will include a review of the OS ERP system as proposed by other researchers. This will be followed by identifying the selection criteria of OS ERP systems and implementation critical success factors.

Methodology chapter will describe the methodology used for the collection of primary and secondary data for this research. It will give the reader complete and appropriate information about research methods, approaches and strategy, with a brief description of why these have been chosen. Besides, it will include a description of research procedures, sampling and methods of data collection, and data analysis. The chapter will conclude with an ethical consideration and conclusion.

In presentation and analysis of data chapter, the result of the questionnaire survey is given. There will be an analysis of the data, which will be shown in the form of tables and charts. Each question's results will be provided and analysed. All the necessary findings for the research will be highlighted during the analysis and in the conclusion.

Artefact chapter will review and summarize the data analysis and evaluate the findings. In order to address the research question, the chapter will also show how the data analysis is used to create an artefact. It will be followed by an outline of literature review findings to support the artefact. Analysing the artefact will conclude the chapter.

As the conclusion, conclusions and recommendations chapter will summarize the work done during the research. With the conclusion, recommendations and suggestions for future research will also be given. Some limitations will be considered which will be given some assessment for research management.

ТҮЙІН

Бұл ғылыми зерттеу алты негізгі бөлімнен құралған. Әрбіреуінің қысқаша сипаттамасы беріліп, тараулар төменде аталып көрсетілген.

«Кіріспе» бөлімі аталған зерттеуге деген бастапқы мағлұмат береді. OS ERP жүйелеріне кіріспе және оны зерттеуге деген алғышарты ретіндегі EPR тарихы - осы тақырыпты зерттеудің бірден-бір өзегі ретінде берілген. Зерттеудің барлық қажетті сұрақтары, атап айтқанда мәселені тұжырымдау, мақсаттар мен міндеттері, қысқаша және бөлек-бөлек көрсетілген. Сонымен қатар, әдістеме, шектеулер мен терминдердің анықтамалары да бар.

«Әдебиеттерге шолу жасау» тарауының мақсаты болып ERP бойынша барлық қол жетімді әдебиеттерді ұсыну және талдау болып табылады. Бұл тарауда ERP қысқаша сипаттамасы мен артықшылықтары мазмұндалады. Аталған зерттеудің басты тақырыбы болып OS ERP жүйелері табылатындықтан, бұл тарауда өзге зерттеушілермен ұсынылған OS ERP жүйелерінің талдауы көрсетіледі. Сонымен қатар мұнда OS ERP жүйелерін таңдау критерийін айқындау мен сәттіліктің сыншыл факторларын жүзеге асыру да болады.

«Әдістеме» тарауында осы аталған зерттеуге қатысты бастапқы және қайталама деректерді жинақтау үшін қолданылған әдістеме сипатталады. Бұл оқырманға зерттеудің әдістері, амалдары және стратегиясы туралы қажетті ақпарат береді, сондай-ақ неге дәл осы әдіс-тәсілдер таңдалғандығының себептері туралы да айтылады. Оған қоса, ол зерттеу рәсімдерінің сипаттамасынан, деректердің үлгілерін және әдістерін жинаудан және деректерді талдаудан тұрады. Аталған тараудың қорытындысы ретінде этикалық амал қолданылып, қорытынды шығарылады.

«Презентация және деректерді талдау» тарауында анкеталық-сауалнаманың нәтижелері ұсынылған. Яғни кестелер мен диаграммалар түрінде көрсетілген деректерді талдау бар. Мұнда әрбір сұрақтың нәтижелері ұсынылған және талданған. Аталған зерттеуге қатысты барлық тұжырым (жаңалықтар) талдау және қорытындылау барысында аталып өтіледі.

Артефакт тарауында деректерді талдау және тұжырым (жаңалықтарды) бағалау қарастырылады және қорытындыланады. Зерттеу мәселесін шешу мақсатында, тарауда - деректерді талдау артефактты қалыптастыру үшін қалай қолданылғандығы көрсетіледі. Содан соң, артефактты қолау үшін әдебиеттерге шолу жүргізу мазмұндалады. Артефактты талдау – тарауды аяқтайды. Қорытынды ретінде, «қорытынды және ұсыныстар» тарауы бүкіл зерттеу барысында жасалған жұмысты жинақтайды. Қорытындыға қоса, мұнда болашақ зерттеулер үшін ұсыныстар мен ақыл-кеңестер берілген. Кейбір шектеулер зерттеуді басқару үшін арналған арнайы берілген баға ретінде қарастырылады.

РЕЗЮМЕ

Данное исследование состоит из шести основных частей. Главы указаны ниже с кратким описанием каждого из них.

Глава «Введение в изучение» дает ознакомительно-вступительную информацию к данному исследованию. История EPR, в качестве предпосылки к исследованию и введение в системы OS ERP дается как ключ данного предмета изучения. Все необходимые вопросы исследования, такие как изложение проблемы, цели и задачи, были кратко и отдельно описаны. К тому же, методология, ограничения и определения терминов также присутствуют.

Целью главы «Обзор литературы» является предоставление и анализ доступной и имеющейся литературы по ERP. В этой главе будет краткое описание и преимущества ERP. Так как главной темой данного исследования является системы OS ERP, эта глава будет включать в себя анализ системы OS ERP, предложенных другими исследователями. Далее тут будет следовать выявление критерия отбора систем OS ERP и реализации критических факторов успеха.

В главе «Методология» будет описана методология, использованная для сбора первичных и вторичных данных для данного исследования. Это дает читателю полную и необходимую информацию о методах, подходах и стратегии исследования, с кратким описанием причин, по которым они были выбраны. Кроме того, оно включает в себя описание процедур исследования, сбор образцов и методов сбора данных и анализ данных. Указанная глава завершится этическим подходом и будет дано заключение.

В главе презентация и анализ данных предоставлен результат анкето-опросника. То есть анализ данных, который будет показан в виде таблиц и диаграмм. Тут предоставлены и проанализированы результаты каждого вопроса. Все необходимые выводы (открытия) к данному исследованию будут отмечены в течение анализа и в заключении.

В главе артефакт будут рассмотрены и обобщены анализ данных и оценка выводов (открытий). В целях решения вопроса исследования, в главе также

будет показано, как анализ данных использовался для создания артефакта. Далее будет следовать изложение открытий обзора литературы для поддержки артефакта. Анализ артефакта будет завершать главу. В качестве заключения, глава «рекомендации и заключения» обобщит проделанную работу в течение всего исследования. Вместе с заключением также предоставлены рекомендации и предложения для будущего исследования. Некоторые ограничения будут рассмотрены в качестве некоторой оценки для управления исследованием.

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DEFINITIONS, ACRONYMS, ABBREVIATIONS

ERP (Enterprise Resource Planning) – Organisational strategic system used for integration of internal and external management of Organisation, containing production and operations, human resource management, financial management, etc.

MRP (Material Requirement Planning) – production planning and stock management system used in logistics and in management of manufacturing processes.

OS (Open Source) – free source code available to a wide range of independent developers. The basic idea behind open source projects is that a broad group of independent programmers should develop a better quality product.

OSS (Open Source Software) – computer software that is offered in an open format and distributed under open source or free software license conditions.

SME (Small- and Medium-sized Enterprises) – companies that do not exceed certain parameters, and whose turnover and headcount are below certain limits.

CSF (Critical Success Factors) – strategically important factors for gaining competitive opportunities that are critical for an Organisation to successfully achieve its strategic mission.

INTRODUCTION TO STUDY

1.1 Introduction

Today, improving corporate management is becoming a strategic aim of the development and functioning of any enterprise. The most popular among systems designed to automate the process of management is Enterprise Resource Planning (ERP) class products. Over the past few decades, the world of management has accumulated quite a lot of experience on the use of ERP systems [1]. The historical development of these kinds of systems began in the mid-1960s, with the first systems of planning and accounting. Today, it is hard to imagine modern businesses without automated enterprise management systems. So, the general goal of ERP systems is the effective management of any enterprise, based on its development strategy.

However, it is known that implementation of modern ERP systems in enterprise is a process that can last for several years. The reason behind such a long process is the size of the enterprise and complexity of the system. According to the Standish Group Company, only 16% of information system implementations are completed on time, i.e. within the planned budget and implementation of necessary functionality [2][3]. About a third of the ERP implementation projects have been terminated ahead of time and others are exceeded time, budget or planned functionality is limited [4]. Implementation of ERP systems is not just installing software to end-users, but rather a complex process that combines both software modification and several activities to change the main Organisation processes.

Most of the world's leading companies have already implemented or are in the process of implementing the ERP systems. There are some Kazakh Organisations that, for more than ten years, have adopted and used the ERP systems. The first movers were "SHNOS", "Ispat-Karmet", "Kaztelecom" and "KazTransOil" in the period 1998-2000, and these remain leaders in the field. Since then, almost all major national companies and even some banks have joined them [5].

Usually, it is impossible to adopt the ERP system using the Organisation's own specialists, thereby leading to the use of external consultants and other specialists

who need more investment, so that even small projects may become much more expensive in the end [6][7]. More often than not, it turns out that the cost of implementing an ERP system is equivalent to the cost of licenses on the system or even higher. Therefore, small- or medium-sized enterprises are not keen to implement the ERP system.

However, implementing the open source (OS) ERP systems also has certain advantages. Today, the open source software (OSS) is already adopted in SMEs all over the world [8]. This is indeed the best choice for SMEs who wish to reduce implementation cost and gain almost the same level of performance as that provided by the traditional ERP. SMEs do not need the full performance of ERP systems. They just need some modules that can meet SME needs - and OS ERPs are an ideal solution. Kazakhstan is now experiencing the OS systems, and recently, the OS ERP system has become interesting for Kazakh Organisations especially for SMEs, as one clear advantage of the ERP system is the lower cost involved.

1.2 History and evaluation of ERP

ERP is the result of a four-decade evolution in management and automation systems. Starting in 1960, computer systems were then used to automate various areas of enterprise activities. Then came the systems in Material Requirements Planning (MRP) class [9]. At the base of such systems' functioning is the concept of product specification (BOM - Bill Of Materials) and the production program (MPS-Master Production Schedule).

The product specification showed the final product in the framework of its components. The production program contained information about the time interval, kind and amount of complete products scheduled for release by the enterprise. With the help of BOM and MPS, the procedure specification exploded, based on which company received information about the requirements of materials necessary for the production of complete products in accordance with the MPS. Then, information about the needs is converted into a series of orders for purchase and production.

Furthermore, this process took into account information about the balance of raw

materials in warehouses.

Using MRP systems, it allowed companies to achieve the following results:

- Reduce the stock of raw materials in warehouses
- Reduce the level of reserves in WIP (work in progress)
- Improve the efficiency of the production cycle so as to reduce lead times of order execution

Despite the rather high efficiency of the MRP system, it had one weakness, and that is, it did not take into account the capacity of the enterprise. This led to the increased functionality of MRP systems with the Capacity Requirements Planning (CRP) module. The connection of CRP and MPS helped take into account the availability of necessary capacities to produce a certain number of complete products. The MRP system with a CRP module is called the closed-loop material requirements planning system (Closed Loop MRP).

In 1980, a new class of system enterprise (Manufacturing Resource Planning) was developed [10]. Due to similarity in abbreviations, such systems became known as MRPII.

The main difference between the MRPII and MRP is that MRPII systems are designed for planning of all enterprise resources (including financial and personnel).

As a result of improvements made to the MRPII systems and their functional expansion, there came the class of ERP systems [11]. An independent research firm, Gartner Group, introduced the term ERP in the early 1990s. ERP systems are designed not only for manufacturing enterprises; they also effectively allow for automating the activities of companies.

The need for automation of administrative processes was first recognized in the late 1960s and early 1970s, when it became clear that the management of large corporations is under the same laws as any bureaucratic structure. One of the laws of Parkinson states: "Staff of the Organisation is not related to the amount of its work."

In other words, with an increasing number of management staff, its work efficiency falls to zero [12].

"*An ERP system is a packaged business software system that enables a*

company to manage the efficient and effective use of resources (materials, human resources, finance, etc.) by providing a total, integrated solution for the Organisation's information-processing needs" [13].

1.3 Open source ERP Systems as alternative solution

The term "open source software" means that the software is being distributed under a special free license, giving the user an unlimited right to run, study, disseminate and change it [14].

Today, researchers agree that in the IT-industry, there is a steady trend towards the promotion and increased use of OSS [15]. Every year, the number of programs in this category has increased in quality and functionality [16]. Almost always, most traditional software have free analogue. Of course, the ERP systems sector is no exception [17][18]. The free enterprise information system, designed to automate company processes, may soon become a serious competitor of IT industry leaders. According to analysts from Gartner Inc., the market of OS ERP systems will grow from the current $7 to $19 billion by 2012 [19].

The legislation in many countries considers computer programs as objects of copyright (intellectual property) [20], and consequently, the rights of creators are protected by law which gives authors and copyright holders control over modification, distribution and use. In order to legalize all the above steps, software users have set up a special free license.

The market research of the ERP system shows that customers are beginning to show interest in the possibility of using OSS as alternative solutions [21][22], since they fully meet needs and are not inferior to the capabilities of traditional products.

For the software developers, an OS ERP system allows them to grow professionally and improve their skills. The availability of a large number of OSS allows them to increase the effectiveness of their own development. OS ERP systems are an effective solution for smaller companies who cannot afford to use the solutions from leading ERP system vendors.

The main weakness of OS ERP systems is a more modest functionality than

traditional ones. Most of the features that traditional ones have are under development and implemented ones are basic features, but they can meet the needs of small- and medium-sized enterprises. However, interest from SMEs in OS ERP systems is not getting any less, and every day more and more SMEs all over the world are implementing them [23].

1.4 Open source software in Kazakhstan

"Open source" is not a new term. It was created as an alternative to the term "Free software". Requirements, included in the free software license, make it easy to install, distribute, modify and study the software by accessing its source [24]. All of this helps reduce implementation costs. OSS enables developers to consult the source code in order to find out whether they can improve, modify and use it for their own purposes. Volunteers from around the world can contribute and offer translation services, technical information, bug reports, and improvements for any particular situation.

However, sceptics still believe otherwise. According to them, OSS often allows for reducing costs at the beginning, but can significantly increase the cost of technical support in the future. Moreover, the situation in Kazakhstan is quite difficult. Kazakhstan recently started to encourage and promote the use of free software and has thus opened the Linux Innovation Centre precisely to achieve such a goal.

Actually, OSS has already been in Kazakhstan for a long time now, but its use in IT projects leaves much to be desired. According to the chairman of the board of JSC «National Information Technologies», the poor public awareness about OS and the absence of any form of advertising is a major barrier to implementing it in Kazakhstan [25]. So the primary and probably the main problem against a successful implementation of OSS in Kazakhstan is that the public is simply unaware of the benefits that can be reaped from using products based on OS.

1.5 Problem statement

By 2011, most of the major Kazakh companies have implemented the ERP

systems [26]. Therefore, it is time for small- and medium-sized enterprises to implement them. This market is characterized by a large number of customers and a growing demand for the use of corporate information systems. The largest providers of ERP systems have already shifted their attention to this sector and have released a special SME-oriented version of their products.

Moreover, the shift is also due to the value of networks, partnerships, of course globalization, as well as the huge information flow across and within SMEs. Recently, more and more SMEs from around the world are adopting the ERP systems [27].

