CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

FACULTY OF ECONOMICS AND MANAGEMENT

DEPARTMENT OF INFORMATION ENGINEERING

FRAMEWORK FOR EVALUATION OF ENTERPRISE SOFTWARE IN SMALL AND MEDIUM ENTERPRISES

Author: **Azamatov Bakhytzhan**

Superviser: **doc. Ing. Prokop Toman, CSc.**

Department of Information Engineering

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Abstract

The research is concerned with problems arising in the process of management of enterprise software integration for better fitting to business needs through evaluation its performance and user's satisfaction. The study proposes the enterprise software evaluation method which was tested in three small and medium enterprises (SMEs). The method can be applied on the SMEs to substitute complicated, expensive and high human recourse demanded methods. The survey specifically designed for the current study was conducted at the initial stage of the research.

Declaration

I declare that the doctoral dissertation titled "**Framework for Evaluation of Enterprise Software in Small and Medium Enterprises**" has been completed by me, without any other outside help and I have used only the sources mentioned at the end of the thesis. It is submitted in partial fulfillment of the requirements for the PhD degree at Czech University of Life Sciences Prague, Faculty of Economics and Management. It has not been submitted before for any degree or examination in any other University.

Author: AZAMATOV
BAKHYTZHAN
KALYKOVICH

Signature: Azamatov Bakhytzhan

Date: September 22nd, 2017

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Azamatov Bakhytzhan

Content

Introduction

Nowadays, software products are mostly a commercial product consisting of a software package together with its documentation. There are quality standards to confirm the quality of the product. It is not necessary for software to meet these standards. Compliance with international or local standards definitely gives people confidence that this product is intended to be a product with a certain level of quality. Currently, in the field of information technology data standards presented by international organizations ISO and IEC are recognized as international standards.

Enterprises use many different kinds of software, but most of that software does not fit a definition of enterprise software. If an employee buys software used by another company as enterprise software but uses it for his personal needs then it is not be considered as enterprise software [1]. Enterprise software is considered as that which is used for organization needs rather than personal needs. The enterprise software also can be explained as the specialized integrated suite of software applications that can provide a common data model and processes at different levels and units of the organization.

In this research, a new software quality evaluation method, which was used by the three organizations in Kazakhstan, is proposed. The method is focused on the phase of the life cycle of the software product when it is delivered to enterprises. The user-based approach of the method enables enterprises to determine the capabilities of the software product based on their needs. A distinctive feature of this method from the known evaluation method of the ISO standards is the orientation on particular enterprise's experience and expectations.

The findings of this work can certainly be useful for SMEs that needs to evaluate their software for practical use as well as for other researchers in this area in order to understand the current situation with the evaluation of enterprise software in Kazakhstan.

Goals

The aim of the current work is to propose a quality evaluation method to improve the knowledge of enterprise software in small and medium enterprises (SME) and to clarify the productivity of their enterprise software through evaluation its performance and user's satisfaction. In addition, the state of Information and Communication Technology (ICT) in Kazakhstan would be analyzed. The motivation for choosing the object quality modeling systems is the current situation, where enterprise software evaluation is rarely used or does not match the requirements or capabilities of the SMEs. The quality of the selected area issues is addressed primarily from the perspective of SMEs needs.

Additional objectives focus on the following questions:

What are the existing models and standards for quality problems in the area of software evaluation?

What is the software evaluation by SMEs in Kazakhstan?

What is enterprise software support in SMEs of Kazakhstan?

Research approach

The reason for this study is mainly the lack of clear information of the quality model using in SMEs and the differences in requirements which the evaluators face because of the size of organizations. There is a need of the quality model to be processed in this case due to the fact that there exists a gap in literature with reference to the same and for this reason more research needs to be done in order to ensure that there is enough information on the quality model and how it could be utilized in SMEs.

Research techniques for the creation of this model have mainly used documents of study, observation and survey results. To study survey findings, the statistical analysis such as t-test and Analysis of Variance (ANOVA) test were utilized. To collect data the SQL database was used. Subsequently, this model is compared with existing quality models and then critically evaluated. Figure 1 below describes the research in the diagram.

Thesis structure

This thesis is divided into 11 chapters:

The first chapter is a general introduction to the topic of information systems and an evaluation of their quality.

The second chapter describes the objectives of the dissertation. In addition, it explains the motivation of the research.

The third chapter describes research approach of the dissertation.

The fourth chapter describes the thesis structure.

The fifth chapter is the Literature Review

The next chapter is Small and Medium-sized Enterprises Overview. The section presents an overview of:

The current state of ICT in Kazakhstan and its attempts towards an innovative economy. Besides that, it discusses e-government in Kazakhstan including its plans and stages. Also it briefly discusses about ERP market in Kazakhstan.

The seventh chapter is overview of software quality models.

The eighth chapter is an analysis of existing models related to process quality approach and analysis of process improvement frameworks.

Part ninth explains in depth the research methodology.

The tenth chapter is the more experimental part of the dissertation.

The last chapter is a conclusion and the final evaluation of results and further recommendations.

Literature Review

There are a number of approaches that could be employed with reference to SPI. Despite this, there is a difficulty in the course of trying to have an understanding of the various differences that exist as well as making an establishment of the models that are usually most suitable for a given organization, for example, the SMEs. However, the SPI model choice is usually found on various factors as was asserted by Spandoni et al. in their research. The various factors that affect the choice of SPI model include the following; resource availability, cost, business or marketing process need, internal knowledge, timeframe and business strategy. Any of the models used in the real sense usually would yield an organization some form of the framework through which there can be an establishment of-of the various objectives as well as goals that are required in order to achieve within a given time frame.

Important Software Process Improvement Models followed in Small and Medium software organizations

Many organizations around the world usually make an implementation of the part of some process improvement where it will initially assess its compatibility with the organization. This would happen before there is an implementation of SPI in a full-fledged manner. There are various models that are usually employed in the current times and the most common of them include the following;

Capability Maturity Model

This model was first employed in the United States of America with its objectives being the improvement of the software discipline in project cases that were both multi-layered as well as multi-contractor. The capability of the organization or the project usually forms the basis of this model with respect to five levels. Each of the given five levels contains a set of processes which are defined in them and they can be known as maturity levels. In this sense, they are usually vital for the purposes of prioritizing the steps that are involved in the Software Process Improvement. In addition to that, they are vital for the purposes of identification of the various improvements that can be implemented in addition to accruing benefits to the organization in a short period of time. Furthermore, the model in question is aiming at a constant improvement of the given process. The given organization

and the management in this sense ought to strive constantly for the purposes of improving their software processes and in this case refine them in a continuous manner.

ISO 2000-IT service management

This model makes its derivation to a large extent on the Information Technology (IT) Infrastructure Library (ITIL). In the given model, a provision of a framework is not given that provides a definition of a set of service management processes which are inter-related and in addition to that are important to the delivery of services that are of high quality. Furthermore, the model additionally aims to achieve simultaneously both the business as well as customer needs/requirements. With reference to this standard's consideration are the whole end-to-end activities involved within service delivery and support provision. It takes a view of the activities from the supplier, through the provider of the services and finally to the end customer. On the eight chapter brief overview of them was provided.

Capability Maturity Model Integration (CMMI)

CMMI as a model was at the later stages of the year 2000 was initiated. The model consequently was launched by the Software Engineering Institute (SEI). As opposed to the previous model, the current model makes its derivation of its basis on various models that are existent already. An example of the various models that already exist includes CMM. However, the model made an integration of some new changes in it as pointed out by Batten (2012). Consequently, the intention of this new model that is the CMM is for organizations to ensure there is an improvement in their efficiency, increase the returns on investment (ROI) as well as have higher levels of effectiveness.

SPICE

This is the Software Process Improvement Capability Determination (SPICE). The model is one that is an emerging standard in the world. It entails the analysis of the process, its improvement, and determination of its capability. Abrahamson (2007). The SPICE model is constituted of nine parts. Initially, this model was published simply as a Technical Report. Some of its parts have however since its establishment gained ISO standard status i. e. ISO/IEC 1504 1-4.

Six-Sigma

Siz Sigma is another model that was developed with reference to SPI. Fauzi (2011) proposed this model as a problem-solving method to the various models that had been previously developed. In this model, the final level is the philosophy where there is an advocation of the customer-driven approach to the various businesses. The postulation is the fact that the decisions of the business ought to be driven by data. In this sense, the needs of the customers ought to be interpreted to be the measurements of the organization. Despite this fact the there is a requirement that this approach should be effectively be implemented and this requirement is that a need for the formation of an understanding of the organization of the manner in which the model makes an integration with as well as an incorporation of other software process models of improvement.

Small and Medium-sized Enterprises Overview

SME definition

The SMEs have an important role in a country's economy all over the world as to their contribution to the total output and job opportunities [17].

The term "SME" encompasses a broad variety of definitions. Different countries and organizations give different definitions to SMEs, they often based on a number of employees, sales or assets. European Commission defines SMEs in the following way; The category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million.[18].

Determination of the status of the small and medium-sized businesses in Kazakhstan is based on the Entrepreneurial Codex of the Republic of Kazakhstan [19]. Kazakhstan defines medium-sized entities as enterprises with €2.4 million assets and 250 employees. Small entities are €0.4 million in assets and 50 employees and both criteria above should exceed the limit [19].

Importance of the Information and Communication Technology in the Small and medium enterprises

The role of small and medium enterprises (SMEs) in a national economy has been accentuated all over the world for their contribution to total productivity and to job opportunities[17].

The importance of SMEs is being increased according to countries economic growth. At the same time, the rapid growth of the information and communication technologies (ICT) determines the performance and competitiveness of the SMEs. It is believed that ICT became a necessity in the SMEs' contemporary management in order to survive in the modern business environment. According to Porter's theory, there is the particular potential of ICT to attain a competitive advantage[20].

The main goal of the implementation of the ICT in SME was optimization of the enterprise operational processes. Cardona, Kretschmer, and Strobel (2013) asserted that the high growth rate in the US economy during the 1990s, which saw productivity and employment rise, was due to the early and fast adoption of ICT[21]. However, some experts argue that due to the fact that the ICT is now being widely used by enterprises, it has lost its effectiveness as a strategic instrument of a company's differentiation and companies no longer are advantaged as they were at the onset of ICT. [22].

IT Management is important in the following respect in that it improves efficiency through ensuring service delivery is faster as well as succinct. In addition to that, it helps companies align business operations in an effective manner.

Cloud computing on its part is important in the sense that it is cost effective in nature and stores an unlimited amount of information, in addition, to backup and recovery.

On the other hand, mobile computing is important because it saves time for the users reducing the incurred expenses in addition to its location flexibility as the users are able to use it anywhere so long as there is a connection.

In a similar fashion, social networking leads to an increase in traffic in a given site consequently increasing the awareness for the site hence making more people be aware of the given site.

While external sources of software and maintenance present other possible and potentially economical alternatives for organizations, choosing the best alternative is an

easy decision process which must be understood and supported. As application acquisition and maintenance constitute a majority of the present-day IT budget of most organizations application sourcing and maintenance decisions have to be thoroughly studied. In some cases, software maintenance can reach 60% of organization's IT budget[36].

Maintenance

According to IEEE software maintenance is the process of modifying a software system or component after delivery to correct faults, improve the performance or other elements, or accustom to a changing environment[37]. Maintenance plays an important role in the life cycle of a software product[38]. There are four Types of maintenance: corrective, adaptive, perfective, and preventive[39]. Adaptive maintenance encompasses the changes needed as a result of some change in the environment in which the system must operate, for instance, altering a system to make it work on another hardware platform, operating system, DBMS, TP monitor, or network. Corrective maintenance is diagnosing and fixing errors. Preventive is increasing reliability to prevent problems in the future. Finally, perfective maintenance depends on users' requests; examples include inserting, deleting, extending, and modifying functions, improving performance, or improving ease of use[39]. Pigoski suggests enhancements as putting together the adaptive and perfective categories, as these Types of changes are improvements [40].

IT Outsourcing

Several empirical studies have identified the reasons for outsourcing. These include a closer focus on the core business, rapid introduction of new products, cost reduction, improved access to technical skill, and the lack of required resources or expertise to develop internally[41]. Outsourcing refers to the practice of transferring business activities of a firm to a third party vendor either within the country or outside the country so that the firm can concentrate on its core business. [42]. IS outsourcing can be defined as "the practice of turning over part or all of organizations IS functions to the external service provider(s)"[43].

Three types of outsourcing can exist. Partial – when only a few parts of the software system are contracted. Complete - when the whole software system under development is contracted. The last classification the outsourcing can be planned or ad hoc[44]. The planned outsourcing is a part of company strategic business plan. The ad-hoc outsourcing can help with solving unexpected software problems.

Overview of the current situation of ICT in Kazakhstan

ICT is growing to be an important aspect of economic development in many nations around the world. For this reason, many governments are putting in place measures to support the ICT sector to a great extent which would, in turn, benefit the nation in the long run. One of such a country is Kazakhstan whose government is on the front line providing the required support towards the ICT sector.

Perspectives of ICT sector development in Kazakhstan

After the global crisis, there was a sharp increase in the volume of direct investment in the information and communication sector. However, in 2012-2013, according to the data by "Taldau"[1a], there is a slight decrease in the share of investments in the information and communication sector in the total volume of investments. The reasons for this trend are the accentuated attention of the state of investment stimulation of the development of the industrial sectors (processing and extractive industries). In 2014, the venture fund "ICT Development Fund" was formed at the expense of private capital, as well as the capital of international companies. The Fund will invest in projects from 100 thousand to 3 million US dollars. With the fall in energy prices that began in 2014, the state has sought to find ways for new projects, including in the ICT field.

Indicators of the use of information and communication technologies in enterprises (in percent)

	2007 %	**2008 %**	**2009 %**	**2010 %**	**2011 %**	**2012 %**	**2013 %**	**2014 %**
Enterprises with computers	79,4	76,6	69,8	62,7	65,2	66,9	66,2	58,1
Enterprises with access to internet	61,7	55,5	54,2	52,9	55,4	58,4	60,7	52,4
Enterprises with web recourses	13,6	7,4	7,6	24,8	20,4	5,8	26,2	19,3
Enterprises with Intranet	9,2	5,4	16,5	17,3	21,0	21,3	25,8	15,0
Enterprises which has web-order service	17,3	14,1	13,0	13,0	4,7	4,5	6,7	7,1

Table 1 Usage of ICT in enterprises Source: KazSTAT 2015[2a].

As can be seen from the statistics of KazSTAT, the development of ICT in the enterprises of Kazakhstan leaves much to be desired. Many of the indicators went down over time. This is despite the fact that the number of enterprises has not undergone a major change.

On the way to the development of the ICT industry, along with the challenges of time, there are organizational, economic, and regulatory issues:

- Regulatory and legal inadequacy of the legislative framework;
- weak level of work on the adoption of standards;
- Unattractiveness for foreign direct investment;
- low profitability of the IT industry;
- lack of qualified personnel;
- The lack of a clear vertical management of the industry;
- lack of information infrastructure;
- The presence of administrative barriers;
- weak specialization of IT companies, including in subject areas;

- low level of statistics of the industry;

Low domestic demand for information technology from citizens and businesses is a factor restraining the development of domestic companies. The low penetration of broadband Internet access among the population, the scarcity of Kazakhstan's web resources and the lack of original content in the Kazakh segment of the Internet reduces the investment activity of the business regarding the development of e-business and e-commerce.

But the gradual development of communication technologies makes their own adjustments: cable and satellite broadcasting is expanding, increasing confidence in electronic mass media as an important source of information about events in the world.

The transition of Kazakhstan to the information society depends on the consolidation of the efforts of business and the state on the wide application of ICT and provision of electronic services.

Enterprise resource planning in Kazakhstan

Much attention is paid to software developers, although it should be recognized that in the segment of enterprise management systems, international solutions prevail. Foreign developers offer their customers industry expertise, international partners' experience, and implementation methodology. However, taking into account local peculiarities of legislation, accounting, taxation, etc. Kazakhstan companies that have chosen products of foreign vendors often require a serious adaptation of their solutions, which leads to an increase in the timing of the implementation of projects and the increased cost of supporting a ready solution.

On the global market over the past four years of Panorama’s independent ERP research shows the average cost of ERP implementations has been $4.5 million and the average duration has been 17.3 months. In this period, approximately 54-percent of projects have exceeded their planned budgets, 57-percent of projects have exceeded their planned durations and a full 46-percent of respondent organizations have received less than 50-percent of the measurable benefits they anticipated from their ERP software initiatives.

YEAR	COST	% COST OVER RUNS	DURATION	% DURATION OVERRUNS	% RECEIVING 50% OR LESS BENEFITS
2015	$3.8M	57%	21.1 Months	57%	46%
2014	$4.5M	55%	14.3 Months	75%	41%
2013	$2.8M	54%	16.3 Months	72%	66%
2012	$7.1M	53%	17.8 Months	61%	60%

Figure 1 Source: Panorama consulting 2016[3a].

If to speak about any statistical data, the world and some regional markets are tracked well, however, with Kazakhstan the matter is more complicated. IDC provided data according to which the volume of the local software market for Enterprise Resource Planning (ERP) was $ 60 million in 2013. In general, one can observe the positive dynamics of the market development, especially after the crisis year 2009: over the last 5 years, the market volume of ERP-systems has grown almost 5 times.

Over the past few years there has been a steady growth in this area and, according to experts, the market capacity has not yet reached its maximum. In addition, new technologies can drastically change the principles of the functioning of ERM-systems and in general become the main engine of the market. Experts say that we live in the era of the "third platform" of information technology, and in the near future, the market will focus on mobile solutions, social networks, large data analysis and cloud services. Recent trends have not bypassed the "heavy" products, including CRM and ERP-systems, which, according to analysts, will eventually go completely into the "clouds".

About what shares hold vendors there is no official statistics. According to IDC SAP is the leader in the market share of more than 70%. As distributed the remaining 30% cannot be learned. By the year of 2016, 13 of the 20 largest companies in Kazakhstan used SAP solutions. And the number is increasing. Assuming that SAP occupies a share of 70%, then all other vendors account for only 30%, which means that hardly any of them can claim more than 6-8% of the market.

It should be noted that the ERP market is traditionally calculated in monetary terms. However, the cost of solutions for vendors is significantly different: the price of SAP is

several times higher than the cost of the same "1C-Enterprise" that is distributed in Kazakhstan, so in quantitative terms, the outlook is completely different. "1C-Enterprise" can cost for one user place around 70USD when SAP can be over 2000USD.

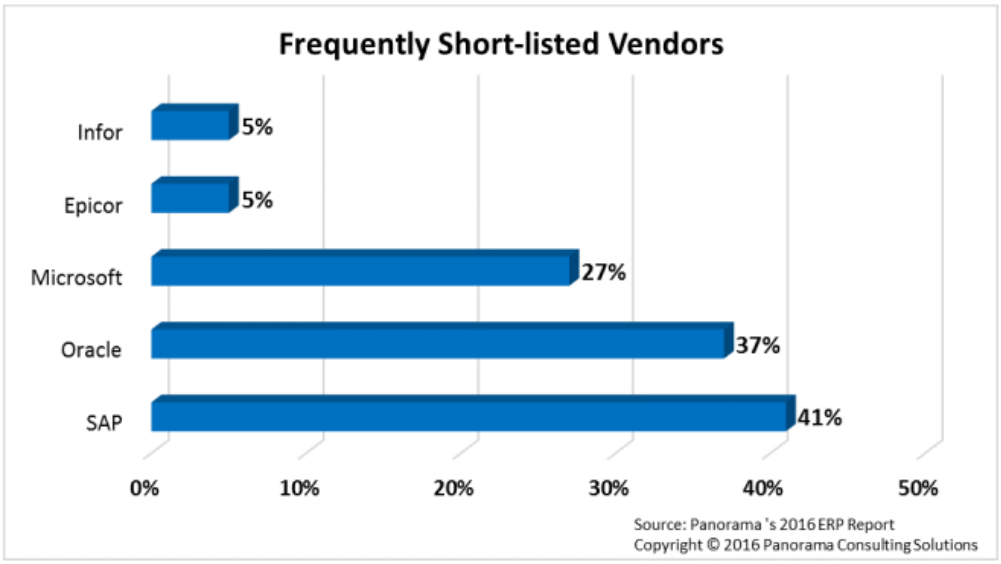

Figure 2 List of global Vendors

In the global market for research, Panorama consulting[3a] business is as follows:

In the figure above we can see the proportions of ERP vendors in the global market. There are three main players in the market and four of them represented in Kazakhstan.

SAP

As already mentioned, the German company is the world market leader, among the 165 clients in 25 sectors are the leaders of the Kazakhstan economy. SAP holds market shares in strategic sectors such as the public sector, oil and gas industry, banks, transport and energy, metallurgy, extractive industries.

2013 for the SAP Kazakhstan office was notable for the translation into Kazakh SAP ERP[4a] the work took about 2 years, on localization spent about 25 million Euros. Also in 2013, there was an increase in demand for SAP solutions in the medium-sized business sector, in such industries as industrial and civil construction, retail and distribution, logistics and production of consumer goods. Nevertheless, in the annual report

published on the official website of SAP AG, you can see that in Kazakhstan the company has shown losses during the last two years. Representation managers explain this by investing in product localization (although the main investments were made in 2012), in the development of the market, in the training of partners. Losses are also associated with the specifics of accounting methods within the company itself.

It is known that SAP implements solutions in the largest companies of Kazakhstan, including at the enterprises of Samruk Kazyna JSC, and in the near future the vendor expects new large projects, as the programs of business transformation developed within the holding, which is currently being developed in the Samruk group of companies. According to the speeches of government officials, seriously considering the possibility of implementing SAP in all "subsidiaries" of the state holding.

Oracle

The American corporation offers more than 50 product and industry categories, where according to external analysts' estimates it is the leader. However, the key product of Oracle is still considered Oracle Database, as well as the assets of the acquired company Sun Microsystems. The corporation in Kazakhstan has about 100 partners. Last year, Oracle opened a representative office in Astana for closer cooperation with state bodies, as the Committee of the Treasury of the Ministry of Finance of the Republic of Kazakhstan is among the largest clients of Oracle E-Business Suite, in addition, serious projects are being implemented in the extractive industry and in education.

Microsoft, Epicor, Galaxy, 1C

Even in the context of Microsoft products and services, MS Dynamics is not a fundamental direction. Nevertheless, Dynamics shows positive growth dynamics in recent years. In Kazakhstan, Microsoft has a very diverse portfolio of projects in the financial sector, in retail, in the extractive industry. And one of the projects on the introduction of Dynamics AX has won the title of the Best IT Project of the Year.

The main income of Epicor, 84%, is in North and South America. The EMEA region brings 11%, from which it can be assumed that Kazakhstan occupies a very, very

modest position. And yet, the company is represented on the Kazakhstan market, and the key to it is customers from the production and distribution sectors.

Russian "1C" for the first time in 2013 held a conference in Kazakhstan, dedicated to the company's solutions and practice of their application. "1C" has been working in the ERP field since 2004, and 4 distributors and about 400 franchise partners work in Kazakhstan.

As for the "Galaxy", this Russian company works in the market of Kazakhstan for 17 years, its clients include quite large companies from the oil and gas and extractive industries.

Vendors vs. partners

SAP has 26 partners in Kazakhstan with more than 500 consultants, and in the next two years, the company plans to increase their number.

Oracle in Kazakhstan has 25 partner companies with the status of Oracle Platinum, with 5 or more specializations for Oracle products.

Unlike competitors, Epicor does not seek to create a large channel of resellers competing among themselves. Epicor offers a real partnership, often with a certain specialization, perhaps subject-oriented or vertically oriented or to cover certain geographic areas.

Microsoft provides software and a share in the license fee, depending on the sales volume. In Europe, for small and medium-sized businesses, there are no competitors to MD NAV, and therefore such a strategy justifies itself. In the CIS countries, the standard of accounting is "1C Accounting". In these circumstances, selling MD NAV is extremely difficult.

Implementation problems

Problems in the implementation of the systems at the enterprise in Kazakhstan are the same as in the whole world: these are the specifics of business processes, the resistance of the company's employees, insufficient training of personnel, wrong design approach, insufficient qualification of consultants, hidden costs, etc. Here and there are reports of another project, the implementation of which exceeded all the deadlines or even the failure

of working with the system. More often than not, the SAP market leader is criticized for the cost, timing, and effectiveness.

Small and medium-sized enterprises (SMEs) often do not want to apply new forms of information technology (ERP), due to lack of financial resources, or knowledge of the use. "1C-Enterprise", which is associated with "1C-Accounting", in Kazakhstan is used in approximately 92% of cases (according to 1C representatives by the 2014 year) in SMEs. He almost completely conquered the "lower" floors of the business where SMEs are located. In the survey conducted by me in the experimental part, one can be convinced of this.

Perspectives of the enterprise resource planning systems market in Kazakhstan

It is clear that each of the ERP vendors is already entrenched in its particular niche. But the recent actions of large foreign ERP systems indicate that they are ready to win back the already monopolized SME market. One of the main problems of this remains that their products are still more expensive even with the proposed boxed versions. Another factor is the development of the 1C market in Kazakhstan. Often in Kazakhstan, SMEs recruit IT professionals and accountants based on knowledge of 1C products. These signs are very important, respectively, in the near future, a coordinative change in this market segment is not expected.

ICT and government’s policy towards innovation

Kazakhstan is one of the fast-growing economies in the post-Soviet region. The private and state enterprises are growing and developing at a high pace. Therefore the government of Kazakhstan has been stressing the importance of taking action toward facilitation of business development as well as increasing business competitiveness and moving from the “raw material economy” to a knowledge-based economy. Hence, on 9th of January 2012, the President of the Republic of Kazakhstan signed a law about the state support of industrial innovation. In accordance with the state policy the Samruk-Kazyna Fund which owns the national development institutions, national companies, and other entities, promotes the policy of implementing the so-called Management reporting system

in the main state organizations. Samruk-Kazyna is also known as National Welfare Fund and can be described as a joint stock company as well as sovereign wealth fund that is based in Kazakhstan. It is the owner of various companies in the nation that are core to its economy and the state is the sole shareholder of the given fund that came into being in the year 2008 after a merger of two funds known as Samruk and Kazyna.

According to the official information available on the website of the Fund, its main role is to:

1) Assist in the modernization and diversification of the national economy

2) Support economic stabilization

3) Facilitate the companies' efficiency growth.

In the framework of the facilitation of the companies' efficiency growth, the Fund supports ICT development in Kazakhstan. Implementation of the ERP and CRM systems is among the most important initiatives of the Fund.

The report of the National Agency for Technological Development includes the Figure 22 which shows the share of innovatively active enterprises increased from 2.1% in 2003 to 7.6% in 2012, since the adoption of the Policy of Industrial and Innovative Development in Kazakhstan. In comparison, the average figures for these indicators in developed countries are 40-50%[23].

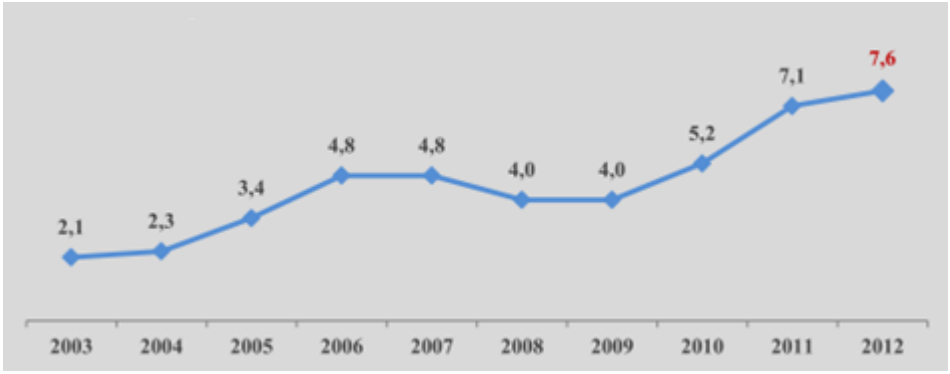

Figure 3 Proportion of active enterprises [24].

In Figure 23 (2012) it can be seen the significant gap between Kazakhstan and developed countries in the area of the innovative activeness of enterprises.

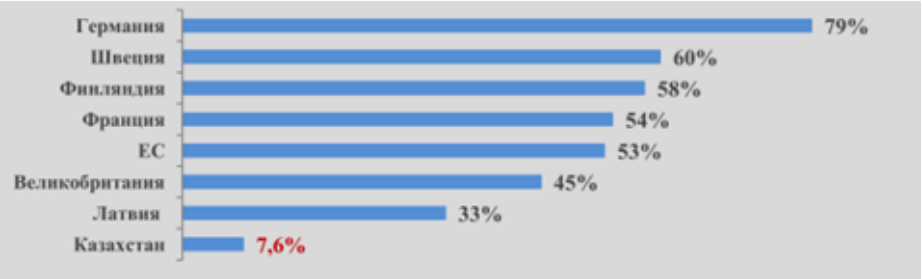

Figure 4 Activeness of enterprises in innovation[25].

The Concept of innovative development of Kazakhstan 2020

The purpose of the Concept is aimed to facilitate the entry of Kazakhstan into the 30 most competitive countries in the world through the development of new technologies and services that will ensure the transition from “raw materials” to an “innovative” economy.

Achieving this objective will be through tasks such as:

facilitation of an innovations generation in Kazakhstan;

further development of the leading innovation clusters;

a specific scenario for Prospective Technological directions;

providing enhanced regional innovation systems;

using the raw potential of the country to attract new technologies and the creation of high-tech industries[23].

According to this concept in 2003 JSC "National Agency for Technological Development" was established as a specialized institute for the development of innovation, and now it is the core operator in support of the innovation in the country.

Instruments of the state support of innovation activity include project and venture financing, innovation grants, technology business incubation centers, commercialization

offices, industrial design centers, service centers of international technology transfer and innovation competitions [23].

The history of e-government is developed in parallel with the development of information technology. The definition of the “Electronic Government” is the use of information technology, particularly the Internet, as the most affordable means of electronic communication between public authorities, citizens and private business.

According to the UN study [26], the E-government index(Figure 24) is increasing in all parts of the world.