According to analysts from Gartner, the cost of implementing information technologies like ERP systems is about 3.4% of the annual turnover [26]. However, there are also the cost of the licenses, consulting services, equipment and its installation, IT-staff and other expenses (insurance, electricity, etc.). These all make it difficult if not impossible for SMEs to implement traditional ERP systems even if they offer lighter versions. Therefore, a solution for the SME sector is an OS ERP system. This ERP solution may save about 50%-80% of the cost of implementing traditional ones. However, there are risks involved in implementing OS ERP systems for SMEs. These risks of adoption rely on the fact that SMEs have limited resources and specific characteristics that make their case different from large enterprises. Besides, it is a well-known fact that even the large companies have failed when it comes to ERP implementation.

Therefore, the OS ERP system needs to be explored in-depth, especially the need to identify its selection criteria in order to know why OS should be used not to mention that critical success factors have to be studied in order to successfully implement them.

Moreover, poor awareness of Kazakh companies about OS benefits and implement OS ERP as alternative to proprietary ERP [25] forces for in-depth study.

1.6 Research question

The successful implementation of the ERP system can give any company

enormous benefits. However, it can also be disastrous if the Organisation has a poor implementation management process.

The main question of this dissertation is:

How to successfully implement the Open Source ERP system in Kazakhstan's SMEs?

Moreover, as the adoption of ERP would not be the same for all the industries that are realizing it, to have successful implementation in small- and medium-sized enterprises, another two critical question will have to be answered:

What are the OS ERP selection criteria according to Kazakhstan's SMEs?

What are the critical success factors for implementing the open source ERP system in Kazakhstan's small and medium sized enterprises?

1.7 Overall aim and objectives of the research

The overall aim of this dissertation is to identify OS ERP selection criteria and implementation critical success factors in order to produce a general framework for successful implementation of open source ERP system in Kazakhstan's small- and medium-sized enterprises. To achieve this overall research aim, these objectives would have to be achieved:

- Conduct background study on ERP evolution
- Determine the advantages of ERP systems and open source for SMEs
- Identify and study the existing ERP implementation frameworks and models
- Ascertain open source ERP system selection criteria and survey to identify the most important ones
- Identify critical success factors for ERP implementation and examine the most influential ones
- Propose a framework for successful implementation of open source ERP system in Kazakhstan's SMEs

1.8 Significance of the study

The ERP system is very important and significant system. Moreover, its

implementation is hard, and complicated process. Besides, OS ERP is not less important as proprietary and its implementation also needs a huge effort to avoid failure. This research will be a significant endeavour in the attraction and motivation of Kazakhstan's SMEs to select and implement OS ERP systems. This study will also be beneficial for ERP vendor and end-user environment, because it will be useful for successful implementation.

1.9 Justification of the research methodology

Research methodology is a very important aspect of any research, as it helps determine the research plan and strategy. This research will collect information using both primary and secondary research methods. The secondary data will be collected during the literature review, while primary data will be collected from the survey. Questionnaires will be used in the research survey. The quantitative research approach is preferred in order to get accurate, statistically reliable numerical data, which is most suitable for this study as it uses questionnaire as its chosen research strategy. A properly chosen research approach and strategy help collect reliable data, and ultimately better results.

1.10 Delimitation of scope and key assumptions

This research aims to provide a general framework for implementing the open source ERP system in Kazakhstan's SMEs. The target is Kazakhstan's SMEs. So the main limitation is that collecting both primary and secondary data will be difficult as OS ERP systems are quite new for Kazakhstan and results have to be seen from the perspective of Kazakhstan's SMEs.

As one of the objectives is identifying the selection criteria and implementation critical success factors of OS ERP systems, the target group for the survey will be very small and very specific, because only ERP specialists, and those who have been involved in the ERP implementation process, have to be surveyed.

Another key limitation is that respondents should be from SMEs or have experience of ERP implementation in SMEs. So, sampling errors might have to be

expected for the survey, as some of the respondents may be unable to give the right data needed to satisfy the research objectives.

1.11 Conclusion

A well-stated problem is a half-solved problem. It is the same for research. If the research problem, research question, and research aim are properly identified, the research should progress more smoothly. So, this chapter gives a brief introduction to the research problem of this dissertation, and identifies its research question, aim, and objectives.

The research target is the OS ERP system, which is already well-recognized among enterprises the world over. The OS ERP system is gaining momentum so that more and more SMEs are adopting it as an alternative solution for traditional ERPs, which remain very expensive. So, the main reason for choosing OS ERP is that it reduces costs. However, the situation in Kazakhstan is quite different. So, the aim of the dissertation is to identify CSF in order to produce a general framework for successful implementation of the OS ERP system in Kazakhstan's SMEs.

LITERATURE REVIEW

2.1 Introduction

ERP systems are designed not only to automate accounting and management. Most of them are also built using a modular principle and include all the main Organisational processes. The basis of ERP systems is to create a single repository of data that accommodates all corporate business information and supports simultaneous access to any required number of company employees with the appropriate authorisation. The ERP system allows for the use of a single integrated program instead of several different ones. An integrated ERP allows for bringing together all divisions of a company in a general system that can serve the specific needs of each division. In general, patented and OS ERP systems do not differ very much as both have typical modules. What is different about OS ERP systems is the ability to modify the source code or directly review it with the developer community or provider. This leads to the fact that open source ERP systems are cheaper to implement than proprietary ones. Moreover, for the SMEs which need automated system with less cost, OS ERP is most suitable.

This chapter presents a literature review, in an effort to define the ERP system, give a complete overview of the concept as well as analyses of benefits as proposed by other researchers. As the focus of this research is OS ERP systems, the chapter will also include a review of the literature on the OS ERP system. This will be followed by identifying the selection criteria of OS ERP systems and implementation CSF, in order to address research objectives.

2.2 Defining enterprise resource planning

As with any other business or IT concept, ERP systems are also defined differently among authors. To understand ERP, some definitions from the literature are cited. For instance, Yen and Sheu (2004) described it as an information system that manages all aspects of an Organisation including manufacturing, purchasing, production, customer service, distribution and sales.

However, Gable (1998) earlier stated it in a slightly different way, as a complete software package solution seeking to integrate all range of business functions and processes so as to take a complete view of business from a single information and IT architecture platform.

Sumner (2009) defined it as software which is aimed at fitting the requirements of users within the Organisation and automating core business functions. Authors defined ERP according to their findings, but from the above definitions, it is clear that ERP is an integrated solution for enterprises to combine all functions and processes related to accounting, manufacturing, production, human resources, and supply chain. ERP provides a comprehensive view of all business functions and also integrates business processes across accounting, which perfectly shows all production activities or business processes. However, rapid changes in development, especially technology changes, need to come up with more modern descriptions and definitions. This clearly relates to ERP, which is a complicated system, which is being improved by the day.

The ERP system is a pure software package. However, it works as more than just computer software and includes several modules, some of them are shown in Figure 2.1. Even with base modules, ERP has a complete Organisational infrastructure that influences the entire Organisational functioning and creates operating strategies.

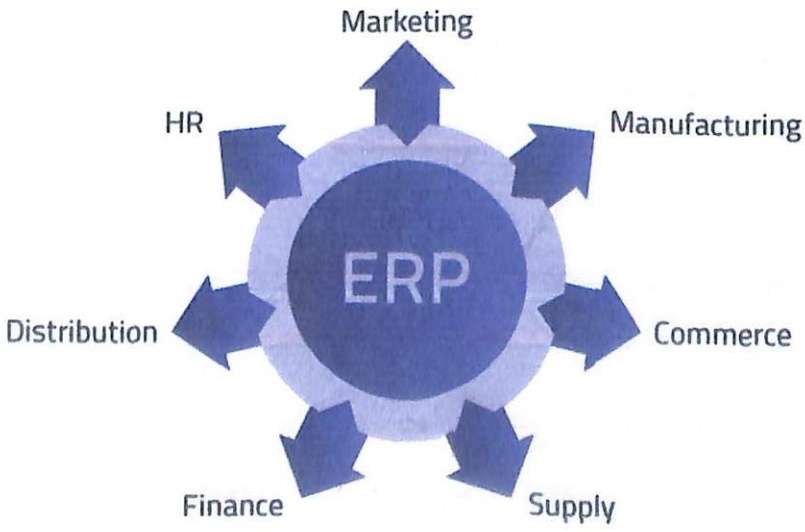

Figure 2.1 Overview of ERP

Source: Navy ERP (2011)

2.3 Defining small- and medium-sized enterprises

While the ERP system cannot be precisely defined because of its complexity, the same is true of SME because of different limitations. The definitions of SME vary and most of them depend on criteria like annual turnover and number of employees [28]. Deelmann and Loos (2002) state that, "*The acronym SME tries to group a sort of companies, which are small and medium sized in a special way. Unfortunately this classification is not well defined*".

According to the Swedish Statistics Bureau (SCB 2003), a company is typically categorized as SME when it has a maximum of 199 employees. However, different countries have their own criteria for SME, so there is no single limitation (Table 2.1).

Table 2.1 SME in different countries

Country	Small-sized		Medium-sized	
	Revenues from sales (million)	Average number of employees	Revenues from sales (million)	Average number of employees
EU countries	$1-10	50	$4-50	250
Russia	$14	100	$14	250
Kazakhstan	$0.6	50	$3-4	200

Source: Zhunussov (2010)

However, big IT companies somehow destine their products for SMEs, which means that they have their own measurements of SMEs. For instance, IT industry giants such as SAP and Oracle categorize SMEs by annual turnover, and Microsoft by the number of personal computers (Table 2.2).

OS ERP systems are oriented to enterprises that identified themselves as SMEs, and OS ERP providers do not give special criteria for SMEs. However, large corporations are able to adopt OS ERP, because the latter depends on modules that Organisations need for their business functions.

Table 2.2 SME according to companies

Vendor	Measurement	Small business	Medium business	Corporation
SAP	Annual turnover	up to €10 million	up to €100 million	more than €100 million
Microsoft	Number of computers	1-24 computers	25-499 computers	more than 500 computers

Source: Kokurin and Zhunussov (2011)

2.4 Benefits of the ERP system

Many researchers [29] have argued that in the beginning, ERP systems were just functional development of MRP and MRP II systems. Analysts at Gartner Group stated that ERP is a class of the MRP II system, which has in its structure the Finance Requirements Planning (FRP) module [30].

However, according to Zhang (2011), the further development of systems has significantly expanded these initial differences. The core principle of the ERP system is based on creating a single data warehouse that contains all corporate business information and provides access to any required number of employees with the adequate privileges [31]. Moreover, it should not only improve the efficiency of enterprise production, but also reduce internal information flow, thereby reducing costs for support.

Modern ERP systems are built on a modular principle [17], which allows customers to select and implement those modules that they really need. Malhotra and Temoni (2010) describe ERP system modules as different by title, content and function, and module preferences are also different.

Nevertheless, the majority of researchers stressed [32][33] that there is a set of functions and tools that can be considered typical for all ERP systems. These typical functions are: managing demand and development of plans; sales and production; material requirement planning; inventory management and procurement; production capacity planning; financial functions; personnel management; and project management functions.

Regardless of which modules are chosen, ERP in general has many benefits. Shang and Seddon (2000) presented a framework of ERP system business benefits. After studying 233 ERP-vendor success stories, interviews with 34 ERP cases, and literature about ERP features, they grouped benefits into categories and provided five benefit dimensions and twenty-one benefits. Table 2.3 shows these benefits, which are also cited by many authors [34][35][36][37][38].

Table 2.3 ERP benefits framework by Shang and Seddon (2000)

No.	Dimensions		Sub dimensions
1.	Operational	1.1.	Cost reduction
		1.2.	Cycle time reduction
		1.3.	Productivity improvement
		1.4.	Quality improvement
		1.5.	Customer services improvement
2.	Managerial	2.1.	Better resource management
		2.2.	Improved decision making and planning
		2.3.	Performance improvement
3.	Strategic	3.1.	Support business growth
		3.2.	Support business alliance
		3.3.	Build business innovations
		3.4.	Build cost leadership
		3.5.	Generate product differentiation (including customization)
		3.6.	Build external linkages (customers and suppliers)
4.	IT Infrastructure	4.1.	Build business flexibility for current and future changes
		4.2.	IT costs reduction
		4.3.	Increased IT infrastructure capability
5.	Organisational	5.1.	Support organizational changes
		5.2.	Facilitate Business learning
		5.3.	Empowerment
		5.4.	Built common visions

Source: Shang and Seddon (2000)

These are mostly 'possible benefits', and it does not mean that all of them will be achieved. However, it is known and proven that ERP implementation have strong benefits [36][37].

2.5 Open source Erp systems gaining momentum

According to a report published in October 2006 by Gartner Group, in 2010-2011 there will be a third wave of open source, after which OS ERP system will be very popular [24]. However, according to this Gartner Group and AMR Research Company studies done in 2006, the popularity and growth of OS ERP systems were not observed [39], but at that moment it was clear that more companies have begun to use OSS for their core functions.

Hence, already in 2008, researchers had stated their interest in OSS. At that time, the use of open source was growing; for example, Operating System, DBMS, Web Servers, among others became fairly large-scale. However, business applications and, in particular, ERP systems, were not so popular.

From the above, it is clear that about four years ago, OS ERP was not popular and companies were not willing to use it. At that time, companies had just started to use OSS for simple business tasks, but after two years OSS became very popular. However, it was not used widespread as a business application. Only in the last two years did OSS completely become a business application and very popular, and many companies have since stated to offer OS ERP systems. Moreover, OS ERP providers are now more focused on SMEs.

However, OS ERP systems were founded long before then. For instance, Compare, which is a fairly well-known provider of OS ERP and CRM, was founded in 1999 by Jorg Janke [39] and was a top 10 project in SourceForge for four years since 2002 and in 2006 they recorded more than 1 million downloads, an average of 60 thousand unique visitors per month, and in May of that year they achieved their highest monthly rate – 100,000 visitors, and received from 20,000 to 30,000 messages. It also has 70 partners, about 50 developers and about 240 customers. Each year, since 2007, about half a million OS ERP are being downloaded. Downloaded does not necessarily mean being adopted but some percentage should be adopted. According to SourceForge, on November 2008, about 500 OS ERP system projects were registered and each year about 100 new projects are registered [40].

Capra et al. (2008) explain that people still have the idea that OSS is "amateur"

development, and always think that OS cannot be useful for business. However, despite the lack of license sales, it is possible to do business by providing services [22]. Examples are known producers of OSS, such as RedHat, Google, IBM, Intel, among others.

The Tiny SPRL Company's business basis is development of the OS ERP system, OpenERP. The reduced cost of IT because of the global financial crisis has allowed them to collect a sufficient number of customers for development, says director Fabien Pinckaers [24]. The number of requests for software revision received from clients has increased every two months by an average of 20% and according to business publication Trends (2011), Tiny SPRL's revenue in one year could increase twenty-fold.

The main interest in OS ERP is to do with cost reduction, because the commercial ERP price for corporations could reach $20 million and for maintenance services a few million each year for a customer with 1000 users. Table 2.4 shows a price comparison of commercial ERP and OS ERP.

Table 2.4 Total Cost of ERP Ownership by Chen (2010)

Company	Users	Commercial ERP	OS ERP
Small	25	$ 50 000 – 60 000	$ 30 000
Medium-sized	100	$ 400 000	$ 150 000
Big	500	$ 3 – 4 million	$ 1 – 2 million

Source: Chen (2010)

As it can be seen, the total cost of ERP ownership could be as low as half the price of commercial ERP TCO. Commercial ERP average cost per user can range between $2000 and $20,000, while OS ERP could be as low as $1000 [41].

2.6 Factors that motivate SMEs to opt for OS ERP

Each Organisation wants to improve their enterprise management system, but they are confused when it comes to selection. Basic factors that they consider might be: does it fit the Organisation; does it support business goals; how does it automate Organisational processes.

Many authors have defined the benefits of OS ERP systems [41][40][42][43]. Moreover, most of them have identified critical success factors and factors that motivate Organisations to select and implement ERP systems [44].

Most of the factors that make OS ERP systems attractive are its openness, and it is already known that OS systems have sustainable priorities as traditional software [37]. Influencing intentions to choose OS ERP can be OSS flexibility; they are flexible as the source code can be modified [45]. Furthermore, reduced implementation cost and decreased dependence on provider make OS ERP more attractive [15]. However, there are other criteria that can influence Organisations to select OS ERP.

Most of the selection criteria for OS ERP are the same as for proprietary ERP. Bernroider et al. (2009) identified about 30 selection criteria and have used 17 for analysis of OS ERP. Table 2.5 shows these criteria, and it is clear that all of them can be used for proprietary and OS ERP selection.

Table 2.5 ERP selection criteria by Bernroider et al. (2009)

No.	Criteria	No.	Criteria
1	Systems reliability	15	Increased organizational flexibility
2	Functionality of the system	16	Enhanced Decision Making
3	System flexibility	17	Reduced cycle times
4	Advanced technology	18	E-business enablement
5	System interoperability	19	Business process improvement
6	Operating system independency	20	Enabler for desired business processes
7	Connectivity	21	Increased customer satisfaction
8	Availability of industry focused solution	22	Improved innovation capabilities
9	Organizational fit of system	23	Enabling technology for CRM, SCM, etc.
10	Internationality of software	24	Costs expended
11	System usability	25	Short implementation time
12	Integrated and better quality of information	26	Vendor reputation
13	Incorporation of business best practices	27	Vendor support
14	Improved service levels/quality	28	Market position of vendor

Source: Bernroider et al. (2009)

Johansson and Sudzina (2009) studied 58 journal articles, identified ERP system selection reasons, and presented a set of general ERP selection criteria. They compared these criteria with respect to OS and proprietary ERP systems and sorted these criteria according to their findings. Table 2.6 shows these sorted OS ERP selection criteria that have been found by Johansson and Sudzina (2009), and it can be seen that they are quite similar with previous criteria identified by Bernroider et al. (2009).

Table 2.6 OS ERP selection criteria by Johansson and Sudzina (2009)

No.	Criteria	No.	Criteria
1	Ease/speed of implementation	10	Vendor reputation
2	Price	11	Flexibility
3	Vendor support	12	Training
4	Reliability	13	Information needs
5	Ease of use	14	Latest technologies
6	Customisation/Parameterisation	15	Scalability
7	Integration	16	Upgrades
8	Organizational fit	17	Modularity
9	Functionality		

Source: Johansson and Sudzina (2009)

Malie (2008) also identified ERP selection criteria in their studies. They studied only research that focused exactly on ERP selection criteria (Table 2.7).

Table 2.7 ERP system selection criteria by Malie et al. (2008)

No.	Criteria	No.	Criteria
1	Cost (affordability)	8	Ease of customisation (flexibility)
2	Technical criteria (infrastructure)	9	Market position of the vendor
3	Functionality	10	Compatibility with organisation structure (organisational fit)
4	Service and support	11	Specialised industry knowledge
5	Vision of the vendor	12	Vendor references
6	System reliability	13	Fit with parent/allied organisation systems (corporate compliance)
7	Compatibility with other systems		

Source: Malie et al. (2008)

Many research papers reviewed by author and these ones chosen to be studied for this research because they are quite recent works and they have reviewed so many previous works on ERP selection criteria and identified the most influential according to their study. So, based on the literature on selection criteria, as proposed by other researchers, some have been chosen as the most complete OS ERP selection criteria for this research. Most of them are based on the CSFs of Johansson and Sudzina (2009), who have already reviewed about 58 articles, and are cited by others. These criteria will be used for further study and questionnaire. Table 2.8 shows these criteria with brief annotations.

Table 2.8 OS ERP selection criteria

No.	Criteria	
1	Ease/speed of implementation	It refers to how fast and easily ERP systems can be implemented [46][41]
2	Total Price	It refers to the total price of ERP system implementation and licensing [40]
3	Vendor support	Customers of proprietary ERP systems are locked in with the vendors. Open source world has large enough communities, which could support OS ERP implementation [41]
4	System reliability	Proprietary vendor tries to be highly reliable but Open Source community finds errors faster and solves it quickly [47]
5	System usability	It is unclear whether proprietary or open source ERP systems is easier to use, but the OS community is likely to improve the system to the level that is more-or-less acceptable for most users [48]
6	Customization	Proprietary ERP systems are often programmed in vendor-specific languages. Since open source ERP systems are programmed in widely known programming languages, there are potential programmers who can then do any customization [40]
7	Integration	Proprietary ERP is only able to be integrated with few systems like Data Warehouse; OS ERP can be integrated with many by customization of source [49]
8	Organizational fit	Processes and functionality of OS ERP systems shall comply with the current organizational business processes [38]

Table 2.8 continue

No.	Criteria	
9	Functionality	Functionality of OS ERP systems meets the needs of SMEs. In addition, they can be easy to learn.
10	Vendor reputation	The reputation of the vendor in the market, how the previous customer evaluates them in terms of services. This is obviously not so relevant for OS ERP, since anyone can investigate the software without any prior commitment [38]
11	System flexibility	Flexibility to change so as to fit the current business process and meet the requirements of the organization
12	Upgrades	Upgrading Open Source ERP is free but Proprietary ERP customers have to buy upgrade or pay an annual fee

Source: Author

2.7 Critical success factors and frameworks of OS ERP system implementation

ERP systems are able to provide essential improvements in service quality, productivity and competence, leading to decrease in service, cost, as well as successful business decision-making [50]. However, ERP is a complicated system so implementation is not as easy as software initialization, and many Organisations would face some problems at different phases [51][52]. According to Wong (2005), the main ERP failure factor is poor project management effectiveness. They have identified other factors that lead to failed ERP implementation. The high rates of failure forces operators to better understand the ERP implementation activity [53]. To reduce the number of failure or to successfully implement ERP, CSF will have to be identified.

Critical success factors are those strategic goals and competitive opportunities that every individual department or Organisation must provide in order to be competitive and successful. These are factors to which the company should pay particular attention, since they determine success or failure in the market. CSFs for ERP implementation provide a model that helps Organisations identify critical issues

in adoption processes [48].

Ngai (2008) identifies CSF in ERP system implementation within 10 different regions. The paper is a literature review of 48 articles, which covers textbooks, conference proceedings, journals, and doctoral dissertations. They have identified 18 CSFs for successful ERP implementation and more than 80 sub factors. Table 2.9 shows these most common CSFs. According to Ngai (2008), the most commonly cited from these 18 factors was "Top management support" while another most critical factor was "Clear and defined project plan", even though it was not included in the model.

Table 2.9 ERP implementation CSFs by Ngai et al. (2008)

No.	Criteria	No.	Criteria
1	Top management support	10	Project management
2	Appropriate business and IT legacy systems	11	Software/system development, testing and troubleshooting
3	Business plan/vision/goals/justification	12	Data management
4	Business process reengineering	13	ERP strategy and implementation methodology
5	Change management culture and program	14	ERP vendor
6	Communication	15	Organizational characteristics
7	ERP teamwork and composition	16	Fit between ERP and business/process
8	Monitoring and evaluation of performance	17	National culture
9	Project champion	18	Country-related functional requirement

Source: Ngai et al. (2008)

Finney and Corbett (2007) studied literature to identify ERP implementation CSFs. They have reviewed about 45 of them and divided factors into two groups, viz. strategic and tactical, following the model of Holland and Light (1999) (Figure 2.2).

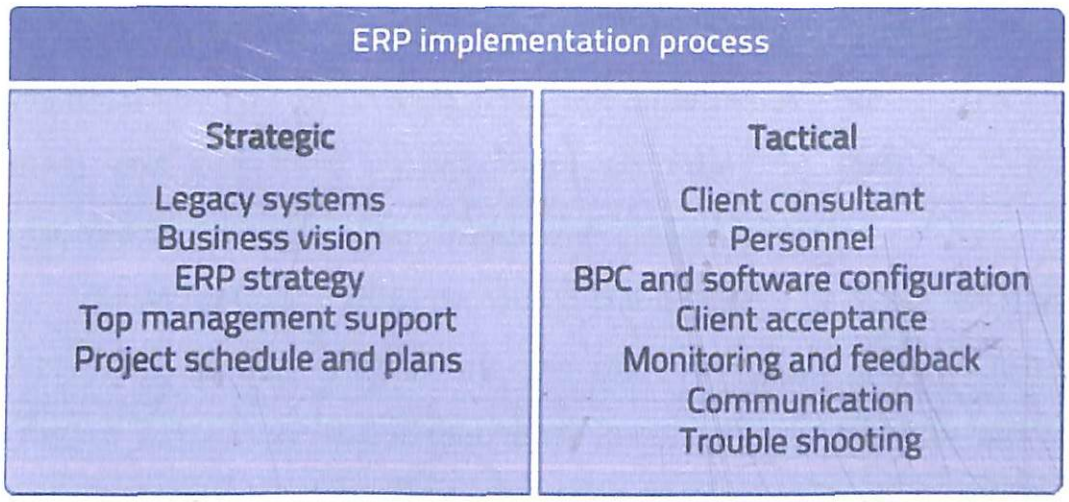

Figure 2.2 ERP implementation CSF model by Holland and Light (1999)

Source: Holland and Light (1999)

Strategic factors give a better overview of doable and tactical factors in terms of quite specific and detailed skillful methods (Table 2.10).

Table 2.10 ERP implementation CSFs by Finney and Corbet (2007)

No.	Strategic critical success factors	No.	Tactical critical success factors
1	Top management commitment and support	1	Balanced team
2	Visioning and planning	2	Project team: the best and brightest
3	Build a business case	3	Communication plan
4	Project champion	4	Empowered decision makers
5	Implementation strategy and timeframe	5	Team morale and motivation
6	Vanilla ERP	6	Project cost planning and management
7	Project management	7	BPR and software configuration
8	Change management	8	Legacy system consideration
9	Managing cultural change	9	IT infrastructure
		10	Client consultation
		11	Selection of ERP
		12	Consultant selection and relationship
		13	Training and job redesign
		14	Data conversion and integrity
		15	System testing
		16	Post-implementation evaluation
		17	Troubleshooting/crises management

Source: Finney and Corbett (2007)

Each of these factors has been explained by the authors and has been chosen as the most obvious and critical ones. All authors have their own argument for selecting them and they had ranked them according to their studies. Moreover, other researchers provided frameworks with critical factors.

Al-Mudimigh (2001) provide a framework with CSFs for ERP implementation. According to their framework, the implementation process has three main levels (Figure 2.3). They stated that most factors that have been identified as critical by them and other researchers could be deployed on these levels [54]

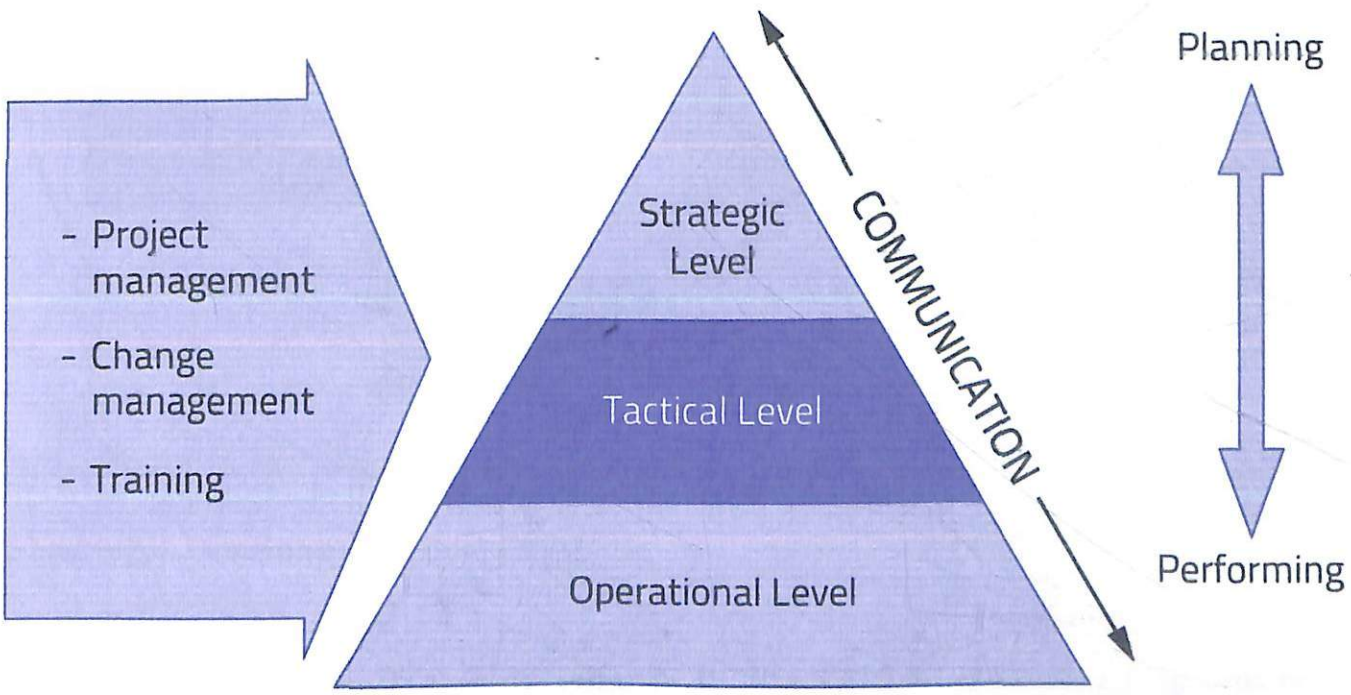

Figure 2.3 ERP Systems Implementation Framework

Source: Al-Mudimigh et al. (2001)

However, Al-Mudimigh (2003) supported their framework after two years and highlighted some of the factors that are conjectured to play a more prevailing role in ERP implementation. Authors termed them as 'dominant' and stressed that they ought to be monitored at all ERP project implementation stages. These factors are: top management commitment, business case, change management, experienced project management, a world-class training system, and communication process. These have all been studied and supported in recent studies [54].