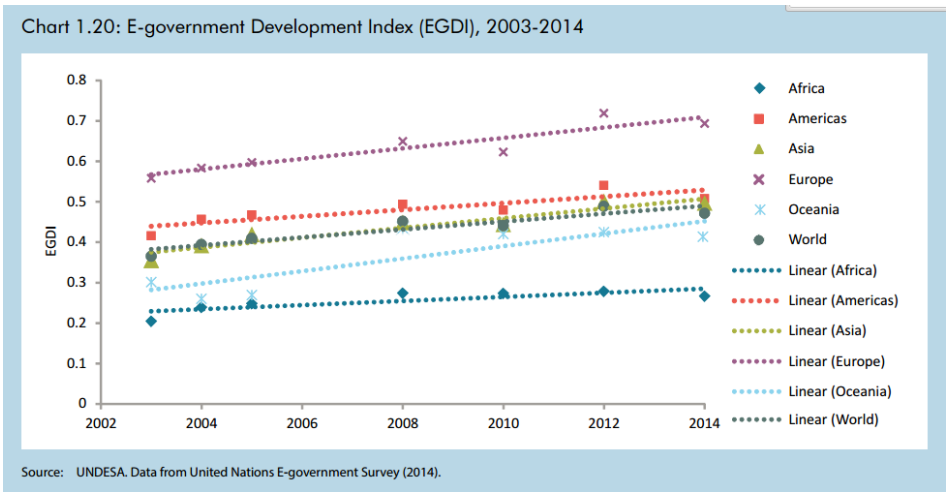

Figure 5 UN study of E-government index[26].

When in 2005 Kazakhstan has adopted the "State program for creation and development of the National Information Infrastructure of the Republic of Kazakhstan" for ICT development. Table 4 shows the achievements from that time.

UN World ranking (193 countries)	2014	2013	2012	2010	2008	2005
E-Government development index	28	-	38	46	81	65
Human Capital Index		-	25	16	22	22
Online Services Index	23	-	14	95	24	24
The index of telecommunications infrastructure		-	77	96	91	91
E-participation index	23	-	2	18	31	31
Ranking of the World Economic Forum (WEF)	2014	2013	2012	2011	2010	2005
Network Readiness Index	38	43	55	67	68	-
The sub-index of readiness		62	52	56	74	-
The sub-index of use		54	65	56		

Table 2 Achievements of the E-government of Kazakhstan from 2005 to 2014[27].

The purpose of introduction of the E-government is a desire to save socially useful time that people may lose when they visit public institutions. The second reason is saving public resources: the amount of long-term recruitment of civil servants can be reduced to the level of "front office."

Development stages of e-government

The first stage is informational. At this stage, the e-government portal was launched and filled with information. The information was about the state agencies, their work and the services they provide to the public. Additionally, the provision of services and regulations were posted online.

At this stage, everyone could get the access to all the necessary information: a list of the required documents, fees and contact details. Even at this stage, the number of in-person visits decreased, due to the online information available to the public.

The second stage was interactive. At this stage was launched the electronic services portal. The portal users now had an opportunity to receive online help from

various agencies without going in person and wasting time in queues. They could send a request to any state agency, without leaving the house and monitor its status. The introduction of interactive services allowed for saving time with document collection. At this stage departmental information system, government databases, licensing and an e-government gateway was introduced.

The third stage of e-government development is transactional. At this stage, citizens were able to pay state taxes, fees, fines and community services. In order to pay for services prior to this, it was necessary to go to the bank, whereas now the service can be received and paid online.

For entrepreneurs, this transactional stage was a truly valuable gift – allowing electronic public procurement. The benefits are obvious and clear - increased transparency and openness of competition and tenders.

The fourth stage of e-government development is transformational. This is today's stage of development of e-government in Kazakhstan.

The main objective now is maximizing the efficiency of service delivery to citizens. Therefore, the interactive and transactional services have been combined into complex services which are often required by the population.

Now, users can register the legal entity in 15 minutes, the same as registering the birth of a child and at the same time solving all other related issues such as making an application to receive the maternity payment and putting the child on the waiting list to kindergarten. Due to their great importance, most of the socially important services are all converted into the electronic format on the e-government portal. For the provision of public services to disabled people, category 1 and 2 were organized for the special mobile group in service centers.

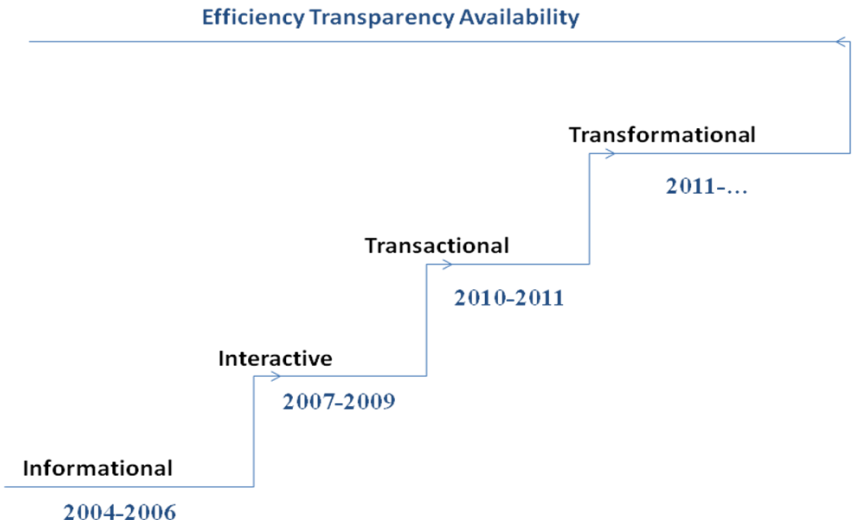

Figure 6 E-government development stages [28].

The access points to government services in Kazakhstan There are various ways to obtain the e-service (Figure 26): Mobile Phone, Public Service Center, Public Access Points, E-Government Portal and Call-Center.

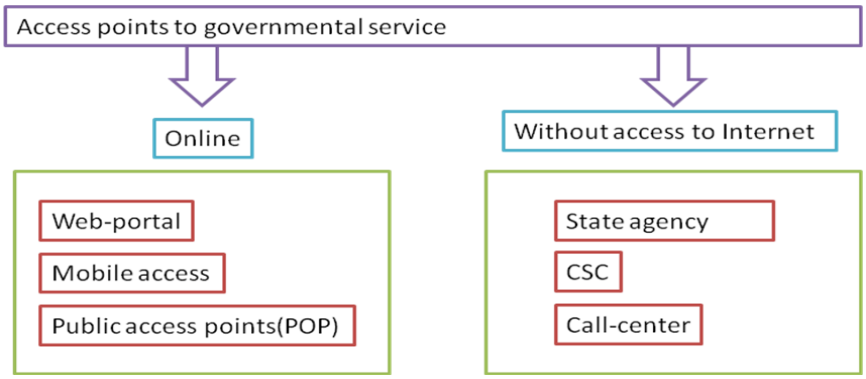

Figure 7 The access points to government services [28].

Mobile government is an additional channel for public services, which makes it possible to receive services on Smartphones, tablets as well as traditional phones.

The E-Government Portal www.egov.kz is developed by the national operator JSC "National Information Technologies" (NIT), a subsidiary of JSC "National ICT Holding "Zerde". The holding was formed in September 2008, due to the decision of the Government of the Republic of Kazakhstan, which is its sole shareholder.

Public service centers set up in 2007 to assist public government services on the principle of one window to eliminate bureaucracy and remove administrative barriers. There are consultants who help customers who lack knowledge, in all public centers[29].

The public access point is a device that looks like an ATM or cash machine (payment acceptance device) with 25/7 unlimited Internet connection. Those who need to get service from the public access point must have a digital signature on a USB. The public access points were introduced in 2006[30].

Unified Contact Center (UCC) the portal of "electronic-government" started its work on 1 January 2010. The main goal of the center is to assist the population on how to obtain public services, work with complaints and advise on implementation of the public services quality[31].

In 2010-75793 appeals received. In 2011-297636 appeals received. In 2012-1 171668 appeals received. In 2013 - 2 657 094 appeals received.

Identification of the client in the system

The electronic signature is the digital signature that can be issued to the internal passport of each citizen of Kazakhstan, and record its identification number on an ID-card of the new type. Information is recorded on the microchip through a standard and inexpensive card reader via the portal www.egov.kz.

According to the chairman of the Committee for Communication and Information of the Ministry of Investment and Development Saken Sarsenov, 70 billion Tenge of public money has been saved since the launch of e-government in 2006 up to 2015[32]. In the first part of 2014 almost 17 mln services were provided (Table 5).

Years	**2010**	**2011**	**2012**	**2013**	**2014**
The number of services provided	1,6 mln	8,3 mln	10,7 mln	27,3 mln	17 mln (6 months)
Payments		19,5mln	141 mln	1,1 billions	3 billions

Table 3 Economized money from 2010 to 2014[33].

Financial support of the "Electronic-Government" project

Total costs provided from the national budget for the implementation of the program for the development of information and communication technologies in the Republic of Kazakhstan for 2010 - 2014 years (Table 6), which was approved by the Government of the Republic of Kazakhstan on September 29, 2010 (exchange rate as per 28.09.2015 1 US dollar = 334 tenge).

2010	2011	2012	2013	2014
17.495 billions Tenge	23 269 billions Tenge	20 893 billions Tenge	5182000 billions Tenge	4491000 billions Tenge

Table 4 Financial support of e-gov [33].

E-government is the only tool in the facilitation of public services for small and medium-sized enterprises. The government is positioned as a service provider.

Since 2012, all existing licenses in Kazakhstan have been converted into an electronic format. The new licenses issued in any state agency are also in electronic form.

Despite the development of E-government in Kazakhstan, there is still a problem with the use of these public resources. One of the main issues is lack of internet access in remote regions. According to the state statistical information system "Taldau" (2014), at least 2 million people have an internet connection and most of them are based in Almaty and Astana. At the same time statistics show that the interest of population to use the e-government services is growing.

Usage of government services by SMEs in Kazakhstan

The number of users of government services arises year by year (figure below). The users can be an as well legal entity or just persons. Unfortunately, there is no specific statistical data from the office about the usage of ego by enterprises.

Years	2011	2012	2013	2014
Registered users	200 000	800 000	1,6 mln	3 mln

Table 5 The number of users[34].

Since services provided can be used by everyone we can assume that table above gives proportional information the enterprises.

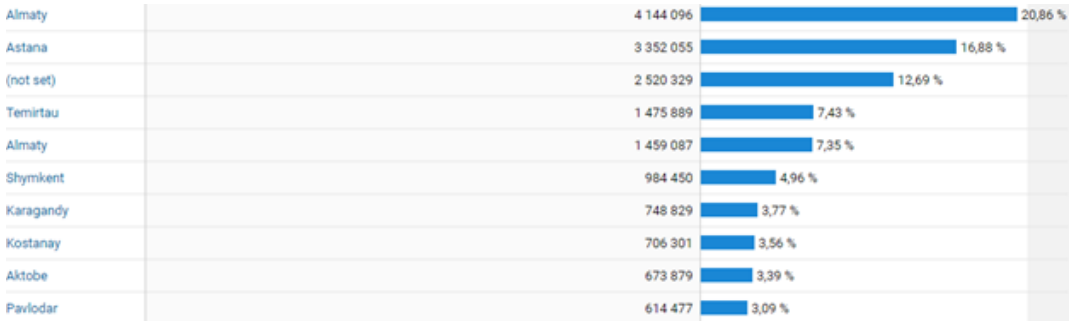

Figure 8 Statistics of usage by regions[35].

The table above gives information about the visitors of the service from the regions. It is obvious that two main regions overwhelming others.

1	Issuance of address certificates from the place of residence	**16238572**
2	Issuance of a certificate of pension contributions	**2772323**
3	Issue of a certificate of registered rights (encumbrances) on real estate and its technical characteristics	**2638413**
4	Issuance of certificate of absence (availability) of immovable property	**2460915**
5	Issuance of a certificate of the presence (absence) of a criminal record	**1511925**
6	Issuance of certificate of registered legal entity, branch or representative office	**394273**
7	Staging children in the kindergarten	**235912**
8	Obtaining a certificate of state registration of a legal entity,	**195598**

	accounting registration of a branch (representative office)	
9	Issuance of a certificate of absence (availability) of immovable property of an individual	**178478**
10	State registration of rights to real estate	**149950**

Table 6 Top ten popular services among users[35].

In the top ten list of provided services the services aimed at enterprise needs takes six's and eight's places(table above), although the others somehow can be related to them.

Software quality models

Quality definition

ISO 9000 defines quality in manufacturing approach as conformance to requirements. ISO 8402 in product orientation defines quality as the presence of specified features. Goal orientation of quality in use in ISO 14598-1 explains quality as meeting to user's needs. From that, we can understand that to have the quality the "product" must meet some requirements. However, requirements can be on a product, system, component, process or service.

Five Definitions of Quality by Garvin[2]:

Transcendent Definition (philosophical): quality unanalyzable property that we learn to recognize only through experience.

Product-based Definition (economics): quality as a precise and measurable variable.

User-based Definition: high-quality products are those that best meet the needs of consumers.

Manufacturing-based Definition: conformance to requirements, excellence is equated with meeting specifications.

Value-based Definition: quality product is one that provides performance at an acceptable price or conformance at an acceptable cost.

To develop high-quality software we must first clarify precise specification of quality[3]. Even if specifications are right and complete, it will become invalid over time due to

technological or other changes. So, quality control of software is compulsory to keep high quality.

Process and Product quality

In my work, I consider software as a product and measure its quality in the specific area of business. But In the 1990s there was a huge rising of another point of view of quality which is called process quality. Since then researchers mostly concentrated on investigating process quality. This is because the process quality is the core of manufacturing. The idea of process quality is that if the level of quality of your processes is high then you will have high-quality products. ISO 9000 can be the example of a process view of quality. The ISO 9000 have a proposal that of establishing a quality management system in an organization will bring high-quality products. The standard itself does not concern with the quality of the products, but with the quality requirements within the company which produces the products. In some sense having been certified by ISO 9000 is still gives benefits to the company as it has that the company have clear quality assurance policies. However, the company pays for it with additional bureaucracy procedures. There were two different initiatives across the ocean: CMMI standard in America and SPICE in Europe. Later on, SPICE has become ISO standard (ISO 15504). These standards offer to prescriptive and normative approaches to improve their processes[5a]. The idea is that we can have ideal processes for the company and the company needs to achieve them.

The problems of these standards can be the rising of paperwork. Also I can say that evaluation of process quality is in fact independent from the product evaluated. In other words we assess how it is done but not what is done. In our case process quality evaluation is not suitable, because we evaluate the product which we cannot change. Often, businesses have opportunity to use the product for trial time. In that sense having product quality evaluation approach is adequate way to check the fitness to specific needs of company. Process quality is important, but mostly it needs to be used in manufacturing, or in our case in development organizations.

Quality models

In order to make software quality measurable McCall's model was proposed in 1977. The organizations which initiated it were General Electric, US Air force Electronic System Division (ESD), and the Rome Air Development Centre (RADC). Since the McCall's model was proposed the new models which were similar, but with redefined characteristics started their own development. The next successful model was Boehm's model. It was presented one year later after McCall's model.
There are many approaches to evaluate software quality. The most known methods/models are:

- McCall's model
- Boehm's model
- Dromey's model
- FURPS
- ISO 25000 and ISO 9126

McCall's Model

Jim McCall presented his model in 1977. His quality model may pretend to be predecessor of many current day models. It was also named as General Electrics Model. In his model he attempts to find a bridge between developer's priorities and users' views by focusing on quality factors which could be important to both sides[1].

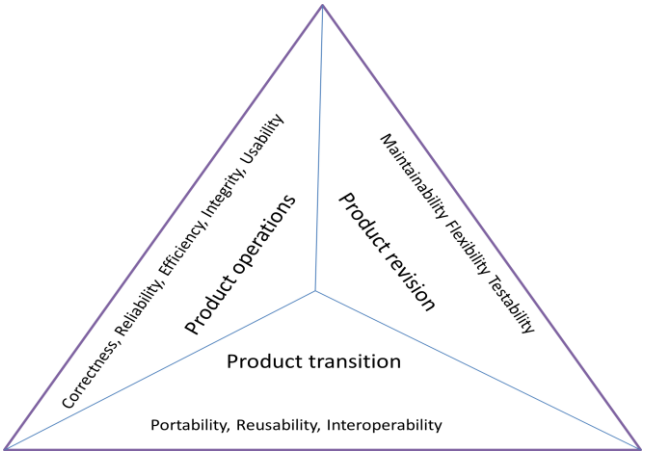

Figure 9 McCall quality model.

The McCall quality model has, as shown in figure above, three major perspectives for defining and identifying the quality of a software product: product revision, product transition and product operations. McCall's model has hierarchical structure:

Major perspectives

- Factors
- Criteria
- Metrics

These major perspectives have 11 factors to specify (figure above). The factors describe the external view of the software, as viewed by the users. There are also 23 criteria they are internal view from of developer's side. Criteria can have interrelated relationship with factors. For example: Completeness and Traceability belong to Correctness when Consistency can belong to Reliability and Correctness. Metrics defined and used to provide a scale and method for measurement.

McCall's quality model, based on the judgment of the person's answering Yes or No questions.

The actual quality metric is achieved by answering yes and no questions that then are put in relation to each other. That is, if answering equally amount of "yes" and "no" on the questions measuring a quality criteria you will achieve 50% on that quality criteria. The metrics can then be synthesized per quality criteria, per quality factor, or if relevant per product or service.

Boehm's Model

He presented his model in 1978 one year after McCall. Boehm's model is similar to the McCall Quality Model in that it also presents a hierarchical quality model. It is also structured similar.

There are characteristics of three levels:

- highest level,
- intermediate level,
- primitive.

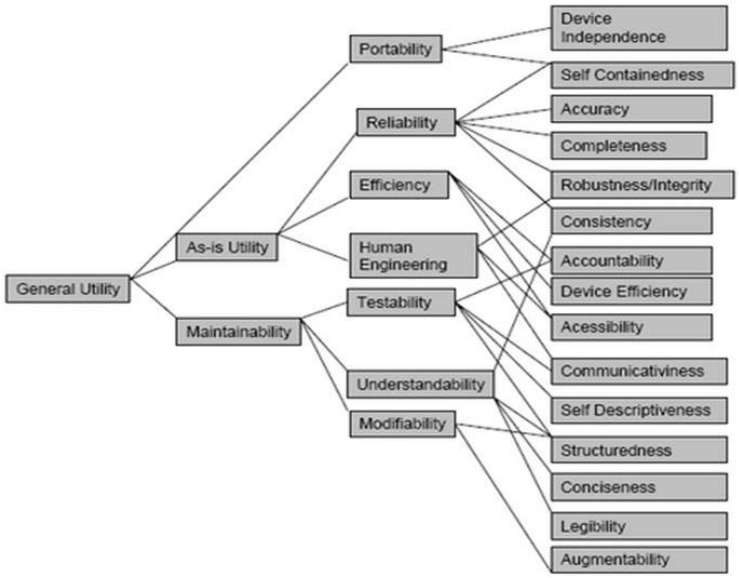

Figure 10 Boehm's Model[6a].

The difference is that McCall's model primarily focuses on the precise measurement of the high-level characteristics "As-is utility" , whereas Boehm's quality mode model is based on a wider range of characteristics with an extended and detailed focus on primarily maintainability. Boehm focuses a lot on the models effort on software maintenance cost effectiveness – which, he states, is the primary payoff of an increased capability with software quality considerations.

Dromey Quality Model

Dromey states the idea that quality evaluation differs for each product and modeling the process is needed to be wide enough to apply for different systems. His model recognized as product based quality model.

Dromey's main elements:

1. Product properties that influence quality.
2. High level quality attributes.
3. Means of linking the product properties with the quality attributes.

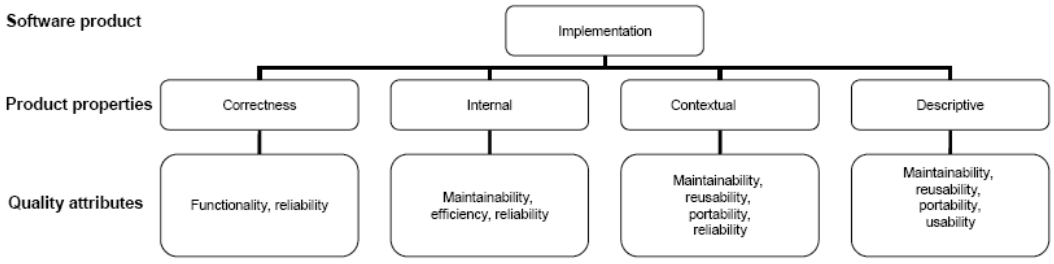

Figure 11 Dromney's model.

It is structured around a 5 step process:

- Chose a set of high-level quality attributes necessary for the evaluation.
- List components/modules in your system.
- Identify quality-carrying properties for the components/modules (qualities of the component that have the most impact on the product properties from the list above).
- Determine how each property effects the quality attributes.
- Evaluate the model and identify weaknesses.

FURPS Quality Model

FURPS model is presented by Robert Grady in 1992. Afterwards it was extended by Rational Software (IBM Rational Software) into FURPS+.

FURPS has five characteristics:

- Functionality – feature sets, capabilities and security;

- Usability – human factors, aesthetics, consistency in the user interface, online and context sensitive help, wizards and agents, user documentation, and training materials;
- Reliability – frequency and severity of failure, recoverability, predictability, accuracy, and mean time between failure;
- Performance – conditions on functional requirements such as speed, efficiency, availability, accuracy, throughput, response time, recovery time, and resource usage;
- Supportability – testability, extensibility, adaptability, maintainability, compatibility, configurability, serviceability, installability, localizability (internationalization).

The FURPS-categories are of two different types:

- Functional (F)
- Non-functional (URPS)

The categories can be used as both product requirements as well as in the assessment of product quality.

ISO 25000 (SquaRE)

The SQuaRE quality model is the most useful one since it has been build based on an international consensus and agreement from all the country members of the ISO organization.

This standard was based on the McCall and Boehm models. Besides being structured in basically the same manner as these models (see Figure 10), ISO 9126 also includes functionality as a parameter, as well as identifying both internal and external quality characteristics of software products. SQuaRE and ISO 9126 will be described more closely in the next chapter.

	Mac Call 1977	BOEHM (1978)	ISO 9126 (1991)	FURPS+ (1992)	Dromey (1992)	SQuaRE (2011)
Maintainability	x		x		x	x
Flexibility	x					
Testability	x	x				
Correctness	x					
Efficiency	x	x	x		x	x
Reliability	x	x	x	x	x	x
Integrity	x					
Usability	x		x	x	x	x
Portability	x	x	x		x	x
Reusability	x				x	
Interoperability	x					
Human Engineering		x				
Understandability		x				
Modifiability		x				
Functionality			x	x	x	x[1]
Performance				x		x[1]
Supportability				x		
Design Requirements				x		
Implementation Requirements				x		
Interface Requirements				x		
Physical Requirements				x		
Verifiability						
Expandability						
Survivability						
Safety						
Manageability						
Dependability						
Security						✦
28	11	7	6	9	7	8

Table 7 Comparison of quality models[7a].

The table above shows the comparison of characteristics of described models. Comparing with the table above from Boukouchi Y. Security and compatibility were added as major characteristics in ISO 25000 in 2011.

Analysis of quality models

In this part we will shortly mention their main differences and some shortcomings ща quality models based on their types. However, there can be more than the types I defined here. The main types were defined as:

- Hierarchical Quality Model
- Meta-Model-Based Quality Model
- Prediction QualityModel
- Assessment Model

There are also can be Multi-purpose models, but we will not give attention to it in this section.

Hierarchical Quality Model

The first proposed hierarchical model was McCall's model. Then Boehm proposed his own model. The models are quite similar, they decompose the quality into quality factors. The main advantage of these models is that evaluator can decompose the quality to the levels where it can be measured. Later on, these models were taken as a basis for the international standard ISO/IEC 9126. The successor of the ISO/IEC 9126 is the new standard ISO/IEC 25010 still keeps this decomposition rules. The close overview of these standards will be in following chapter.

FURPS is also hierarchal model. It has main five quality factors where four of them aimed at users. Only the 'supportability' aims on developers and maintainers. This is quite convenient comparing with ISO/IEC 25010 where some characteristics have mixed stakeholders.

Problems of these models can be the ambiguousness of their characteristics. The newest standard brought a new measurement reference model, but still there is insufficiency of detailed measures. Being flexible also brings uncertainty to it as a standard in some strict rules needed projects.

Meta-Model-Based Quality Model

COQUAMO was developed by ESPIRIT to make clear connection between measurement and quality factors. They also see the quality factors as a core of their model. The model argues that factors should have differently evaluated depending on development stages. Furthermore, they appeals to have different metrics in that stages.

The concept of Dromney's model described above. The model is elaboration between product properties and external quality attributes.

Kitchenham build his SQUID relying on COQUAMO. The SQUID suggests to monitor internal measures which has impact to external quality.

For these models the lack of base quality models can be defines as a disadvantage.

Prediction QualityModel

The example of these models is "reliability growth models" where the main idea is to monitor the failure behavior of the software. This gives the ability to predict future changes of behavior of the software. These models also can be defined as statistical models if they use statistical methods of prediction.

The shortcomings of these models are the difficulties in interpreting the results. The models mostly use regression or data mining methods to obtain the data for analysis.

Assessment Model

The EMISQ model is quite similar to ISO/IEC 9126. It also defines quality characteristics and has one level of subcharacteristics. These subcharacteristics can be mapped to metrics. However, it can use not just a well-known metrics, but also the ones which detect coding anomalies. The advantage of EMISQ model is that its reference model has defined 1500 mapped metrics. However, the problem of these assessment models is unclearness of decomposition of quality factors. We can have a lot of defined measures, but at the same time have problem with lack of structure of quality model. The usage of some measures in some sense can be problematic due to motivation of its usage in the specific case.

Standardization of software quality and its measurement

Standardization is very important because standards help to unite the points at issue and create uniform rules[4]. However, in the area of Information and Communication Technology work on a worldwide level, there are two international organizations used for standardization. They are the International Electromechanical Commission (IEC) and the International Standards Organization (ISO). Nowadays they have a joint technical committee, which is ISO/IEC JTC1 Information Technology.

There is also CMMI standard[5], which is initially American, but currently widespread standard. It has five levels of maturity.

Maturity levels characterize an improvement which organization achieves relatively to a set of process areas, whereas capability levels characterize organizational improvement relative to an individual process area.

Maturity levels:

Maturity Level 1: Initial

Maturity Level 2: Managed

Maturity Level 3: Defined

Maturity Level 4: Quantitatively Managed

Maturity Level 5: Optimizing

Among the major old standards for quality IS / ICT can be classified mainly standards and technical reports: ISO / IEC 9126, ISO / IEC 14598, ISO / IEC 15939 and ISO / IEC 12119 "Information technology - Software packages - Quality requirements and testing ". The successor of these quality standards nowadays is the SQuaRE. SQuaRE series of standards is dedicated to software product quality only.

Quality model hierarchy

The ISO quality model categorizes the software quality into characteristics, then further subcategorizes into sub-characteristics and eventually, the last step is quality attributes (Figure 2).

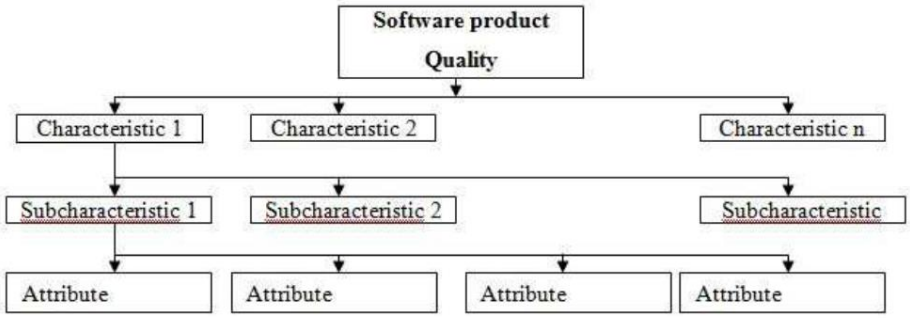

Figure 12 Tree quality model hierarchy(ISO/IEC 9126-1)[6].

In reality, hierarchy above is not perfect, as some attributes may contribute to more than one sub-characteristics. Figure 3 shows the real model.

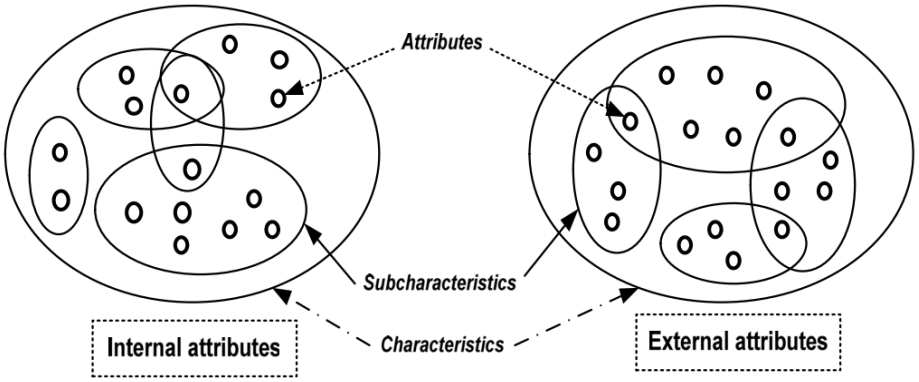

Figure 13 Quality model hierarchy[6].

The connection between internal and external attributes of the measures is never perfect, and the effect that the internal attribute in the associated external dimension is determined by experience, and depends on the specific context in which the software is used.

Standard ISO / IEC 9126

Having software to achieve a high level of quality is an essential tool for the maintenance of all processes in the field of economics, management, and environmental management. An evaluation software quality control product on the market is still a largely subjective process. Therefore, the rules for an objective and uniform assessment of

software quality are definitely acceptable and have been the focus in the field of international standardization[7].

The first standard for the standardization of software quality was published in 1991, it was known as international standard ISO / IEC 9126 "Software Product Evaluation - Quality characteristics and guidelines for their use". After the publishing the standard, Pfleeger reports on some important issues in the ISO / IEC 9126, such as the lack of guidelines on how to give an overall assessment of quality, there is no guidance on how to measure quality characteristics and it focuses on the point of view of the software developer[8].

In the figures below we can see the quality model of ISO 9126 and relationship model of metrics and attributes.

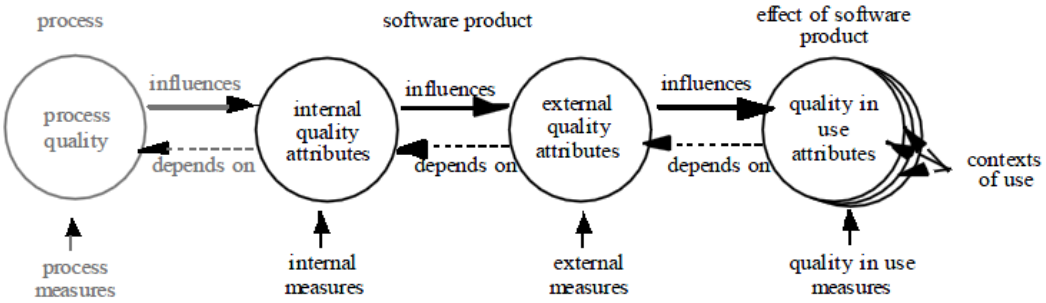

Figure 14 Software Quality Model Framework[9].