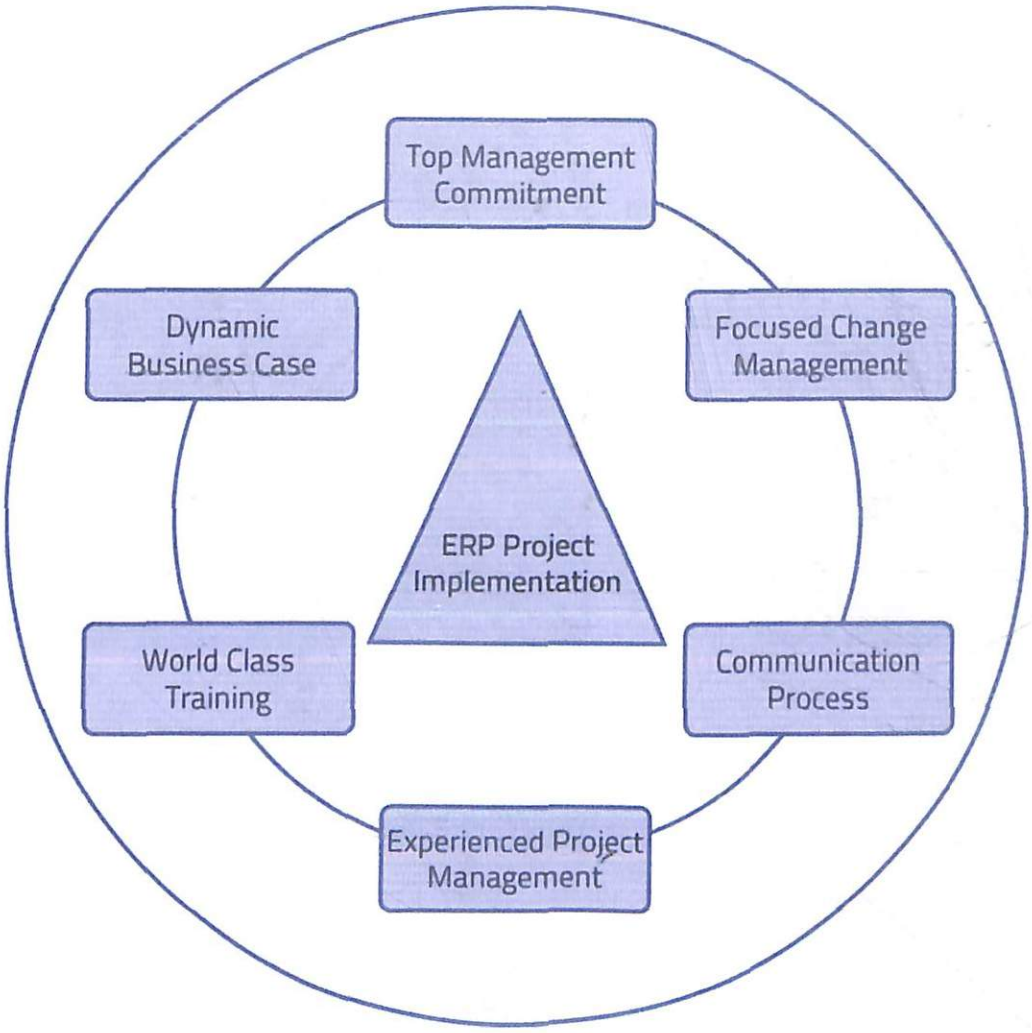

Figure 2.4 Dominant factors model

Source: Al-Aboud (2011)

Moreover, these factors, as shown in Figure 2.4, are related to business processes and people, and are thus highly interdependent. In other words, failure in one factor can affect the overall ERP implementation project.

Another module from Bhatti (2005) is the use of CSFs to illustrate framework (Figure 2.5). Many authors provided frameworks, modules and guidelines, and use CSFs which proves that for ERP implementation, CSFs have to be identified.

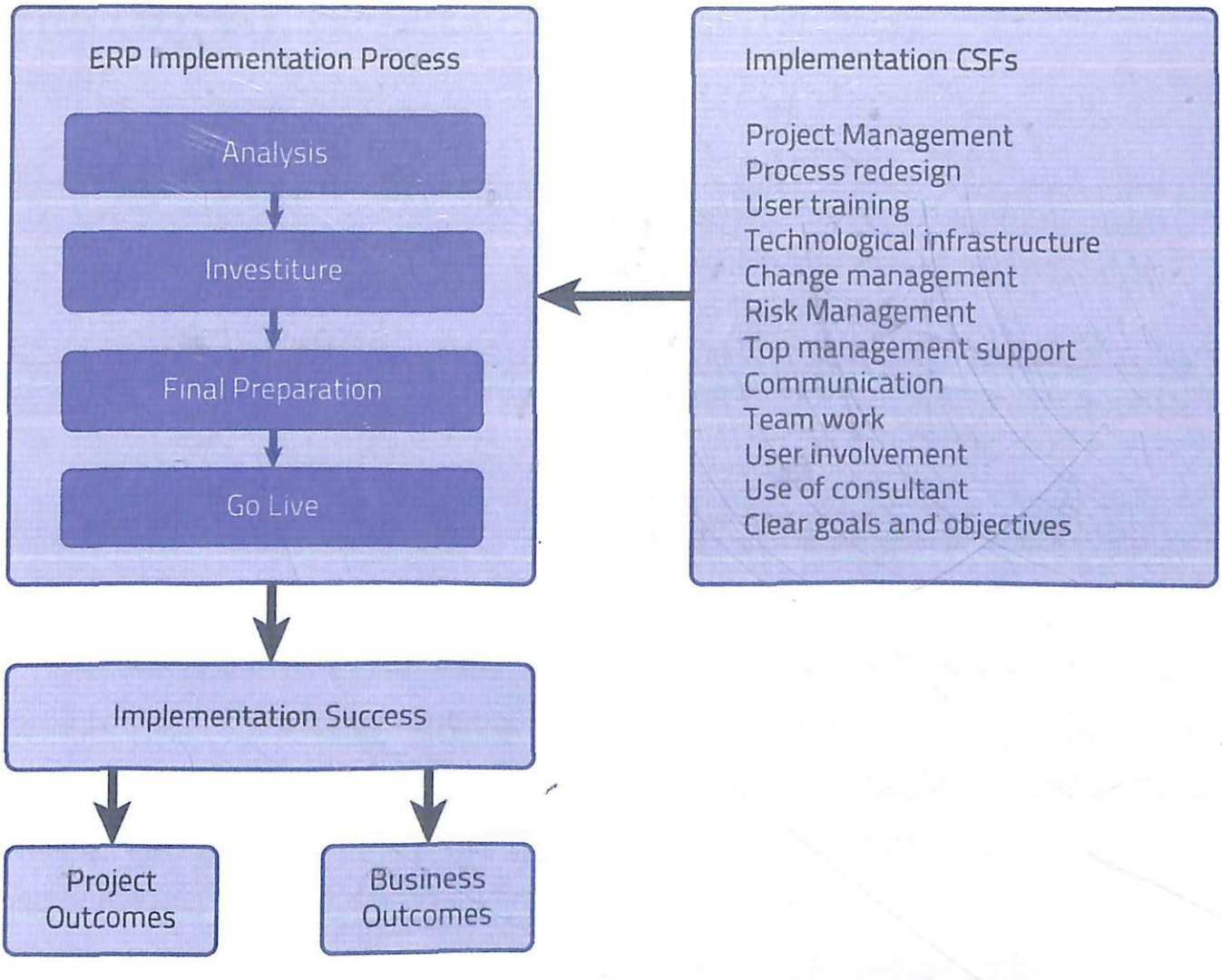

Figure 2.5 ERP systems implementation framework by Bhatti (2005)

Source: Bhatti (2005)

Besides, from the literature review, other researchers, Nah (2001), produced a model of 11 critical success factors; and almost all of the aforementioned authors cited this research in their study, and used their factors (Table 2.11). The reason for this is that this model was confirmed on the basis of 55 CIOs opinions on implementing ERP in their Organisations [45].

Table 2.11 CSFs in ERP implementation by Nah et al. (2001)

No.	Critical success factors	No.	Critical success factors
1	Top management support	7	Business plan and vision
2	Project champion	8	Business process reengineering
3	ERP teamwork and composition	9	Software/system development, testing and troubleshooting
4	Project management	10	Monitoring and evaluation of performance
5	Change management culture and program	11	Appropriate business and IT legacy systems
6	Communication		

Source: Nah et al. (2003)

These factors were similarly identified by Somers and Nelson (2001) who described 22 CSFs using responses of top management from 86 Organisations implementing ERP (Table 2.12). They studied the relevant literature, over 110 case studies, and included the critical requirements of practitioners and academicians. These last two articles are the ones most cited by authors.

Table 2.12 CSFs in ERP implementation by Somers and Nelson (2001)

No.	Critical success factors	No.	Critical success factors
1	Top management support	12	Dedicated resources
2	Project team competence	13	Use of steering committee
3	Interdepartmental cooperation	14	User training on software
4	Clear goals and objectives	15	Education on new business processes
5	Project management	16	Business Process Reengineering
6	Interdepartmental communication	17	Minimal customization
7	Management of expectations	18	Architecture choices
8	Project champion	19	Change management
9	Vendor support	20	Partnership with vendor
10	Careful package selection	21	Use of vendors' tools
11	Data analysis & conversion	22	Use of consultants

Source: Somers and Nelson (2001)

According to the review of literature on frameworks and modules which illustrate CSFs in ERP implementation, the model of 11 CSFs by Nah et al. (2001) was chosen as the most complete and generally used one, and it is commonly cited and supported by other authors [55][56][57][24][58][38][59][60]. These factors are already presented in every previously mentioned module and framework. In most of them, all 11 factors can be observed, or at least, factors very similar in meanings are presented. Table 2.13 shows the chosen CFSs with some explanation and this model will be further analysed.

Table 2.13 OS ERP CSFs

No.	CSFs	
1	Appropriate business and IT legacy systems	Required a certain degree of conformity to IT and organisational change in order to successfully implement ERP [13][38]
2	Business plan and vision	Clear and focused long-term goals, objectives, which are needed to guide on-going organizational effort and outline proposed strategic and tangible benefits, resources, costs, risks, and the timeline [55][24]
3	Business process reengineering	Organisations should be willing to adapt their business processes to fit the new information system requirements in order to minimize the degree of customisations and modifications in ERP [55][37]
4	Change management culture and program	Regular communication, expectations of challenges to dispel fears. User involvement, education, training and support of implementation. Acceptance of change with shared values and goals [61]
5	Communication	Consistent, timely, open and honest two-way communication of requirements, expectations and comments [38]
6	ERP teamwork and composition	There should be an ERP team, which is balanced or cross-functional, and comprise a mix of external consultants and internal staff. Team members should be those who possess the best business, technical knowledge and leadership and are highly motivated [61]

Table 2.13 continue

No.	CSFs	
7	Monitoring and evaluation of performance	Milestones and targets need to be actively monitored to track the progress of an ERP project. Performance monitoring, regular reports and project updates can help management monitor the progress of the implementation effort [38]
8	Project champion	Visible senior manager or team committed to promote the implementation process and has power to set goals and legitimize change [57]
9	Project management	Management of scope, schedule, budget and measurements of success. Good project management is essential because success in ERP implementation, as in most IS projects, is commonly evaluated based on the degree to which time and budget requirements are met [55][38]
10	Software/system development, testing and troubleshooting	Vigorous and sophisticated testing, troubleshooting and quick response. Functionality and link with core procedures should be established. Rigorous and sophisticated software testing eases implementation [57]
11	Top management support	The project must receive approval and support from top management. They must publicly and explicitly identify project as top priority; also involve legitimizing change and provide encouragement and incentives, allocate appropriate resources and share system vision and role [38][57]

Source: Author

2.8 Conclusion

This chapter gives a brief review of the literature related to ERP and its implementation. It also studied more closely the description of ERP and SME. The selection criteria and CSFs implementation were identified in keeping with the research objectives; and the most adequate ones that are cited and supported by the great majority of authors were chosen. In addition, the literature on ERP benefits and growth in terms of OS ERP implementation were closely examined. Needless to say, the data from this literature review will be used as secondary data for further analysis.

METHODOLOGY

3.1 Introduction

Research methodology is a key part of any research, partly because it determines how the researcher will solve the research problems [62]. Researchers use official statistics that are published in journals, newsletters, and reports. Any missing information is gotten from surveys, which gather the subjective opinions of people. It is clear that the reliability of facts and conclusions of research depends for the most part on the method used to gather and analyze the collected data and assumptions. So, a properly chosen research methodology gives clear results and affects the final result of the research.

In this chapter, the methodology of the research is outlined and the research strategy presented. Moreover, this chapter outlines the approaches and procedures that have been used. Research methods are always important because data collection methods answer the question of how the data was collected. Data represents the result of research and answers the question that is the focus of the study. In addition, this part of the research also presents the research procedures, design of the study, and data collection methods. Finally, the relevant ethical considerations will also be discussed.

3.2 Justification for the paradigm and methodology

The way to study social facts and phenomena or gain specific understanding and explanations is to describe the paradigm [63] Brunel and Morgan cited in [64] define four paradigms: radical humanist, radical structuralist, functionalist, and interpretive. These correspond to four conceptual measurements of radical change, regulation, subjective, and objective.

This dissertation employs the functionalist paradigm, which has been defined as problem-oriented with practical solution. Most business research orients towards a functionalist paradigm [65]. The research target is to provide a framework for the successful implementation of open source ERP system in Kazakhstan's SMEs.

Research may be seen as a system of logically consistent, methodical, Organisational, and technical procedures, all subordinated to the same goal of acquiring precise objective data. Such research suggests that data is to be collected and evaluated from different resources as literature and survey [66]. The relevant data from literature ought to be clarified, supplemented, and evaluated with surveys. Moreover, the survey gives a more significant data, in the sense that it is not found in the literature.

The literature reviewing method is quite simple. The literature review itself presents a brief description of ERP, SME and open source ERP. Moreover, the benefits and advantages would have to be identified. The selection criterion and implementation critical success factors would also have to be identified for conducting a survey and producing a framework. The questionnaire is created by ERP system implementation CSF and open source ERP system selection criterion that were found in the literature.

3.3 Research approach

The key to the success of any research is its systematic and comprehensive approach towards problem-solving. Usually, researchers use a combination of qualitative and quantitative research methods, to achieve the objectives. However, the method used in any research depends on the expected result, because, while success depends on the method that has been chosen, the result depends on how effective the method is used.

Conducting thorough and expert interviews relates to the qualitative research method. The main difference between a qualitative and quantitative method is that in the first case, the data is collected from a relatively small group of respondents and not analysed by the mean of statistics, while the use of the quantitative method studies a large group of people, and the data is subsequently analysed using statistical methods [67].

In this research, a quantitative research approach is used, because it involves conducting various surveys based on the use of structured closed questions to be answered by a large number of respondents. The main objective of quantitative

research is to obtain a numerical estimate of reaction from respondents to an event. Such studies are used when accurate, statistically reliable numerical data is needed. Depending on the research objectives, the study needs to identify which CSFs are most important for implementing the OS ERP system, and also which criteria are most influential for selecting the OS ERP. By the quantitative method, it was possible to get accurate and detailed information from a large number of respondents.

3.4 Design of study

Sekaran (2002) states that the design of research is a monitoring strategy for research study in which procedures and methods for gathering and examining the information that have to be collected are specified. It is a strategy for testing hypothesis. The strategy of research includes methods of selecting respondents for participation in the research, data collection, and analysis.

According to Tan (2007), the most common types of research designs are case studies, surveys, experiments, correlation or regression, comparisons, and historical design. These are not only designs. For instance, Saunders (2009) add action research, grounded theory, ethnography, and archival research. They also mentioned designs like case study, survey, and experiment. In addition, Tan (2007) states that research can contain more than one design of study; for example, a survey can be done in a chosen industry, and additionally an in-depth case study of a specific company from this industry can also be done.

The most appropriate design of study chosen for this research is survey, which is a common and general strategy in management and business research. It answers to questions like who, where, what, how many, and how much. Surveys allow for the collecting of a large amount of information from a considerable part of the population. A survey is frequently done via questionnaires, which are used in this research because it is directed to the sample, while the data obtained from questionnaires are standardized and easy to compare.

3.5 Research procedures

Procedure starts with problem identification where the researcher determines which problem will be investigated and what results need to be obtained in the end [68]. The problem is always something that has yet to be studied. When the problem is clear, the research strategy will be efficient. As a result, the problem allows for obtaining new knowledge about the subject.