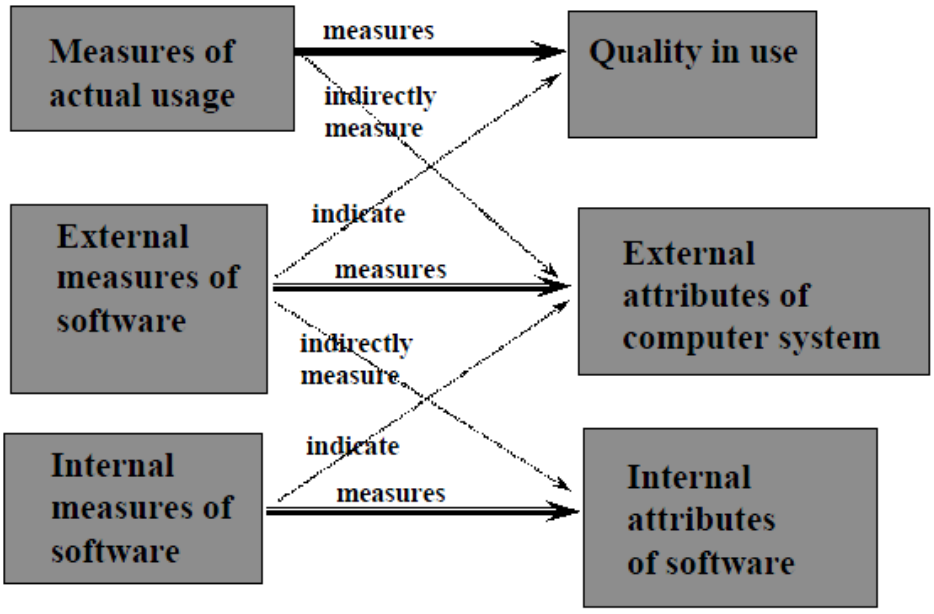

Figure 15 relationship model of metrics and attributes[9].

The internal measure is a measure derived from the product itself. The external measure is a measure of a product derived from measures of the behavior of the system of which it is a part.

ISO 9126 has six characteristics: maintainability, reliability, functionality, usability, portability, efficiency.

From 2001 to 2004, ISO has published an extended version containing both the ISO quality model and an inventory of the proposed measures for these models. Version ISO 9126 is a series of standards consisting of four documents, one standard and three Technical Reports[10]:

- Quality models - ISO 9126-1.
- External metrics (TR) - ISO 9126-2.
- Internal metrics (TR) - ISO 9126-3.
- Quality in use metrics (TR) - ISO 9126-4.

The major differences between the 1991 version and the 2001 version are[11]:

• The introduction of normative sub-characteristics, most of which are based on the informative sub-characteristics in ISO/IEC 9126 (1991);

• The specification of a quality model;

• The introduction of quality in use;

• the removal of the evaluation process (which is specified in the ISO/IEC 14598 standards);

Standard ISO / IEC 14598

ISO/IEC 14598 series - Information technology – Software product evaluation has six standards describing the quality evaluation process from various points of view:

General overview

Planning and management

Process for developers

Process for acquirers

Process for evaluators

Documentation of evaluation modules

Figure 16 ISO/IEC 14598-1 Evaluation Process[11].7

In the figure above evaluation process is shown. It has four main steps during which 10 sub-steps must be done.

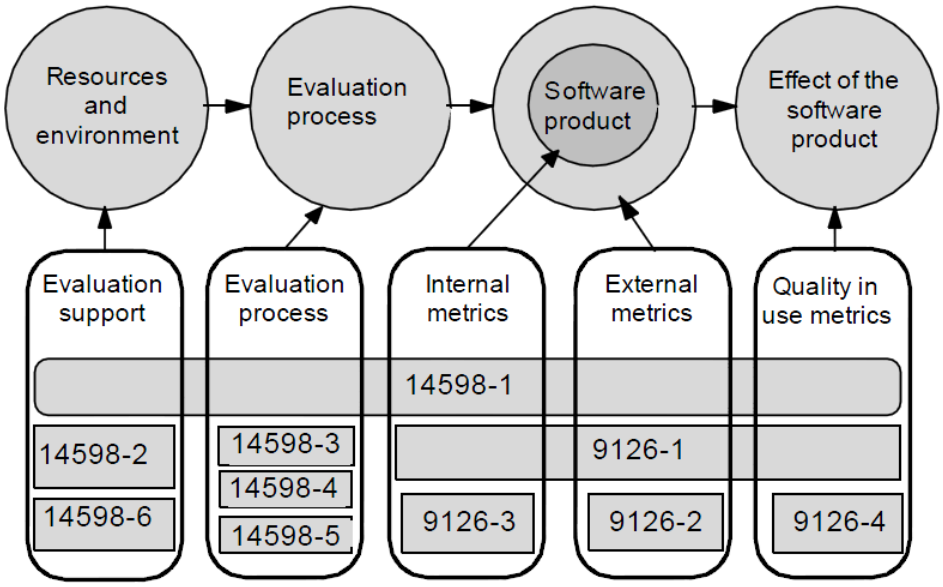

Figure 17 ISO/IEC 9126 and ISO/IEC 14598 standards [11].

In Figure 7 is shown the relationship of ISO/IEC 9126 and ISO/IEC 14598 standards.

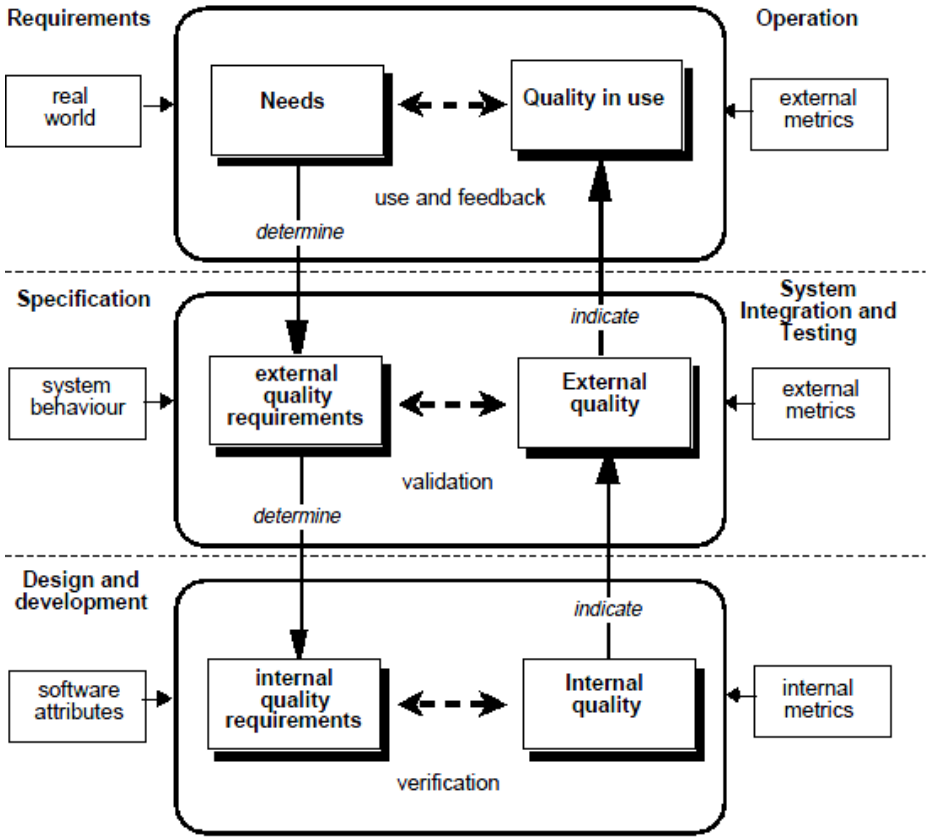

Figure 18 Quality lifecycle (ISO/IEC 14598-1).

The figure above describes Quality in the software lifecycle.

Standard ISO / IEC 15939

ISO / IEC 15939 "Information Engineering - Software Development - Software measurement process", describes the measurement of the overall structure of software attributes, including quality attributes[12]. The process is described by the model, which defines the activity of the measurement process that is necessary to adequately specify what measurement information is required, as the actions and results of the analysis should be applied and how to determine if the test results are valid. This standard identifies the process that supports defining a suitable set of measures to deal with specific information needs.

Standard ISO / IEC 12119

ISO / IEC 12119 "Information technology - Software packages - the quality requirements and testing," describes the necessary information about the quality, which is the software provider of the shelf shall be published prior to the conclusion of the contract and the rules checking these requirements[13].

This standard defines the definition of quality and pledges to provide to the potential customer a description of the product in advance. It gives the clients a chance to observe the document with the working title “Product description” so they may decide to buy or not to buy the software.

ISO 25000

The Software Quality Requirements (SQuaRE) is derived from ISO / IEC 9126, Software engineering - Product quality. In the old ISO / IEC, 9126 standards consisted of six quality characteristics and the description of a process model of software product evaluation. ISO / IEC 9126: 1991 has been replaced by standards: ISO / IEC 9126:2001, the development of software - quality products and ISO / IEC 14598, Software engineering - Product evaluation.

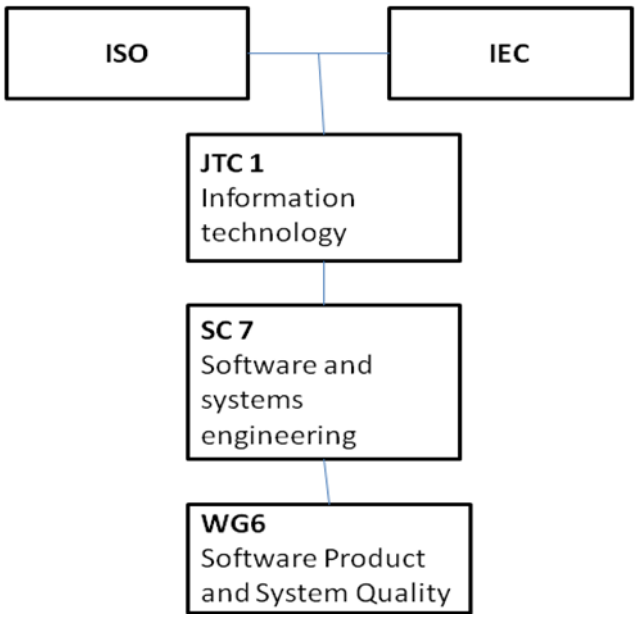

Figure 19 Map of the committees and groups [14].

The figure above shows us the structure of technical committees. ISO/IEC JTC 1/SC 7-Software and systems engineering committee works on SQuaRE. It is consist of 17 Working Groups (WG)[15]. Each of them works on their own topic. ISO/IEC JTC 1/SC 7/WG 6 works on Software Product and System Quality.

The part of the SQuaRE series of International Standards is ISO/IEC 25010, which consists of the divisions:

Quality Management Division (ISO/IEC 2500n)

Quality Model Division (ISO/IEC 2501n)

Quality Measurement Division (ISO/IEC 2502n)

Quality Requirements Division (ISO/IEC 2503n)

Quality Evaluation Division (ISO/IEC 2504n)

SQuaRE Extension Division (ISO/IEC 25050 – ISO/IEC 25099)

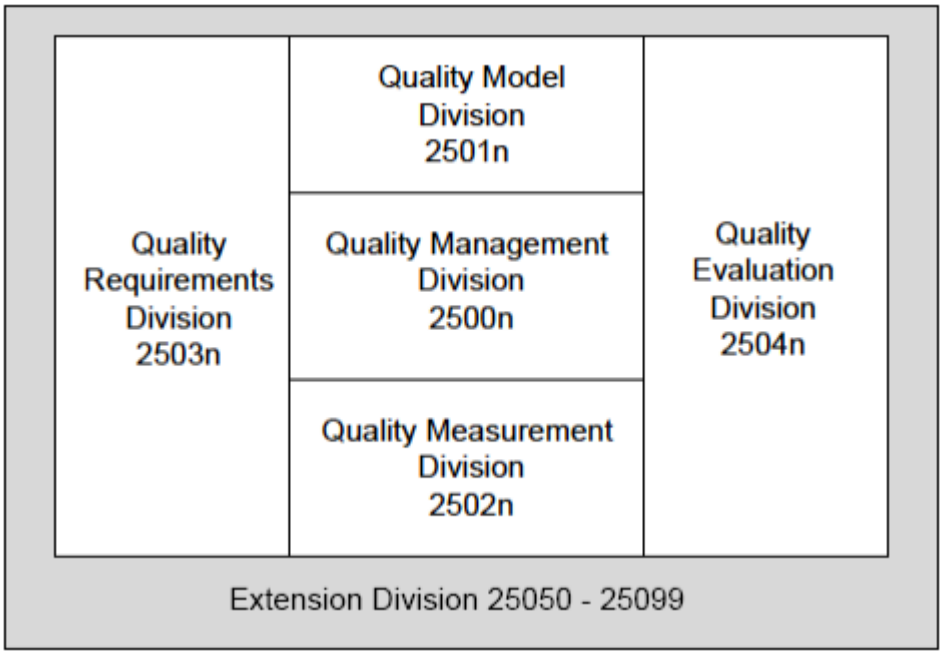

Figure 20 SQuaRE series of International Standards divisions[6].

Compared with the previous version of divisions the last one has one more - SQuaRE Extension Division (Figure 10) (ISO/IEC 25050 – ISO/IEC 25099). This new

standard includes requirements for the software quality of a Commercial Off-The-Shelf software product and the general industry usability reporting format.

The Quality Measurement Division currently consists of the following International Standards[9]:

ISO/IEC 25020 – Measurement reference model and guide

ISO/IEC 25021 – Quality measure elements

ISO/IEC 25022 – Measurement of quality in use

ISO/IEC 25023 – Measurement of system and software product quality

ISO/IEC 25024 – Measurement of data quality

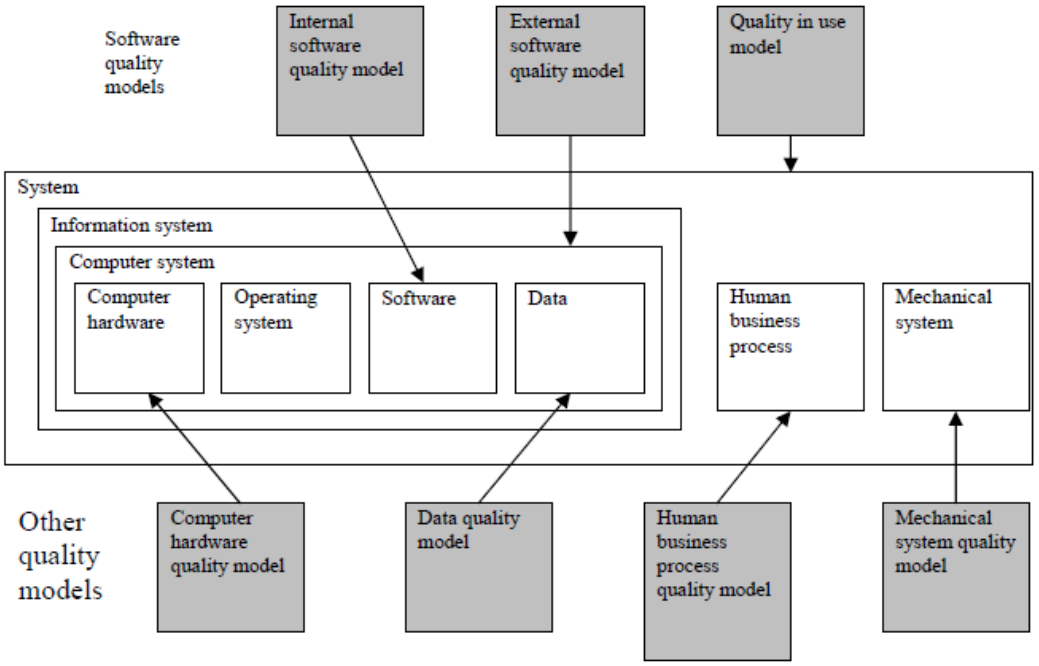

Figure 21 System model and quality models[4].

The figure above shows the interaction between the different quality models and system models.

Model for External and Internal software product quality

The software product quality model categorizes software product quality into eight characteristics (Figure 12) where each of them is composed of a set of sub-characteristics:

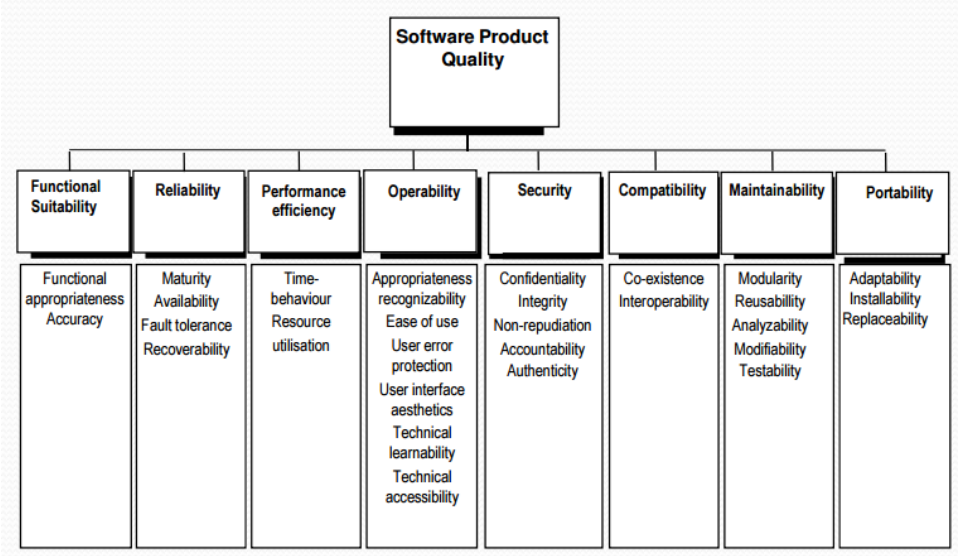

Figure 22 Software product quality[6].

Compared with ISO/IEC 9126 there are two additional characteristics: security and compatibility.

Functional suitability expresses that the software shall provide the functionality

to the user that fits their requirements and expectations. This also includes

functional correctness, i.e. that the software does what is required. In many contexts, correctness is equated with quality. It is only one specific aspect, however.

Reliability describes how frequently the software does not provide the expected or specified service.

Performance Efficiency describes how efficiently the hardware resources are used by the software and in what time the users get a response from the software.

Usability describes how well and with what satisfaction a user can operate the software.

Security has become important in ISO/IEC 25010. In previous ISO/IEC 9126, it was not part of top-level characteristics. It describes how software is prepared against attacks.

Maintainability or maintenance is essentially further development. In some contexts, this is also can be understood as code quality or internal quality.

Portability is important to bring our software to new or further platforms.

Compatibility how user can easily combine the software with other software and

hardware systems.

Quality in use model

Quality in use is the level to which the product or system may be used by specified users, to meet their needs for specific purposes with efficiency, effectiveness, and freedom from risk in order to meet specific conditions of use (Figure 13). Quality in use is how the user sees the quality of a system which contains the software. It is measured in conditions of the result of using the software in the environment, and it is less about properties of the software itself[9]. It can be measured by the level to which the users can possibly achieve their goals.

The quality in use is categorized into five characteristics:

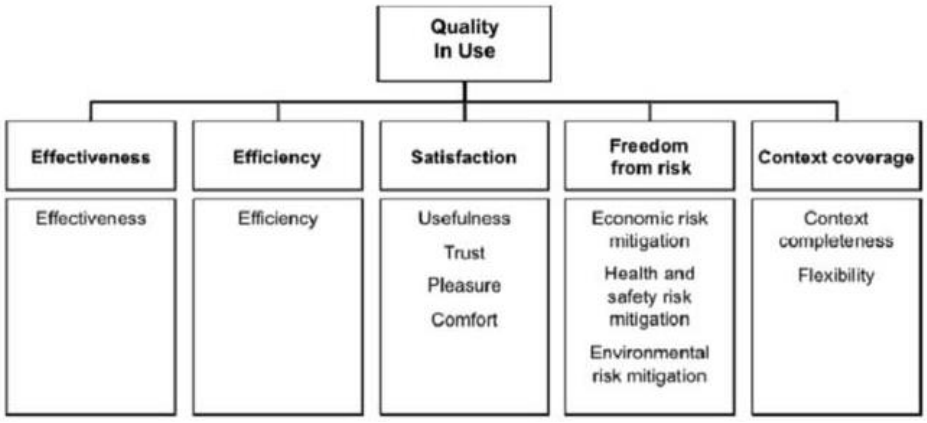

Figure 23 Quality in use model[6].

Effectiveness assesses how the user can get his objectives with accuracy and completeness.

Efficiency assesses the resources expended in relation to the accuracy and completeness with which users achieve goals.

Satisfaction assesses user's satisfaction with a product or system in the context of use.

Freedom from risk assesses the degree to which a product or system counters the risk.

Context coverage assesses the degree to which a product or system can be used with effectiveness, efficiency, freedom from risk and satisfaction in both specified contexts of use and in contexts beyond those initially explicitly identified.

Software quality reference model

The software product quality measurement reference model shown in Figure 14 describes the relationships within a quality model.

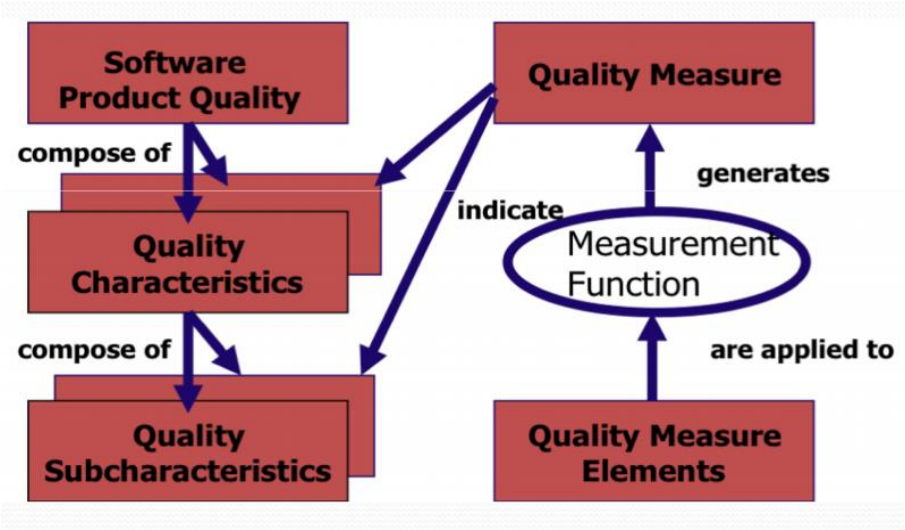

Figure 24 Software Product Quality Measurement Reference Model[6].

25021	Attribute	An essential feature or characteristic of the object, which can be distinguished quantitatively or qualitatively by human or automated means (ISO 15939:2007)
	Quality measure elements	The measure defined in terms of attributes and measurement methods for quantifying it, including, if necessary, the conversion with the help of mathematical functions used to build quality assurance measures
25022 25023 25024	Quality Measure	The measure, which is defined as a function of the measurement values of two or more elements of a measure of quality

Table 8Explanation of the measurement values [12].

In Table 1 is the explanation of the Attribute, Quality measure elements, and Quality Measure.

Data quality model

Data quality model in SQuaRE is ISO/IEC 25012:2008 Software engineering -- Software product Quality Requirements and Evaluation (SQuaRE). This model can be used to establish data quality requirements, define data quality measures as well as to plan and perform data quality evaluations.

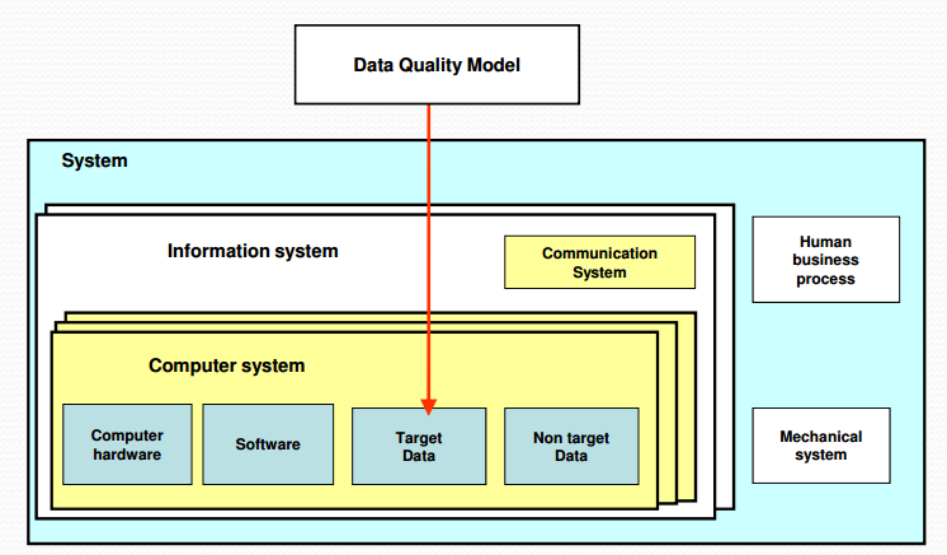

Figure 25 Data quality model in SQuaRE[16].

The International Standard focuses on the quality of the data as retained in a structured format within a computer system and defines for target data (Figure 15) its quality characteristics. The nontarget is data, which is not supposed to be considered.

Quality measurement

ISO/IEC 2502n - Quality Measurement Division is the standards that form this division include a system/software product quality measurement reference model,

mathematical definitions of quality measures, and practical guidance for their application. Examples are given of internal and external measures of software quality, and measures of quality in use.

ISO/IEC 25022 provides a suggested set of quality measures (external, internal and quality in use quality measures) to be used with the ISO/IEC 25010 quality model. The user of these International Standards should select the quality characteristics and sub-characteristics to be evaluated, from ISO/IEC 25010. ISO/IEC 25010 quality of software is primarily divided into product quality and quality of use (QinU). The same division has already been applied to the quality of IT services (Praeg and Spath 2010), namely product and customer quality. The sense of customer quality is consistent with the QinU concept.

Developers, evaluators, quality managers and acquirers can select measures from this standard for defining requirements, evaluating system/software products, measuring quality aspects and other purposes. They can also modify the measures or use measures that are not included here.

Intended users of this International Standard include:

Acquirer

Evaluator

Developer

Maintainer

Supplier

User

Quality manager

International Standard 2502n – Quality Measurement Division that currently consists of the following International Standards:

ISO/IEC 25020 – Measurement reference model and guide: provides a reference model and guide for measuring the quality characteristics defined in ISO/IEC 2501n Quality Model Division. The associated standards within the Quality Measurement Division provide suggested measures of quality throughout the product life-cycle

ISO/IEC 25021 – Quality measure elements: offers quality measure elements that can be used to construct software quality measures.

ISO/IEC 25022 – Measurement of quality in use: provides measures for the characteristics in the quality in use model.

ISO/IEC 25023 – Measurement of system and software product quality: provides measures for the characteristics in the product quality model.

ISO/IEC 25024 – Measurement of data quality: provides measures for the characteristics in the data quality model.

In the figure below is shown the relationship between this standard:

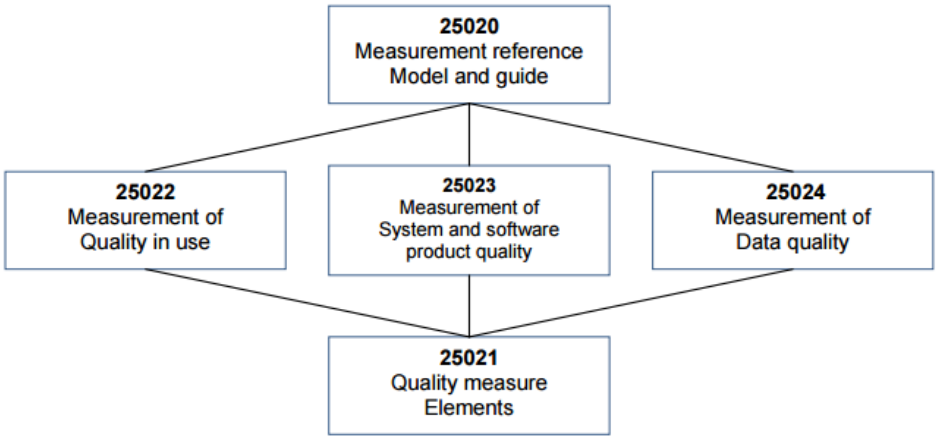

Figure 26 Structure of the Quality Measurement division[9].

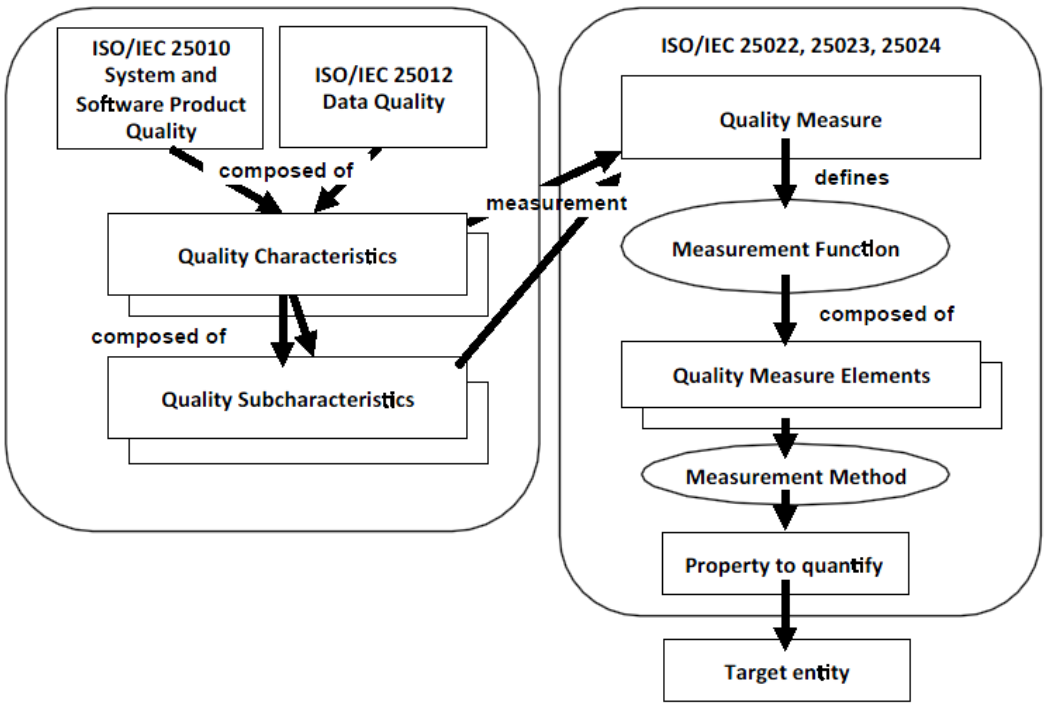

Figure 27 Measurement of quality characteristics[9].