This research procedure starts from the identification of the research problem, question, aim and objectives, and after formulating all of these, the research topic is identified. Then, a research proposal is set forth, which includes and clarifies the research aim, question, and objectives. The literature review has been done to acquire secondary data, while the research methodology has been identified by selecting the appropriate research method and research approaches. To collect primary data, a survey has been conducted.

3.6 Sampling

According to Ary (2009), the small collection of people that needs to be surveyed or observed is defined as the sample, and the larger one is defined as the population.

In this research, the target is small and medium sized enterprises, and for obvious reasons it is close to being impossible to collect data from all SMEs in Kazakhstan. However, for observation, a subset of the population has been studied. The sample was chosen from self-selected individuals. The survey was in the form of a questionnaire, and people involved in this questionnaire were from both vendor and end-user environment. These respondents hail from SMEs in three big cities (Atyrau, Almaty, Astana) that have implemented the ERP systems.

3.7 Data collection

Data collection is a very important stage of the study because the quality of collected information ultimately affects the results. The collection of information sources is meant to simplify the task of finding the necessary information. A research

plan for gathering information was carried out, where information were collected in the form of secondary and primary data. Research data collection methods are divided into primary and secondary data collection methods.

Blaxter (2006) strongly suggest using a combination of both primary and secondary data collection approaches in order to meet research objectives. As a rule, the most appropriate data collection is a combination of primary and secondary collection methods, as it provides the most comprehensive way to obtain reliable information with minimal investment of time and money. In this research, both data collection methods are used.

3.7.1 Primary data collection

The most frequently used primary data collection instruments include various types of surveys, and about more than half of primary data collection methods are interviews. There are several types of surveys, and the survey method used in this research is questionnaire. Questionnaire has been chosen to evaluate the importance of the CSF and identify important criteria that influence the selection of OS ERP systems. These CSFs and criteria have been found and clarified from the literature and by using the respondents' identified perception. The questionnaire had an introductory part and four sections. The introductory part provides information for respondents about this research and about the aim of the survey. The first section is background information which identifies the respondents' company background, work position, and which ERP modules have been implemented. In the second section, OS ERP selection criteria are given and respondents had to indicate a degree of importance to each criterion. The next section also deals with such a degree of importance except that it concerns CSFs. The last section identifies the top 3 CSFs for each stage of ERP implementation (pre-implementation, during-implementation, post-implementation). The questionnaire is sent via email and social networks.

3.7.2 Secondary data collection

Secondary data were used as the theoretical basis of this research and methodology, and to establish a detailed perception of the knowledge related to ERP and OS. Accordingly, secondary data collection gathers and analyses existing secondary information, also called 'a desk study'. Secondary information is data collected previously for all kinds of purposes and in terms of content it is a study of the available sources.

The secondary data used in this research is mainly from various research papers, academic journals, articles, trade magazines, and books related to ERP systems and open source topics. All identified sources and information found in these sources have been studied and filtered according to their relevance to the research aim.

3.8 Data analysis methods

After collecting data, the next step is data analysis. Data analysis is a process in which data is assigned a certain value. Analysis consists of three separate stages: editing, which means rejection of all inconsistent or damaged replies; tabulation, that is, bringing together various responses and creating data tables; interpreting, in other words, analysing tables and numbers and getting their actual meaning. To get accurate, full and reliable primary information, a quantitative survey research approach was selected. The data analysis method should be quantitative.

A quantitative research methodology deals with areas that need to be quantified, and represents the collection and analysis of primary data. These kinds of studies are usually carried out when accurate, statistically verified numerical data are needed.

Both qualitative and quantitative analysis passes all three analysis stages of editing, tabulation, and interpreting. However, the issue is how the data should be consolidated into a table and considered in advance at the planning stage of the study. There might be cases where research fails because it might turn out that the questionnaire cannot be parsed. Typically, data must be summarized as combination tables so that the researcher can determine how respondents will answer the questions.

Questions for this research have been analysed and studied by the author in research planning stages. The author made the decision about research procedures and research methods like data collection and data analysis methods, as well as the decision to use the quantitative analysis method before starting the methodology part. The survey questions have also been done before, allowing the author an opportunity to analyse each question separately for its meaning, correctness, understandability, and importance.

3.9 Ethical consideration

This research involves questionnaire participants voluntarily. Beforehand, questionnaire respondents were informed about their rights and research purposes. The survey was passed on to respondents individually through emails and social networks. The important issue regarding the protection of respondents is how information is processed. According to the Ethics Fast-Track form, participants should not be involved in any serious ethical threats; also, this form guarantees the rights and protection of participants. In order to protect confidentiality, the author has not put in any personal or private questions.

3.10 Conclusions

A correct methodology is important as it helps collect correct information. Proper data collection, data analysis methods, and appropriate research approach or procedures all make the final result of the study more reliable. This chapter provides a brief explanation about methods used in this research and how the data have been analysed. A quantitative research approach has been chosen as most suitable for this study, and as a research strategy the questionnaire was chosen. Moreover, as the main sources for data collection a combination of primary and secondary data is used. Finally, having taken into account the relevant ethical considerations, the Ethics Fast-Track form was chosen.

PRESENTATION AND ANALYSIS OF DATA

4.1 Introduction

This chapter presents the analysis of data and explains the result of survey findings. The result is based on participants' answers to the survey questionnaires. These respondents are those who have been involved in ERP system implementation as well as those using the ERP system in Kazakhstan's SMEs. The questionnaire was conducted in the Russian language, but some questions were both in Russian and English. All the data collected from the survey was translated into English and then analysed. The questions were evaluated separately before being assigned into understandable percentages.

4.2 Survey findings

In this survey, participants were people from both the vendor environment who have implemented or are implementing ERP systems, and end-user environment who are using and are involved in ERP systems implementation processes in SMEs. Vendors are those who provide system implementation (i.e. ERP systems) to both SMEs and large enterprises, while end-users are those who are making use of these systems.

The survey was passed on to respondents through emails and social networks. All the participants gave brief responses, none of which were inconsistent or damaged, so none of the replies were rejected. Although respondents were not required to give any feedback, most of them gave feedback through email about the questionnaire and about their answers to the questions.

4.2.1 Characteristics of the respondents

This research survey was conducted among 31 participants, 7 of whom were from the vendor environment. Among them were a founder, business analyst, project managers, consultants, and a programmer. From the end-user environment, 24 people participated, among whom were business analysts, IT managers, leading IT

specialists, DBMS specialists, IT engineers, senior programmer, system operators, programmers, and an application engineer.

4.2.2 Questionnaire

The questionnaire had 4 sections, each section and section questions will be analysed separately in order to ascertain the most appropriate information from the gathered data. All the data will be shown using graphics and tables.

4.2.2.1 Section 1 – background

The first question of the first section was about company background. Although the questionnaire was sent to people both from end-user and vendor environment, Figure 4.1 shows that the vendor side was less responsive than the end-user side. As shown below, about 77% of respondents are from the end-user environment, while only 23% are from the vendor environment. This shows that the end-user environment was more interested in doing this kind of questionnaire and in giving replies.

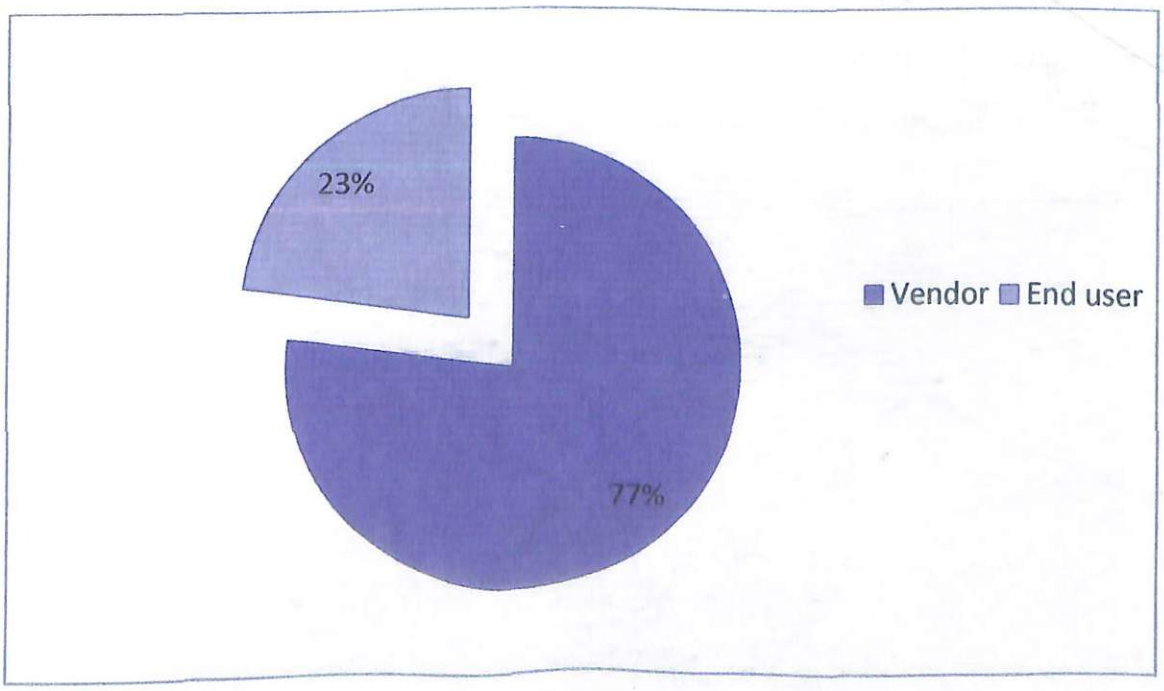

Figure 4.1 Percentage of respondents

The next question was conducted in order to find out about respondents' work position. Participants from the vendor environment were less in number, but the type

of respondents varied. They were 2 project managers, 2 consultants, 1 business analyst, 1 programmer, and even 1 founder who participated.

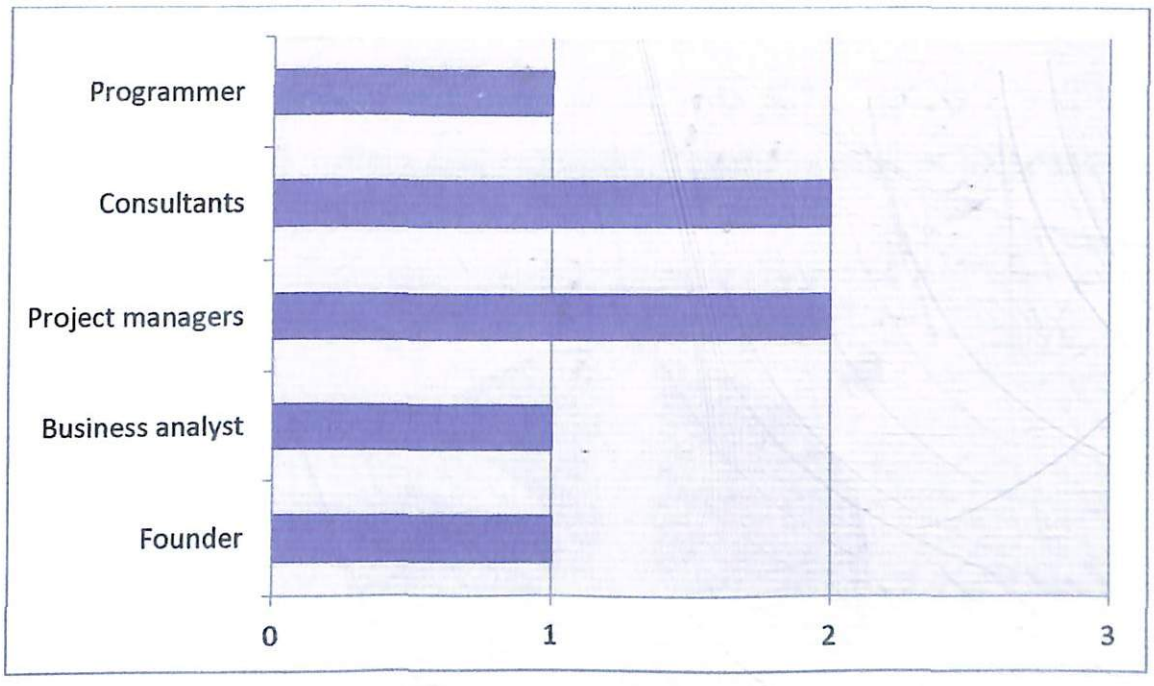

Figure 4.2 Number of people from vendor environment

According to the gathered data, there were more participants from the end-user environment, and accordingly the type of respondents was also more than from the vendor side. From 24 respondents, there were 2 Business analysts, 5 IT managers, 4 Lead IT specialists, 2 DBMS Specialists, 3 IT Engineers, 1 Senior Programmer, 4 Programmers, 2 System operators, and 1 Application engineer.

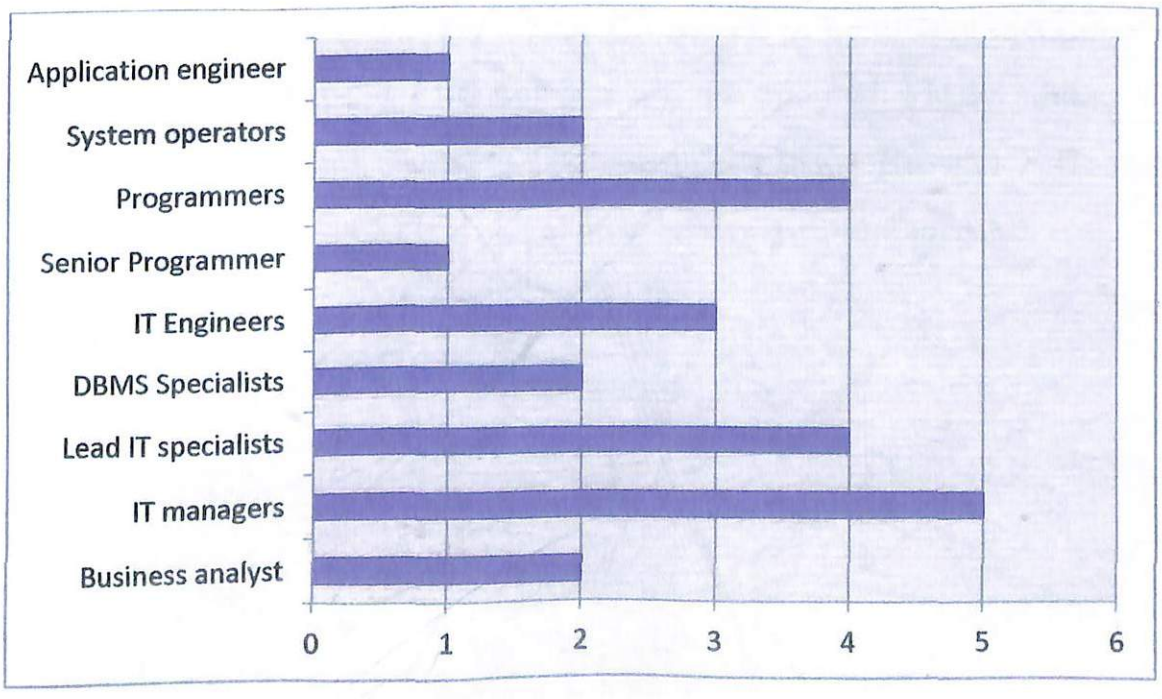

Figure 4.3 Number of people from end-user environment

Figure 4.4 shows the ERP systems mentioned by respondents. These are ERP systems that have been used or implemented by respondents from either vendor or end-user environment. 34% of respondents mentioned SAP, which is a well-known ERP. The next most popular ERP is 1C with 32%. This is a well-known Russian company which is widely adopted in the Commonwealth of Independent States (CIS countries).