In the figure above is shown how the quality characteristics are measured. The quality characteristics and sub-characteristics can be quantified by applying measurement functions. A measurement function is an algorithm used to combine quality measure elements. The result of applying a measurement function is called a quality measure. In this way, quality measures become quantifications of the quality characteristics and sub-characteristics. More than one quality measure may be used for the measurement of a quality characteristic or sub-characteristics.

A	ID	Identification code
B	Name	Quality measure name
C	Description	What it describes
D	Measurement function and QMEs:	

Table 9 The format used to document quality measures[9].

The format in the table above is used in the table below. The table below describes some measurement examples.

Name	ID	Description	Measurement function and QMEs	Method
Task completion	EF-G-1	What proportion of the tasks are completed correctly?	X = A/B A = number of tasks completed B = total number of tasks attempted	Measure user performance
NOTE This measure can be measured for one user or a group of users. If tasks can be partially completed the Task effectiveness measure should be used.				
Task effectiveness		What proportion of the goals of the task is achieved correctly?	$\{X = 1-\Sigma A_i \mid X>0\}$ A_i= proportional value of each missing or incorrect component in the task output (maximum value = 1)	Measure user performance
Flexible context of use	CFL-G-1	Extent to which the product can be used in additional contexts of use.	X = A / B A = Number of additional contexts in which the product would be usable B = Total number of additional contexts in which the product might be used	Analysis of user performance or context description
Pleasure scale	SPL-G-1	Does the user obtain pleasure from using the system?	X = A/B A = questionnaire producing psychometric scales B = population average	Questionnaire

Figure 28 Some measurement examples[9].

Analysis of Software Process Improvement Frameworks

The software development industry is the most rapidly growing sector which is taken as a deserving economic activity in the world. The SMEs are taking an active role in software development industry. Despite this fact, there are various SMEs that are not capable of adopting or making an implementation of various SPI Frameworks, for example, Capability Maturity Model Integration (CMMI) due to the challenges in their financial areas. In addition to that experience, personnel, time constraints among others are the factors that make the implementation of models like CMMI to be difficult. CMMI is usually employed in the large enterprises and for this reason may not be the best one for SMEs despite the fact that it is capable of improving the cost, time and the quality in SMEs.

The following are additional factors that make CMMI be inappropriate for SMEs despite the advantages it may have on SMEs. CMMI is quite complex in nature making it unsuitable for SMEs. To add on to that it requires documentation as well as training which is quite expensive for the SMEs. For this reason, there has been a motivation to ensure that models like CMMI that are unaffordable to SMEs are done away with and better methods are put in place to ensure the well-being of SMEs.

Alternative Model for SMEs

There have been various efforts that concern the adoption of different SPI frameworks in the quest of improving the product quality and process of the users.

In this case, the center of focus was the overcoming the various challenges that are posed by the existing models for use by SMEs. In this sense, various models have been proposed in the course of addressing the challenges that are being faced by models like CMMI. These models include the following;

Game Theory Model

This theory was proposed by Dagnino and it is an approach that was developed with an aim of addressing the challenge of interoperability of the various SPI frameworks that were present in the past. This is because the given frameworks in the past provided for the commitment of the organization towards SPI and that of the interaction of various roles in projects concerning SPI. The Game Theory Model worked for the interest of increasing the commitment as well as the readiness for SPI thus overcoming the previous challenge in this area.

Miramontes Model

This model was suggested by Miramontes and others as a method of lighting up the process of software together with its strategies. The focus of this model is to lead to the optimization of the process through lightening them without missing the CMMI certification necessities. In this regard solving the challenge that had been presented by CMMI.

Goal-Question-Metric Framework Model

This model was suggested by Kreimeyer and Lindemann as a way to solve the problem of testing the software process that exits for the purposes of finding an improvement. This includes among others the methods of structural complexity management that can be employed for the purposes of analyzing the software process in order to systemize its behavior as well as structure. In this sense, the propounders of this model proposed this model in order to guide SPI in the process of structural analysis. This model makes a provision of the main direction of the various possible strategies of analysis that are crucial in helping to comprehend the dependency model and in addition to that aid in the acquiring of information from the various particular goals.

Khan Model

This is a model that was introduced by Khan for the purposes of supporting the SPI implementation in global software development. The underlying foundation of this framework by Khan was the comprehension of the various factors that affect the SPI project in domain global software development.

Software development framework based on agile methodologies

There are various scholars who are of the opinion that Kazakhistan SMEs are struggling with the Capacity Maturity Model. In this sense, they are quite reluctant to adopt the model into their organizations. However, the SMEs, on the other hand, is ready and willing to make an adoption of the agile methods that are able to work in line with the CMM for the SMEs for the efforts of making their objectives in their businesses and be able to attract the various international customers.

There are different presentation stages or levels of the CMM by some agile features, for example, collective code ownership and pair programming. In this sense, it will reduce the expenses of training and in the early stages of software development although the requirement of documentation would not be a condition. In this manner, the SMEs would be able to earn extra income by saving capital which they can use in various other investment ventures. The following are the agile practices that SMEs can adapt to lead to the production of skilled human capital, high-quality software, and services in addition to successful projects among others.

Continuous integration is suitable for the defect prevention at the CMM optimizing level KPAs

- Team focus is applicable to the organizational process at the CMM defined level KPAs
- Simple design and coding standards are applicable to the software product engineering at CMM defined level KPAs
- Pair programming is applicable to intergroup coordination at the CMM defined level KPAs and for software quality assurance at the CMM repeatable level KPAs
- The small version is applicable to software project planning at the CMM repeatable level KPAs

Collective ownership is applicable to software configuration management at the CMM repeatable level KPAs [48]

CCMI-SCRUM MODEL

This model was propounded by Lukasiewicz and Miler with the purposes of mapping some scrum practices at the levels 2 and 3 of CMMI. Their belief is that agile methods lead to the improvement of value to the various enterprises. They are easy to get and cheaper due to their changes that are required frequently. The problem comes in the process of making a combination of these two approaches in order to lead to maximum results at the least cost usage. In this sense, there is a reduction in costs and time in addition to adding the quality of agile practices, suitability for different project kinds, manageability among others.

The proposal for the combination of CMMI and SCRUM by the two scholars to be a model that is coherent to improve agility and discipline of improvement of software. It is currently being used in many organizations including SMEs as it is suitable for a range of enterprises as opposed to the earlier models.

COMBINING THE SCRUM WITH THE CMMI IN SMES MODEL

This proposition was made by Lina and Dan with the belief that Scrum is able to solve various issues that take place when there is an implementation of CMMI in SMEs. For them, CMMI is able to work even in small organizations, in this case, the SMEs. In this case, they carried out a study that was based on the various characteristics of SMEs where they studied merging the SCRUM and CMMI feasibility that was present between the highlighted gaps together with them. In this sense, their study led to the identification on how SMEs were able to adopt practices that are complimentary hence ensuring that CMMI and SCRUM are able to support each other. There are various practices that are present in SCRUM that is not present in CMMI while on the other CMMI makes a provision that ensures that SCRUM works best for big organizations. In addition to that CMMI offers various practices that aid in the improvement of Scrum adoption in SMEs. In this way, the two scholars provided the ways in which the two can be combined to ensure that they work best in SMEs.

SPI FRAMEWORK FOR SMES BASED ON CMMI

SPI is the core issue in the process of developing software technology for purposes of SMEs according to Zhang and Shao.[49] Many SMEs are committed to ensuring that they better quality software and in this case, they have an interest in using and improving CMMI although the cost and complexity of CMMI as mentioned above present a challenge to the SMEs to achieve this purpose. In this sense, SMEs have tailored and merged CMMI KPAs where they have merged it with iteration model. The framework proposed by Zhang and Shao has led to the division of the process of development into two parts. These are software development iteration that is applied with incremental delivery together with the spiral development models or approaches. The second part is the project management and support that covers requirement engineering, planning, configuration management, decision analysis, process quality assurance, analysis, and measurement as well as the organizational environment.

CCMI AND SIX SIGMA BLENDED FRAMEWORK

The blending of CMMI and six sigma is a new framework that was developed by Habib et al. This model helps SMEs in increasing the improvement process in SMEs. In this sense it adopts the CMMI through tailoring it to meet the requirements blends it into six sigma's DMAIC methodology that is Define, Measure, Analyze, Improve and Control. This methodology is able to reduce the time for attaining levels 2 and 3 of CMMI. It is their belief that there is a requirement of a considerable investment of the SPI that is based on CMMI which encompasses the efforts, capital and time of the given organization. It is quite complicated with reference to SMEs. Despite this fact it is important for them to start the initiatives for SPI in order to get a significant competitive chance as well as to survive in the industry.

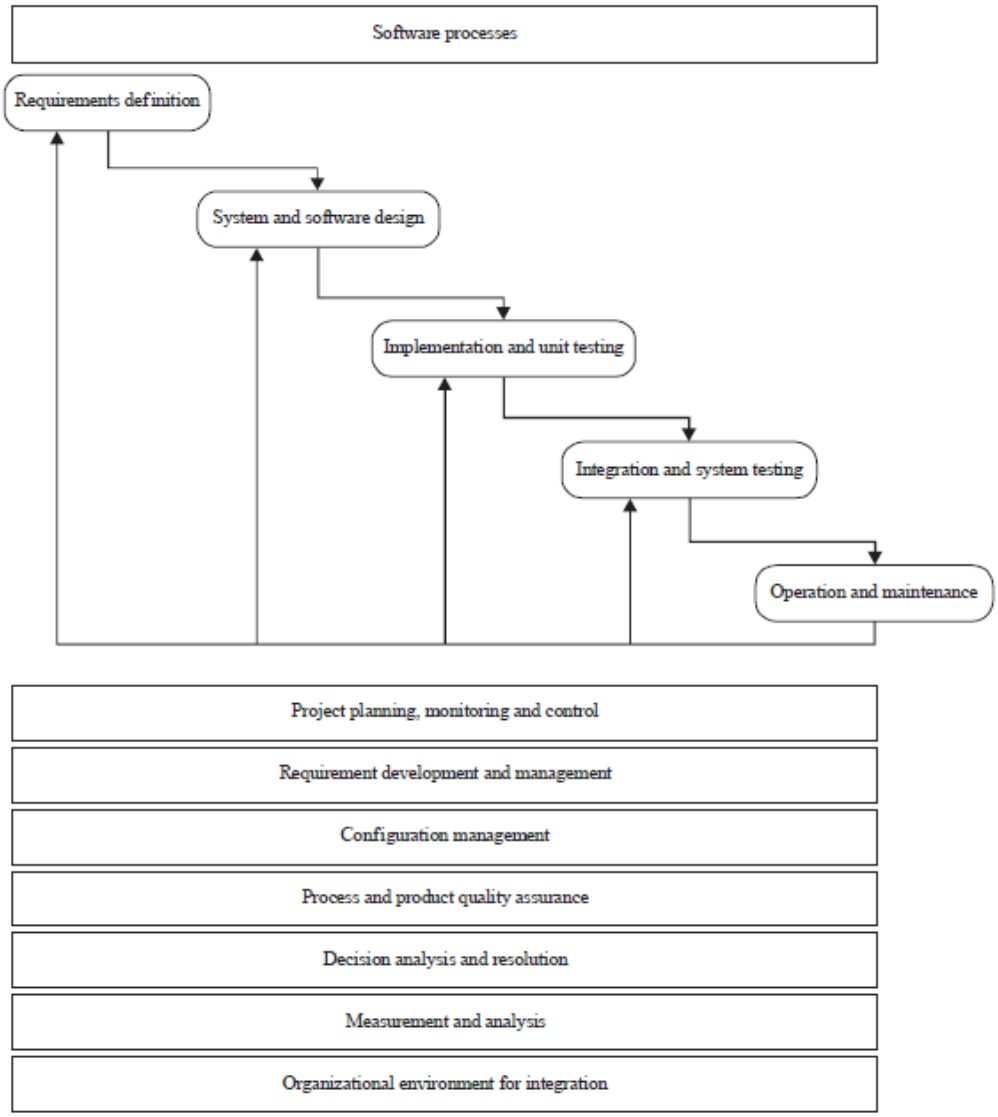

Figure 29 Figure shows improved framework

The figure above shows the model of the blended framework of CMMI and Six Sigma. This blend employs six sigma in the enhancement of the control of the initiatives of SPI. This is because the six sigma analysis and control documentation make an address of many practices of CMMI. In this case, the organizations should not put extra efforts. The blending of the two approaches aid in the identification of the process areas that are required for the improvement. In applying the 5 phases of the DMAIC methodology to the given project that needs improvement.

Addressing effort toward the spi implementation framework

SMEs have a vital role that they play in the industry of software development as pointed out by Munoz-Mata et al. [50] Consequently they are of the opinion that guaranteeing the software quality is fundamental due to the fact that it encourages the implementation of SPI by SMEs. The unfortunate thing is that many SMEs do not have the required knowledge to address the efforts of SPI and they are not aware the position to start that creates many obstacles on the implementation of SPI path. This makes it hard to achieve its targets. There is a suggestion by the scholars of a framework to address the efforts of SPI basing on solving the problems, culture, and needs that are in the current situation. In this sense, there is an offer of information that relates to agile methods, practices, and models for consideration and implementation.

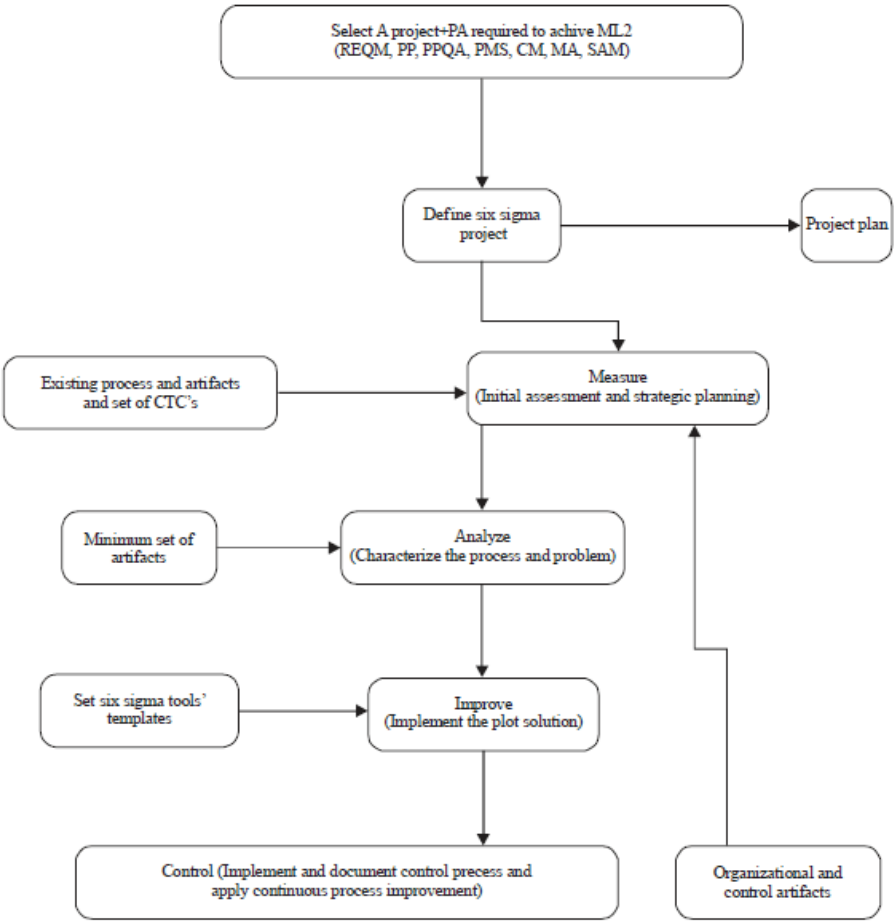

Figure 30 Spi implementation framework

BC6S Framework

The scholars developed the model in the quest to help in the process of identification of the main problems by SMEs as a starting point together with as a guide towards the implementation of SPI. This framework by Munoz-Mata et al. is based on three elements and these are a selection method for process pattern that is quite suitable, a process pattern group as well as a software tool for the use of the previous features in an automatic manner.