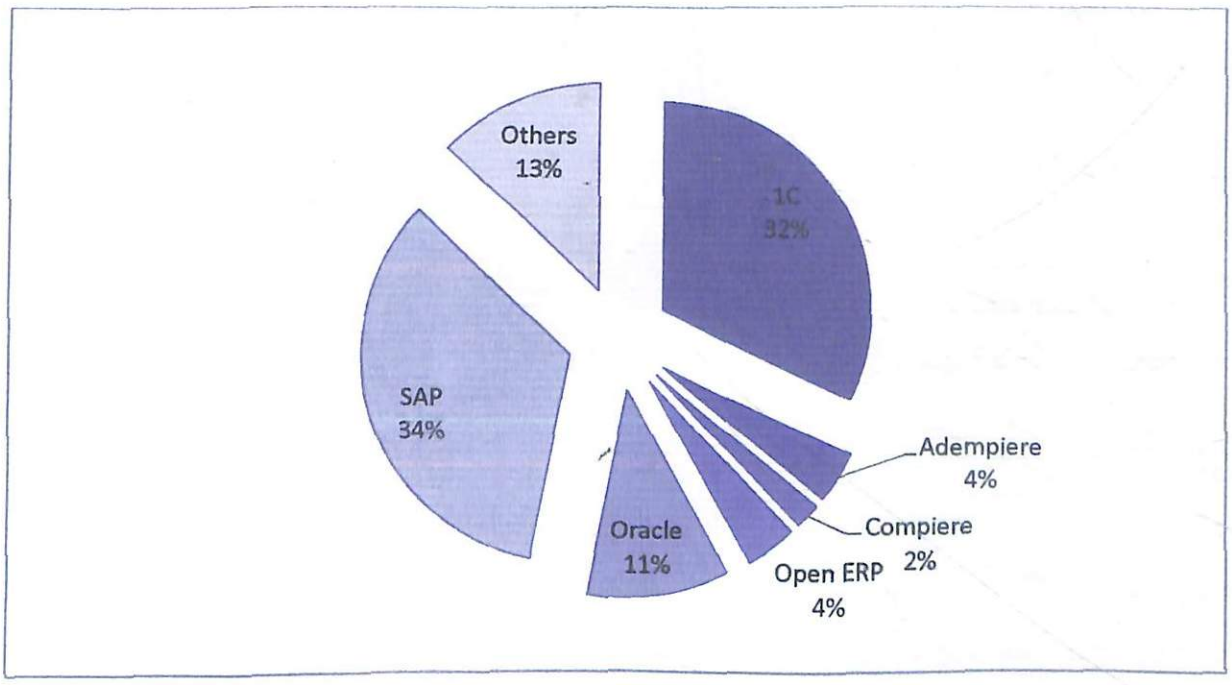

Figure 4.4. Percentage of ERP systems mentioned by respondents

Table 4.1 shows that respondents have used only 3 of OS ERP systems. They are Compiere, Adempiere and OpenERP, which in total were mentioned 5 times out of 47. It means that OS ERP systems are not adopted widely among Kazakhstan's SMEs. Most of them prefer 1C, which is a trusted Russian ERP and absolutely reliable in adoption by SMEs. Also, most prefer well-known SAP.

ERP systems	#
1C	15
Adempiere	2
Compiere	1
Open ERP	2
Oracle	5
SAP	16
Others	6
Total	47

Table 4.1 ERP systems mentioned by respondents

Figure 4.5 shows modules that were adopted by respondents. The most implemented module with 24% is Financial Management. This comes as no surprise as most companies normally implement first of all Financial Management modules.

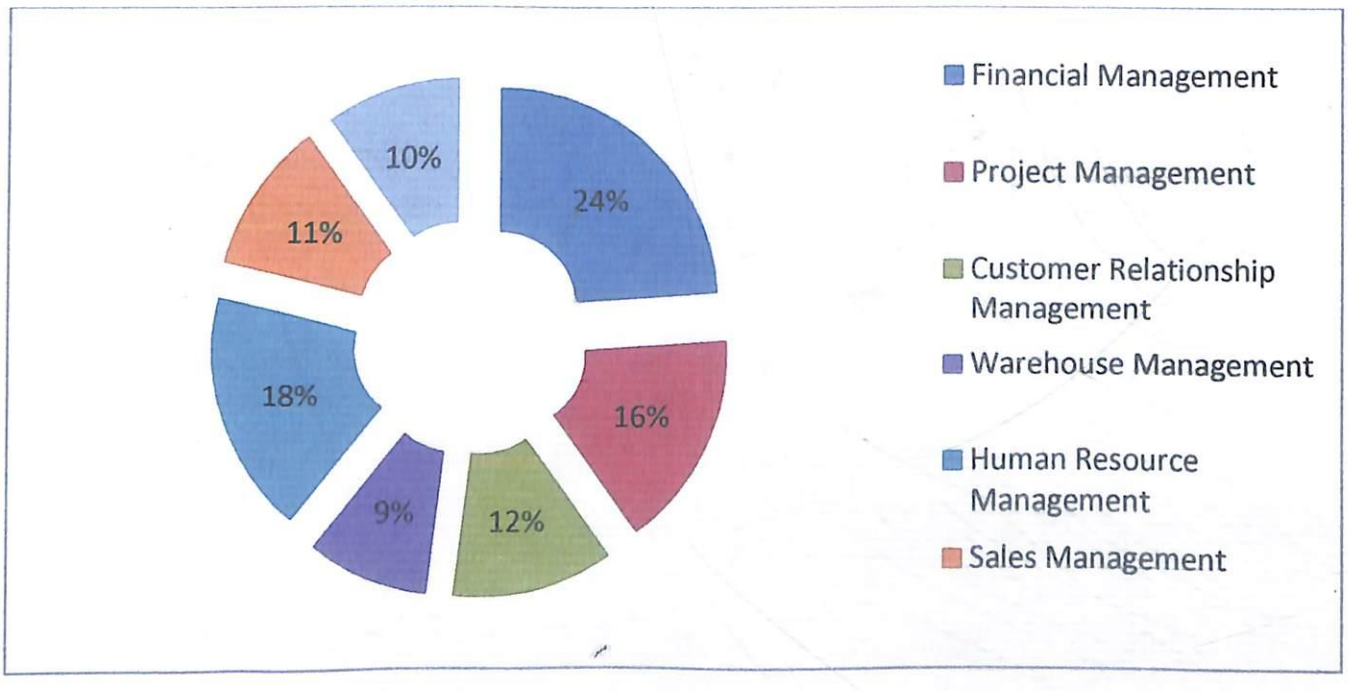

Figure 4.5 Percentage of modules adopted by respondents

Other modules' percentages are quite similar. Also, it can be seen from Table 4.2 that the numbers are not so different. From here, it can be said that all ERP modules are well adopted by SMEs.

Modules	#
Financial Management	20
Project Management	13
Customer Relationship Management	10
Warehouse Management	7
Human Resource Management	15
Sales Management	9
Others	8
Total	**82**

Table 4.2 Modules adopted by respondents

4.2.2.2 Section 2 – Criteria that influence the selection of an OS ERP

This section identifies the importance of each criterion that influences the selection of OS ERP systems. Respondents choose from each level of importance as in the following:

1 - Extremely critical and important for selection

2 - Critical and important for selection

3 - Somewhat critical and important for selection

4 - Important but not critical / necessary for selection

5 - Neither critical nor important for selection

Table 4.3 Criteria that influence the selection of an OS ERP

No.	Criteria	5	4	3	2	1	Total
1	Ease/speed of implementation	6	15	4	5	1	113
2	Total price	6	14	7	3	1	114
3	Vendor support	9	11	5	2	4	112
4	Reliability	18	8	3	1	1	134
5	Ease of use	11	11	4	2	3	118
6	Customization	14	8	7	1	1	126
7	Integration	13	7	7	3	1	121
8	Organisational fit	16	7	4	2	2	126
9	Functionality	15	10	5		1	131
10	Vendor reputation	3	11	10	2	5	98
11	Flexibility	7	14	6	2	2	115
12	Upgrades	11	8	7	4	1	117

Table 4.3 shows the criteria that were in the questionnaire. As can be seen from Figure 4.6 below, the author has calculated the various totals and they do not vary much. All the 12 criteria are quite important according to respondents. The first column of the table shows the number of selection by respondents at the level "Extremely critical and important for selection" where most numbers are quite same. On the other hand, the seventh column at the level "Neither critical nor important for selection" shows only small numbers. This means that when it comes to selecting OS ERP systems in SMEs, all these criteria are important.

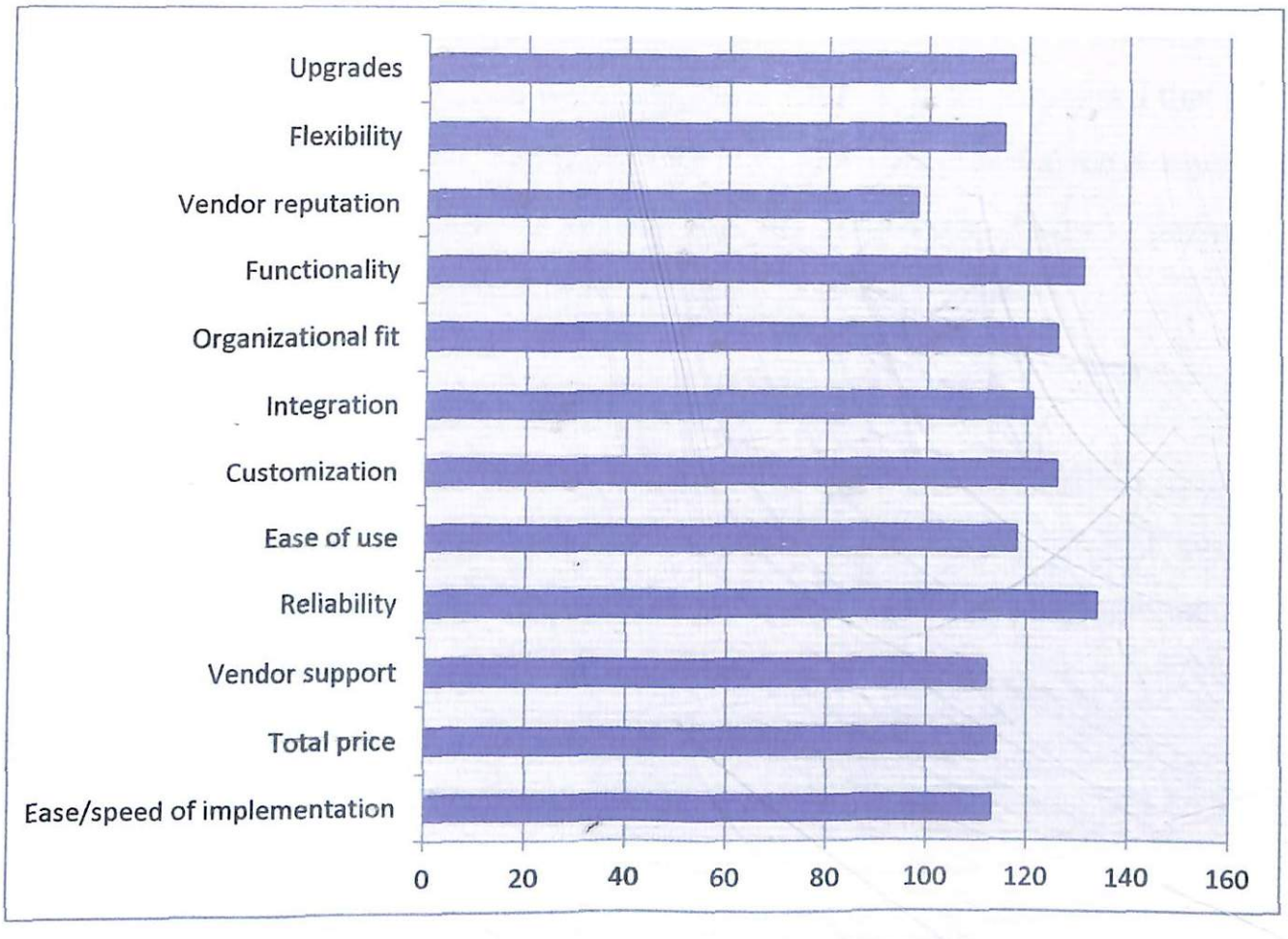

Figure 4.6 Criteria that influence the selection of an OS ERP

However, the aim of this section is to rank the OS ERP system selection criteria. Table 4.4 below shows the ranking of these criteria according to respondents. It shows that ranking first is Reliability, next Functionality, and then continued with Customisation, which has the same rank as Organisational fit. These are the Top 3 OS ERP system selection criteria in Kazakhstan's SMEs according to respondents.

Table 4.4 Rank of OS ERP system selection criteria

Ranking	Criteria	Total
1	Reliability	134
2	Functionality	131
3	Customization	126
4	Organisational fit	126
5	Integration	121
6	Ease of use	118
7	Upgrades	117
8	Flexibility	115
9	Total price	114
10	Ease/speed of implementation	113
11	Vendor support	112
12	Vendor reputation	98

Besides, respondents were asked to give some more criteria not mentioned by author, but which in their opinion were important. Most of them responded that there are no other important criteria, and the author has indeed covered the most important ones. However, some respondents replied that the author has skipped "Security", which is a very important criterion in selecting any enterprise systems.

4.2.2.3 Section 3 – Critical success factors

This section shows CSFs ranking. Respondents evaluated each of the factors in terms of its importance in determining the success of implementing OS ERP systems in Kazakhstan's SMEs. They identified the level of each factor's importance as follows:

1 - Extremely critical and important for success

2 - Critical and important for success

3 - Somewhat critical and important for success

4 - Important but not critical / necessary for success

5 - Neither critical nor important for success

Table 4.5 CSFs of ERP system implementation

No.	Critical Success Factors	5	4	3	2	1	Total
1	Appropriate business and IT legacy systems	11	13	4	3		125
2	Business plan and vision	9	16	4	1	1	124
3	Business process reengineering	8	12	9	1	1	118
4	Change management and culture	5	11	9	2	4	104
5	Communication	13	7	7	2	2	120
6	ERP teamwork and composition	13	10	4	4		125
7	Monitoring and evaluation of performance	10	14	4	2	1	123
8	Project champion	12	10	8	1		126
9	Project management	17	12	1		1	137
10	Software/system development, testing and troubleshooting	13	8	8	1	1	124
11	Top management support	14	11	4	1	1	129

Table 4.5 shows the CSFs and total of each factor. The factors' totals are also quite similar (Figure 4.7). It means that according to respondents, CSFs that have been identified by the author from literature review are important for successfully implementing an OS ERP system in Kazakhstan's SMEs.

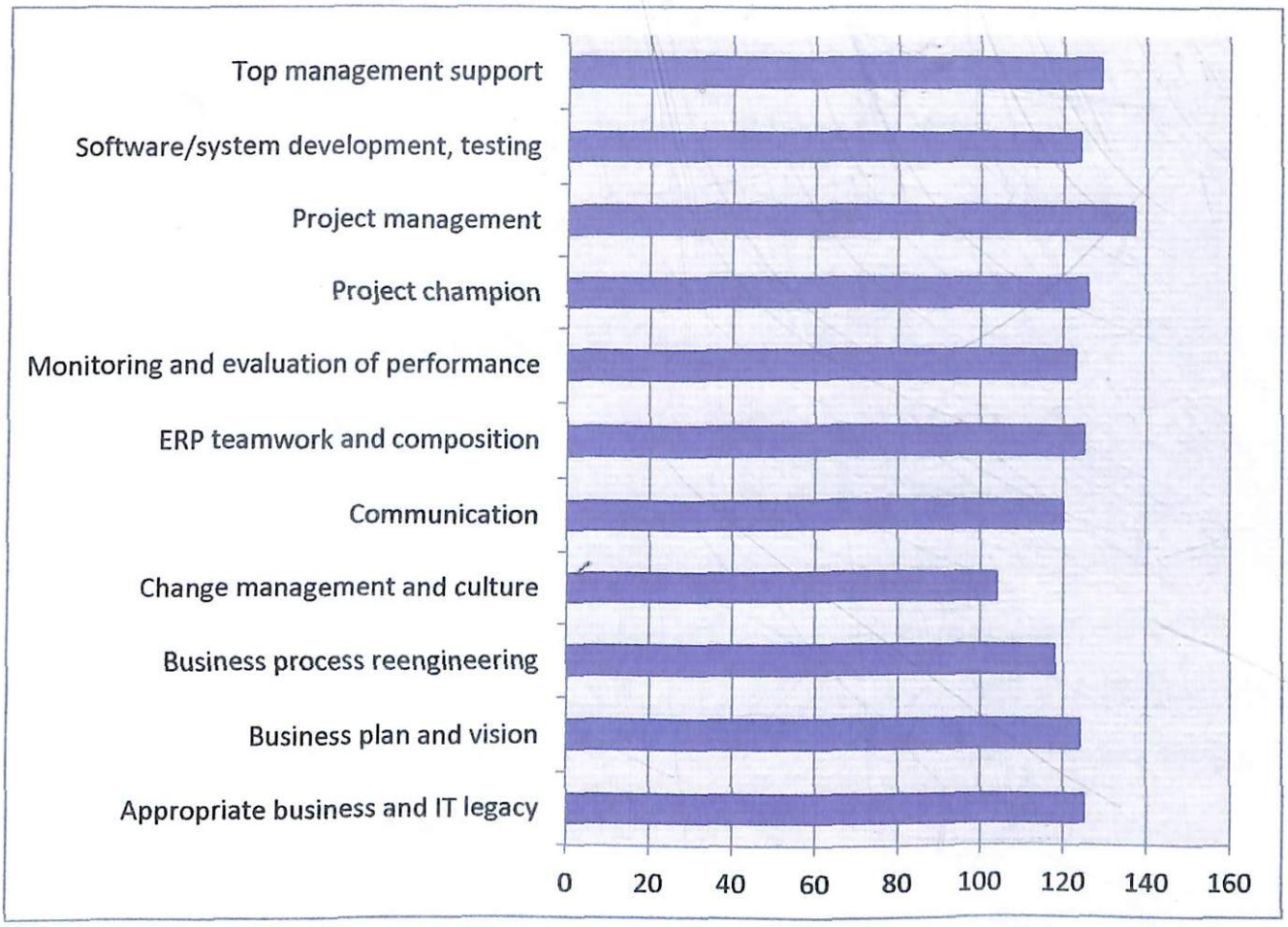

Figure 4.7 CSFs of ERP system implementation

Table 4.6 shows the ranking of CSFs. From there, it can be seen that the top 3 factors are Project management, Top management support, and Project champion. According to respondents, these factors are very important for successfully implementing OS ERP systems. All these factors are important because to implement any system, it needs Top management support, then it has to have Project management, and Project champion should lead this project.

Table 4.6 Ranking CSFs

Ranking	Critical Success Factors	Total
1	Project management	137
2	Top management support	129
3	Project champion	126
4	Appropriate business and IT legacy systems	125
5	ERP teamwork and composition	125
6	Business plan and vision	124
7	Software/system development, testing and troubleshooting	124
8	Monitoring and evaluation of performance	123
9	Communication	120
10	Business process reengineering	118
11	Change management and culture	104

In this section, there is the question of some extra factors that can be critical to the successful implementation of OS ERP systems in Kazakhstan's SMEs. Most respondents replied that the key important factors are already presented, with just a few pointing to "staff training" as critically important.

4.2.2.4 Section 4 – CSFs for implementation stages

This section identifies the top 3 CSFs according to their importance at ERP system implementation stages. Table 4.7 shows these factors according to stages. These stages are pre-implementation, which is the period before the actual installation. During-implementation is when the system package has been installed and Customisation has been started to map and satisfy the Organisation's business processes and Organisational needs. Post-implementation is the real adaptation period.

Table 4.7 CSFs for implementation stages

	Pre-Implementation	During-Implementation	Post-Implementation
Top 1	Appropriate business and IT legacy systems	ERP teamwork and composition	Monitoring and evaluation of performance
Top 2	Business plan and vision	Communication	Software/system development, testing and troubleshooting
Top 3	Business process reengineering	Project management	Top management support

4.3 Conclusion and findings

This chapter analyses the data gathered from the survey. All survey findings are tabulated and shown in graphics. The analysis of data has helped identify some key moments in the implementation of OŞ ERP systems in Kazakhstan's SMEs, as well as criteria and factors which are the main objectives of this study.

One of the most important points is that Kazakhstan's SMEs are not tending towards implementing the OS ERP systems. Table 4.1 shows that respondents used only three OS ERP systems. Another interesting point is that all OS ERP system selection criteria and implementation factors have quite the same importance according to respondents (Table 4.4, Table 4.6). However, according to CSFs ranking, Project management is ranked first, and there is a big difference with Top management support that comes in second. This means that Kazakhstan's SMEs care most of all about Project management in implementation of the OS ERP system, because without Top management support the project will not be able to get of the ground, and if starts it needs to be well managed to avoid failure.

Moreover, the top CSFs for implementation stages are different from general ranking (Table 4.7), which means that in general factors that are important generally would have to be considered. However, for the stages, only factors that are important at each separate stage have to be considered. Furthermore, these data findings will be used to provide the artefact.

ARTEFACT

5.1 Introduction to the artefact

This chapter is considered to be the most important in this study for it summarises and presents the research findings through artefact and deliverables. The key findings collected and analysed from survey questionnaire will be evaluated in conjunction with the literature review in order to satisfy the general aim of this study, which is providing a general framework for the successful implementation of OS ERP system in Kazakhstan's SMEs.

5.2 How the analysis was used to create artefact

In order to address the research question, primary research was carried out. Primary data was collected based on a distributed questionnaire. This data was analysed and the final outcomes have been presented. It started from identifying what ERP systems Kazakhstan's SMEs are using. Although respondents were asked about ERP, its purpose was to determine whether OS ERP systems are used by Kazakhstan's SMEs and which ones. As has been identified, respondents mentioned only 3 OS ERP systems. The analysis shows that OS ERP systems are not widely adopted in Kazakhstan's SMEs.

Although participants were not required to give any feedback, most of them gave feedback through email. According to those feedbacks, they either do not have enough knowledge about OS ERP or are just unaware. Besides, they do not consider OS ERP as an alternative solution. Most stated that in order to automate some Organisational processes or bring in certain modernisation measures within the company, they chose the mostly used and known ERP as 1C or SAP, and then find a vendor who implements it, because they meet core business needs. Besides, participants stated that they did not follow any guide about the ERP implementation process. They just tried to relay basic project management principles.

This gives the rationale for this study, because the purpose of this research is to provide a framework for the successful implementation of OS ERP in Kazakhstan's

SMEs. There is big gap when it comes to the implementation of OS ERP. It might be due to insufficient knowledge about it, because as identified from the literature review, the chairman of the board of a national IT company stated that poor awareness is a major barrier against implementing OS, and respondents also mentioned poor awareness about OS ERP as a factor.

5.2.1 General framework for implementation of OS ERP

In order to provide such a framework, the literature review identified some OS ERP implementation CSFs and criteria that motivate Organisations to select OS ERP. They used surveys to identify the most influential ones for Kazakhstan's SMEs and ranked them according to importance.

The survey identified Reliability, Functionality, Customisation and Organisational fit as the top influential criteria that motivate Kazakhstan's SMEs to select OS ERP, and these criteria are used to provide the framework, partly because their totals are quite high. Another finding that is used in the framework is the top CSFs. They are also ranked according to importance. As can be seen from the data analysis and framework below (Figure 5.1), Project management, Top management support, and Project champion were identified as the most critical factors for the successful implementation of OS ERP system. These top 3 CSFs have been identified as very critical for all implementation stages. Finally, in order to provide sufficient framework, CSFs for implementation stages are identified. They have been questioned independently, meaning that respondents show the top 3 CSFs for each of the implementation stages separately.

Below, Figure 5.1 shows the framework that has been created from survey findings. It is divided into two parts, selection and implementation. The selection part comes first and consists of the most important criteria. It narrows down the implementation part which is also divided into 2 parts, the main CSFs that have to be considered at all implementation stages, and the implementation stages. The implementation stages are divided into 3 phases as 3 implementation stages, which consist of CSFs that are very important at each step.

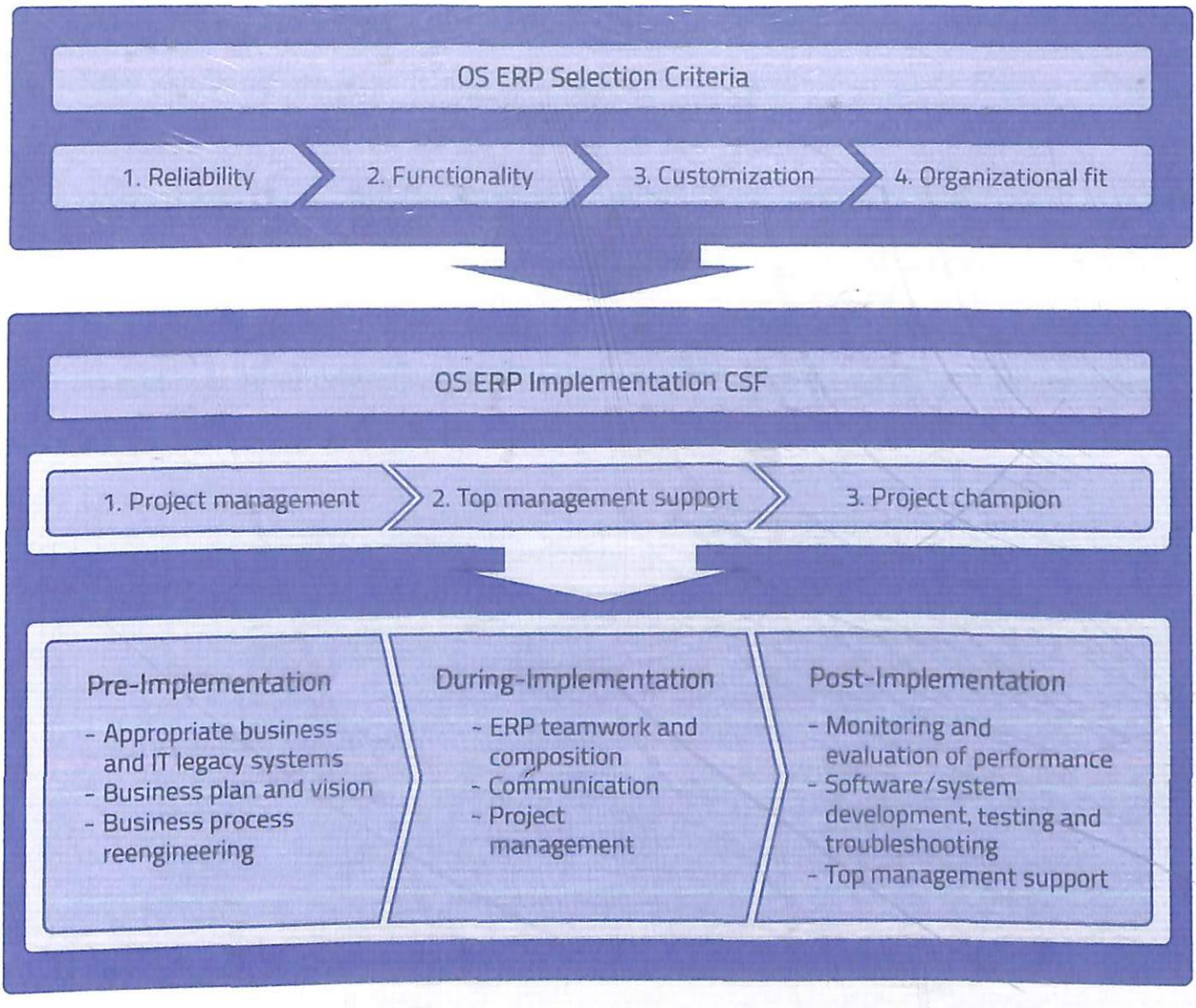

Figure 5.1 General framework for implementation of OS ERP system in Kazakhstan's SMEs

5.3 How the literature review was used to support the artefact

In order to collect secondary data, a literature review was carried out. To conduct the questionnaire, all the necessary information was found from the literature. Further, the survey outcomes were supported by the literature review findings.

If Organisations successfully implement ERP, they could gain enormous benefits. However, it can also be disastrous, especially if Organisations fail with the implementation process. So ERP implementation would not be the same for all enterprises or industries. The main objectives of this study are to identify selection criteria and CSFs for implementation of OS ERP in Kazakhstan's SMEs.

5.3.1 OS ERP selection criteria

ERP implementation is a hugely complicated process, and starts from a selection of the system [70]. One of the objectives of this research was to identify OS ERP selection criteria. From the literature, 12 criteria were identified which were used in the survey in order to ascertain the most important ones for Kazakhstan's SMEs. Besides, they were ranked according to importance level. Table 5.1 shows these criteria and a general comparison with those of Bernroider (2009) and Johansson and Sudzina (2009). It shows only 12 ranked criteria from each, because for this survey only 12 were taken.

Table 5.1 Comparison of selection criteria

No	Criteria based on survey findings	Criteria by Bernroider et al. (2009)	Criteria by Johansson and Sudzina (2009)
1	Reliability	Systems reliability	Ease/speed of implementation
2	Functionality	Functionality of the system	Price
3	Customization	System flexibility	Vendor support
4	Organizational fit	Advanced technology	Reliability
5	Integration	System interoperability	Ease of use
6	Ease of use	Operating system independency	Customisation/ Parameterisation
7	Upgrades	Connectivity	Integration
8	Flexibility	Availability of industry focused solution	Organizational fit
9	Total price	Organizational fit of system	Functionality
10	Ease/speed of implementation	Internationality of software	Vendor reputation
11	Vendor support	System usability	Flexibility
12	Vendor reputation	Integrated and better quality of information	Training

Source: Author

From the table, it can be said that almost the same criteria were identified but the ranking is quite different. It means that for each type of industry or even each type of enterprise, ERP selection criteria ranking could be diverse. For instance, the top criteria for Kazakhstan's SMEs were quite similar to the top criteria for European Union countries identified by Bernroider (2009), and somewhat different from those of Johansson and Sudzina (2009). So it means that for each case, separate research and analysis should be carried out.

5.3.2. OS ERP implementation CSFs

OS ERP implementation CSFs are also identified from the literature and ranked according to importance level. Table 5.2 presents a general comparison of ranking from survey findings with those of Nah (2003) and Somers and Nelson (2001). Table 5.1 presents only the top 11 factors by Somers and Nelson (2001) and Nah (2003), because this study focuses on only 11 CSFs.

Table 5.2 Comparison of CSF

No	CSF based on survey findings	CSF by Somers and Nelson (2001)	CSF by Nah et al. (2003)
1	Project management	Top management support	Top management support
2	Top management support	Project team competence	Project champion
3	Project champion	Interdepartmental cooperation	ERP teamwork and composition
4	Appropriate business and IT legacy systems	Clear goals and objectives	Project management
5	ERP teamwork and composition	Project management	Change management culture and program
6	Business plan and vision	Interdepartmental communication	Communication
7	Software/system development, testing and troubleshooting	Management of expectations	Business plan and vision

Table 5.2 continue

No	CSF based on survey findings	CSF by Somers and Nelson (2001)	CSF by Nah et al. (2003)
8	Monitoring and evaluation of performance	Project champion	Business process reengineering
9	Communication	Vendor support	Software/system development, testing and troubleshooting
10	Business process reengineering	Careful package selection	Monitoring and evaluation of performance
11	Change management and culture	Data analysis & conversion	Appropriate business and IT legacy systems

Source: Author

Despite the fact that CSFs are quite the same, the degree of importance is also different as happened with the selection criteria, which totally proves that adoption of ERP would not be the same for all industries and enterprises that are trying to realize it. The reason for the difference is that in this study the main focus is the implementation of OS ERP in Kazakhstan's SMEs, and it also proves that for each case CSFs have to be identified separately.

5.3.3 CSFs for implementation stages

A real understanding of the implementation process with all its aspects, factors and stages help predict possible challenges and avoid all kinds of problems. Planning in advance always helps to do the task better. Therefore, each step has to be well organized and managed. According to the framework, the ERP implementation part consists of three stages with CSFs that have been identified from a separate survey for each stage. Moreover, as found above, despite the fact that there are already existing models and frameworks, each case has to be evaluated separately.

Table 5.3 presents a general comparison of the author's findings about stages against the findings of Somers and Nelson (2001) and Nah (2003).

Table 5.3 Comparison of CSF for implementation stages

CSF based on survey findings	CSF by Somers and Nelson (2001)	CSF by Nah et al. (2003)
Pre-Implementation stage 1. Appropriate business and IT legacy systems 2. Business plan and vision 3.Business process reengineering	**Stage: Initiation** 1. Architecture choices 2. Clear goals and objectives 3. Partnership with vendor 4. Top management support 5. Careful selection of package	**Preparation, analysis, design Chartering phase** 1. ERP teamwork and composition 2. Top management support 3. Business plan and vision 4. Effective communication 5. Project management 6. Project Champion 7. Appropriate business and IT legacy systems
During-Implementation stage 1. ERP teamwork and composition 2. Communication 3. Project management	**Stage: Adoption** 1. Top management support 2. Project team competence 3. Use of steering committee 4. Partnership with vendor 5. Dedicated resources	**Implementation Project phase** 1. Change management program and culture 2. BPR and minimum customization 3. Software development, testing and troubleshooting
Post-Implementation stage 1. Monitoring and evaluation of performance 2. Software/system development, testing and troubleshooting 3. Top management support	**Stage: Adaptation** 1. Interdepartmental communication 2. Interdepartmental cooperation 3. Project team competence 4. Dedicated resources 5. Use of vendors' tools	**Implementation Shakedown phase** 1. Monitoring and Evaluation of performance

Table 5.3 continue

CSF based on survey findings	CSF by Somers and Nelson (2001)	CSF by Nah et al. (2003)
	Stage: Acceptance 1. Interdepartmental communication 2. Interdepartmental cooperation 3. Top management support 4. Project team competence 5. Education on new business processes	**Maintenance** **Onward & Upward** 1. Business vision
	Stage: Routinization 1. Interdepartmental communication 2. Top management support 3. Interdepartmental cooperation 4. Vendor support 5. User training on software	
	Stage: Infusion 1. Interdepartmental communication 2. Interdepartmental cooperation 3. Top management support 4. Vendor support 5. Partnership with vendor	

Source: Author

As can be seen from the table, Somers and Nelson (2001) divided the implementation process into 6 stages, Nah (2003) into 4 phases, while the author's into 3 stages. For instance, Somers and Nelson (2001) separated stages according to

the model of Cooper and Zmud (1990), while Nah (2003) based theirs on Markus and Tanis (2000) ERP life cycle model. However, it does not matter how stages should be divided; the key is that they have to be separately considered. The table shows that CSFs are quite diverse. However, there are some that are similar at certain stages. Again, it is because they are for different cases.

5.4 Framework

From survey and literature findings, a framework is created for OS ERP implementation in Kazakhstan's SMEs. As can be seen from Figure 5.1, the first phase of the framework is OS ERP selection. As identified, ERP selection part cannot be separated from implementation [71]. The framework shows that the OS ERP selection part has the main criteria, which are identified as the most important.

Selection

When it comes to selecting OS ERP, Organisations must consider how the system's reliability satisfies their expectations [72]. Afterwards, they should consider whether system functionality could be used for Organisational purposes. This continues with identifying the Customisation level in order to customise functionality to meet business core tasks [40]. Moreover, Organisational fit also needs to be considered, because it is better to choose a system that complies with current business processes, in order to reduce system Customisation [73]. Anyway, some Customisation will be carried out, but too much Customisation might create certain challenges to implementation.

Implementation

When Organisations are satisfied and have chosen an OS ERP, then comes the implementation level. It is also a very complicated process and according to the framework, it is divided into 2 segments, the first one with the most important CSFs for all stages, and the second one with CSFs for each implementation stage.

As can be seen, project management should be the most important for all stages.

As identified from the literature review, the main ERP failure factor is poor project management effectiveness [74]. So, at the beginning, core ERP project management principles have to be identified according to the business goals and objectives [75]. At this phase, challenges should be evaluated and managed, as well as budget, deadline and other aspects [76].

The project should be reviewed and approved by the top management if it satisfies core strategic goals [77]. Afterwards, the top management should support the implementation project and identify the project champion.

Project champion leads the project and should have the power to set goals and legitimize change [78]. It should also continually try to resolve challenges and manage resistance [13].

These are three main factors critical for all stages of OS ERP implementation, because every single phase should satisfy the managed project plan, and should be controlled by project champion, supported by the top management [79]. Each single step should be well managed, planned and supported.

Implementation stages

The pre-implementation stage should start with the appropriate business and IT legacy systems, which means Organisation should correspond to the required degree of business functions and IT level in order to successfully implement ERP [13][21].

Subsequently, the business plan and vision should be identified. Clear, focused and long-term business plan, vision, goals and objectives should be identified according to OS ERP benefits [55].

After setting up the business plan, business process reengineering takes place. In order to align business processes to the ERP system, and reduce system modification, BPR should be done according to a new business plan [57].

When pre-implementation activities are done, the actual implementation starts, which is about installing system package and Customisation. During implementation, the most critical factor according to the framework is ERP teamwork and composition, because ERP implementation is not just installing software to end-users,

but rather a much more complex process [4]. Therefore, teamwork and its composition are very important. The team should be a mixture of consultants and internal staff.

Of course, when teamwork is a key factor, communication should be taken into consideration. According to the framework, the next CSF during the implementation stage is communication. Consistent, timely, open and honest two-way communication makes teamwork more effective [38].

However, project management was the main CSF for all stages, and during the implementation stage it should be considered again separately, because the overall project management is quite different from any detailed plan with well-defined tasks, responsibilities and accurate estimation of required effort [75].

Lastly, the post-implementation stage comes. Here, the most critical is monitoring and evaluation of performance because milestones and targets need to be actively monitored to track the progress of ERP adoption. Performance monitoring, regular reports about project updates can help management monitor progress [38].

This is followed with software/system development, testing and troubleshooting. During monitoring, some issues might appear to be resolved, so a thorough and sophisticated testing, troubleshooting and quick response should be carried out. A further development of functionality to link with new core procedures should be established [57].

Finally, top management support comes as CSF. It has also been identified as critically important for all stages. However, further adoption also needs some control and support from the top management. There were cases when ERP implementation fails during last implementation and adoption phases [80].

5.5 Testing of the artefact

CSFs were identified as critical for successful implementation, and criteria as important for the proper selection of OS ERP which are ranked according to their importance for Kazakhstan SMEs. Moreover, this final result of ranked CSFs and selection criteria has been reviewed and confirmed by consultant from vendor and IT

manager from end-user environment who were involved in testing the artefact.

The consultant totally agreed with these rankings and supported them by stating: "*These are perfect rankings, and in selected specific cases just some factors or criteria could be differently ranked but top ones are completely in-line for most cases*". The IT manager also agreed and added: "*These are the most important factors and criteria, also their rankings are very suitable for Kazakhstan's SMEs. Specially, the selection criteria are very well ranked*".

The consultant and IT manager have also reviewed the framework. The consultant states thus: "*This framework's complete flow of OS ERP implementation process and all criteria and factors are in the right place*". He highlighted that dividing the framework into parts was a good decision: "*The author made a great decision to divide the implementation process into selection and implementation, because selection is the first phase of implementation. When customers need to implement the ERP system and they cóme to us, they do not know which ERP they want*".

Moreover, he agreed with dividing implementation into three parts and identifying some CSFs for all stages: "*The implementation part is very important and complicated. So in order to achieve success in implementation, each detail has to be considered in advance, and definitely each implementation stage needs to be planned separately by considering factors that are very critical at each stage. This framework illustrates some very good allocation of CSFs. I absolutely agree with the author that there have to be factors that are important overall and separate ones for each stage*".

He also gave some comments according to the criteria and CSFs: "*Choosing only the top factors and criteria for the framework was a good decision because for most Organisations these factors are more than enough, as there are parts, steps and stages which make this framework totally complete*".

Finally, he highlighted ranking and gave this suggestion: "*For separate cases, if more detailed selection and implementation are needed, they can use ranks. However, this framework is already detailed and complete*".

The IT manager also supported it and gave detailed comments, as well as

highlighting certain parts and stages. He fully agreed with this framework, and stated: "*This is a well managed and planned framework. Most Organisations could follow it. In our case, we just decided to implement 1C ERP and found a vendor to implement it, so we did not consider alternative ERP systems*".

He approves dividing into parts and stages: "*The framework is perfectly divided into parts as selection and implementation which are also divided into stages. During the implementation, we always had unpredicted problems at each stage, and we spend more time than planned.* "

Finally, he gave some recommendation: "*Factors and criteria that are presented in the framework may not be enough, because both selection and implementation are important and should be considered in detail. However, it is a general framework, with parts and stages making it complete*".

Generally, the consultant and IT manager both state that it is an absolutely complete, detailed and comprehensive framework, which means that this work is a totally suitable framework for implementing OS ERP in Kazakhstan's SMEs.

5.6 Conclusion

This chapter concludes this research and provides its artefact. The artefact is drawn up according to the literature review and survey findings. The artefact realises the general aim of this research, which is coming up with a framework for the successful implementation of OS ERP in Kazakhstan's SMEs. This chapter explains step by step this framework. Besides, two experts have tested it and both agreed and found that the framework is quite useful and clear. Therefore, this study has successfully completed its purpose by having provided a suitable framework for implementing the OS ERP system among Kazakhstan's SMEs.

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter summarizes this research work, and will clarify whether the research aim has been achieved and research questions answered. This research summary is presented and concluded with some recommendations. Subsequently, some limitations faced while conducting the study are also presented. Finally, suggestions for further research are put forward.

6.2 Conclusions relating to the research questions

In order to satisfy the research aim, the empirical literature on ERP was examined. ERP implementation is a big, complicated, and high-risk project. In order to avoid challenges, unpredicted problems and project failure need to be well planned, organized and properly managed. Organisations have to understand the critical issues that influence the whole implementation activities.

A successful implementation of the ERP-system can give a company huge benefits. However, it could be disastrous if the company has poor implementation management.

The main question of this study was: *How to successfully implement the Open Source ERP system in Kazakhstan's SMEs?*

Moreover, as the target is Kazakhstan's SMEs while the entire adoption process of ERP would not be the same for all industries that are realizing it, to have a successful implementation in Kazakhstan's SMEs, two more critical questions would need to be answered:

What are the OS ERP selection criteria according to Kazakhstan's SMEs?

What are CSFs for implementing OS ERP system in Kazakhstan's SMEs?

So, the general aim of this research is to provide a general framework for the successful implementation of OS ERP-system in Kazakhstan's SMEs. In order to achieve this aim, first of all, all the necessary literature would have to be studied and reviewed. From the literature review, all the essential information was found. The

ERP benefits and OS advantages are investigated as well as the ERP implementation model and frameworks. Ultimately, the OS ERP selection criteria and implementation CSFs were found.

After the literature review, a survey was conducted and all data were studied and analyzed. The selection criteria and implementation CSFs are used in the survey in order to identify the most influential ones and provide ranking according to importance level.

From the survey and literature findings, a general framework was then proposed, which consists of several steps and stages. The first part of the framework consists of OS ERP selection criteria, which are the top criteria taken from the criteria ranking according to survey findings. Then, the implementation stage followed with top CSFs, which were found from CSFs ranking and survey results. Further, the proposed framework was tested and evaluated by two experts, a consultant from a vendor company and an IT manager from the end-user environment. Both of them reviewed and agreed that the framework is very suitable for Kazakhstan's SMEs in order to successfully implement the OS ERP system.

6.3 Recommendations and suggestions

The OS ERP is quite a new term for Kazakhstan, so it needs more in-depth study. This research provides just the general framework for OS ERP implementation. However, this is still not enough, because the OS ERP could be used by large corporations and for them, it needs a more detailed and comprehensive guide or plan.

Moreover, this framework could be studied further, and more detailed sub-factors could be added. The factors themselves might be quite unclear or not enough to follow, but by conducting an in-depth survey and identifying more detailed sub-factors, it could make this framework more comprehensive and hence more widely applicable.

Additionally, experts suggested adding more selection criteria and factors, because implementation is complicated, and there has to be more criteria and factors

in order to avoid possible issues in the foreseeable future. However, this is only a general framework that is more focused on Kazakhstan's SMEs.

Finally, it could be suggested that a more detailed framework could be provided. However, for Kazakhstan, OS ERP is quite new, and for the further development of the OS ERP implementation framework, it will be better if OS ERP will be used more widely.

6.4 Limitations

While conducting this study, there were some limiting factors. The most significant limitation was that it focused solely on Kazakhstan's SMEs. OS ERP is quite innovative and new for Kazakhstan's SMEs, even the term OS is not widespread. So because of this limiting factor, it was not easy to collect primary and secondary information.

Another limitation is that the surveyed group had to be specialists that have been involved in ERP implementation in their SME, and it was quite a task to find these specialists.

6.5 Further research

This study is complete and comprehensive, with its main target being the provision of a framework for the successful implementation of OS ERP in Kazakhstan's SMEs. However, there are points that still need to be studied more. As have been identified from the literature review and survey findings, the poor level of awareness among Kazakhstan's Organisations about OS ERP points to the need for a more detailed research.

Until the day that OS ERP will be widely used by all kinds of Kazakhstani Organisations, this research could be taken as the basis and could be further developed to satisfy the need of the current situation.

6.6 Conclusion

Overall, this dissertation project may be considered as the initial point of departure for further research into this area. Hopefully, this research can be considered as the basis for a more comprehensive study in the foreseeable future.

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