GAMIWARE: A GAMIFICATION PLATFORM FOR SPI

Organizational change management is a crucial knowledge to any project of SPI as well as human factors as pointed out by Munoz-Mata et al. and particularly for the motivation and commitment of people as it ought to be considered for any success in SPI. In their view, the gamification discipline is able to aid state a mechanism that is able to ensure people are motivated as well as committed towards tasks progress.

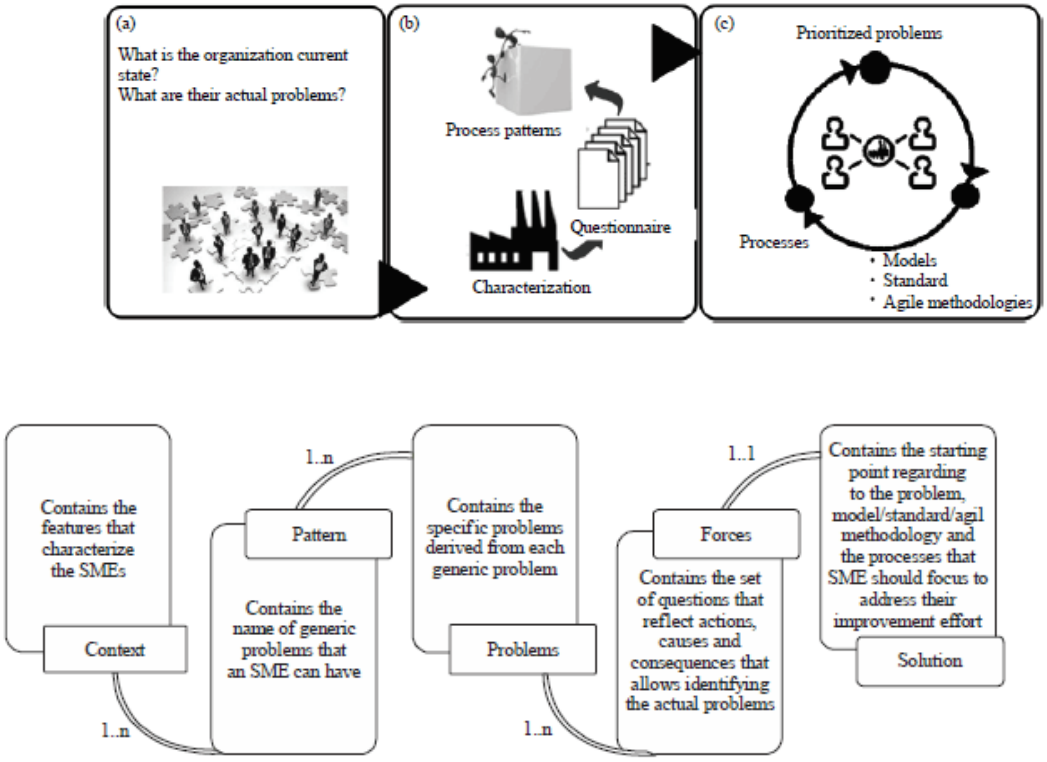

Figure 31 Gamification Platform For Spi

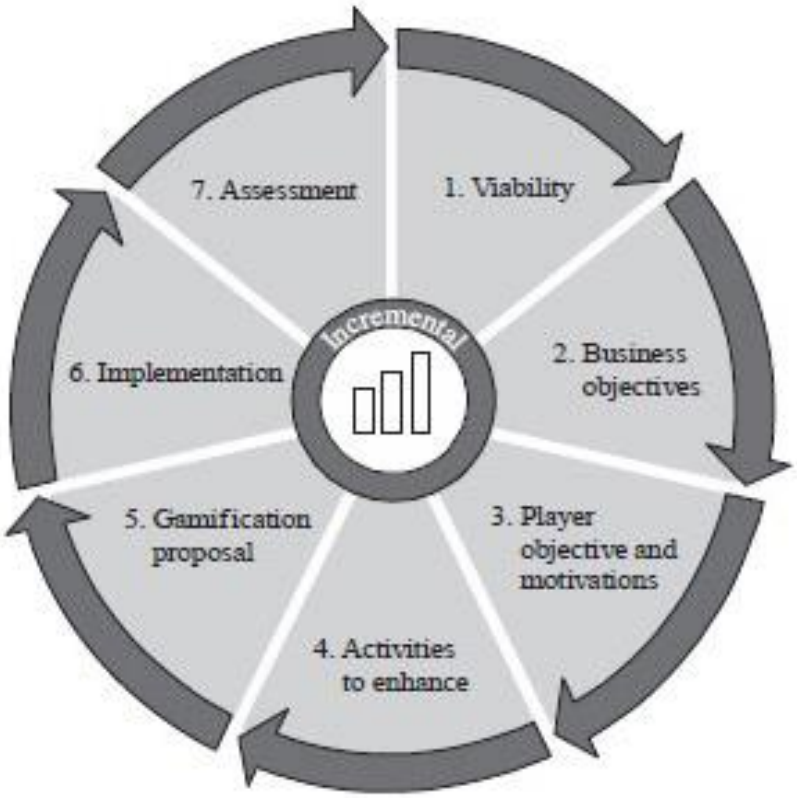

Figure 32 Life cycle

In a similar fashion, Herranz et al. made a development of a framework that puts emphasis on the needs of the needs of the organization for the purposes of taking advantage of gamification crosswire nature. In this sense, this model is founded on incremental iterations to tolerate the people involved in SPI project to handle the resistance to change for the purposes of making improvements to the processes and the adoption of SPI where the process of gamification includes seven phases as shown. (The first phase is about the implementing gamification feasibility. The second phase concentrates on establishing the business objectives to decide either gamification is feasible or not. In the third phase, the specialist group profiles are explored. Gamifying activities to be recognized and the SPI proposal aspects are considered in the 4th phase. The 5th phase is about the gamification proposal which concentrates on some of the software professionals and about establishing the metrics and assessment tool. Gamification proposal is

implemented on the 6th phase and the results are assessed and analyzed in the last phase). This is depicted in the figure above.

COMPARISON OF SPI FRAMEWORK

The table below shows the various advantages of the different models as well as their limitations hence forming a table of comparison that each of the models possesses.

Table 1: Advantages, limitations and gap towards a complete suitable SPI framwork for SMEs

Models	Advantages	Limitations and gap
Agile methodology in software development framework[13]	• Cover all the software engineering practices in the 5 CMMI levels • Successfully mapped 30% KPAs with XP practices	• Focus on software engineering practices only • Use one agile method only which is XP • No clear guidelines to implement these practices • No real life evaluation
CMMI-Scrum model[14]	• Cover most of the project management aspects in CMMI level 2 and 3 which is 60% of these 2 levels KPAs • The model was evaluated with good results	• Focus on project management practices only • Use one agile method only which is Scrums • Don't cover CMMI level 4 and 5 KPAs • CMMI level 3 KPAs related to organizational aspects are not included
Combining Scrum with CMMI in SMEs model[15]	• Merge CMMI and Scrums to work smoothly	• Focus on project management practices only • Use one agile method only which is Scrums • CMMI KPAs not clearly addressed • No real life evaluation
SPI for SMEs based on CMMI[23]	• Fully cover KPAs for CMMI level 2 and 3 • Give the required awareness for accelerating organizational improvement	• Don't take any agile methods advantages • Don't cover CMMI level 4 and 5 KPAs • Focus on project management practices only • No real life evaluation
Blending CMMI and six sigma framework[16]	• Successfully blend CMMI and six sigma • Provide tools and templates to help SMEs reach the required CMMI level • No real life evaluation	• Focus on project management practices only • Use one agile method only which is Scrums • Don't cover CMMI level 4 and 5 KPAs
Addressing effort toward the SPI implementation framework[2]	• Provide a complete solution for SMEs to adopt SPI smoothly • Provide a set process pattern and web tool for facilitating the framework • The framework was evaluated with good results • Take the advantage of several agile methods • Cover software engineering and management aspects as well in addition to considering the change management	• Would be better if authors focus on CMMI and try to cover all its KPAs • The framework can be enhanced to be full improvement framework not just a starting point • The web tool is only in Spanish, better to have english version for international SMEs
Gamification framework for SPI[10]	• Innovative framework to motivate people and increase their commitment • Well-defined methodological framework for gamification application focusing on the software houses idiosyncrasies	• Partially evaluated • Software engineering practices were not address • No tools provided to help to analyze the current organizational practices and to address the organizational change management

Figure 33 Framework of CMMI and Six

The figure above shows the model of the blended framework of CMMI and Six Sigma. This blend employs six sigma in the enhancement of the control of the initiatives of SPI. This is because the six sigma analysis and control documentation make an address of many practices of CMMI. In this case, the organizations should not put extra efforts. The blending of the two approaches aid in the identification of the process areas that is required for the improvement. In applying the 5 phases of the DMAIC methodology to the given project that needs improvement.

ADDRESSING EFFORT TOWARD THE SPI IMPLEMENTATION FRAMEWORK

SMEs have a vital role that they play in the industry of software development as pointed out by Munoz-Mata et al. [50] Consequently they are of the opinion that guaranteeing the software quality is fundamental due to the fact that it encourages the implementation of SPI by SMEs. The unfortunate thing is that many SMEs do not have the required knowledge to address the efforts of SPI and they are not aware the position to start that creates many obstacles on the implementation of SPI path. This makes it hard to achieve its targets. There is a suggestion by the scholars of a framework to address the efforts of SPI basing on solving the problems, culture, and needs that are in the current situation. In this sense, there is an offer of information that relates to agile methods, practices, and models for consideration and implementation.

Data & Methodology

Survey approach

The major goal of the study is the proposition of a method that will improve enterprise software usage in SMEs in addition to clarifying the productivity of their enterprise software by the evaluation of its performance as well as user satisfaction. This would be made possible by the use of the methodology of conducting a survey in the paper. This research was conducted by applying a questionnaire with 29 questions. Three different types of answers were expected: Yes/No, 5 point scale and free response (to a certain extent). In the questionnaire, the respondents answered the following questions: "What should software do? How should it perform?" The survey took place in March 2016.

Online public sources of information were used for enterprises selection which was selected randomly and according to the industry's share in the total economy using the data from the Committee on Statistics of Kazakhstan (KazSTAT) [24] (Figure 30, Table 10).

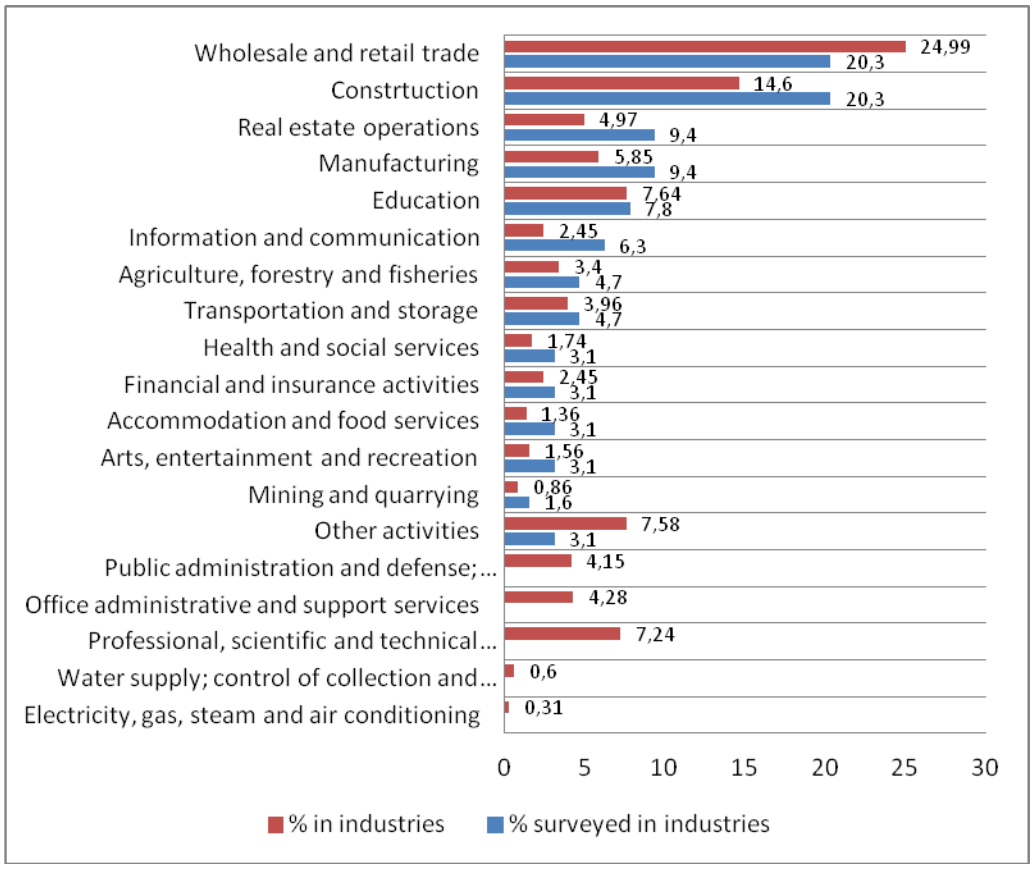

Figure 34 Number of surveyed respondents related to industries, Source: own.

Eleven regions out of fourteen were represented in the survey(see table below).

Region	Surveyed
Astana city	8
Almaty city	20
Akmola region	1
Almaty region	7
Aktobe region	2
West Kazakhstan region	2
Zhambyl region	2
Karaganda region	11
Kostanay region	4
South Kazakhstan region	4
East Kazakhstan region	3

Table 10 Regions represented in survey, Source: own

The respondents, who work with software, were searched on the website of the Committee of Statistics of Kazakhstan and survey was conducted by telephone. Out of 64 organizations participated in the survey only 55 organizations, from different industries, which use 77 software were analyzed.

The structured questionnaire was used (Figure 31). Structuring the questionnaire helped me to optimize the questions to gain more results and spend less time. Another advantage was that the respondents were able to provide answers that were reliable to a great extent without fearing anything. My initial attempts to run the survey through other means such as social websites and email showed that the respondents do not understand clearly the questions.

The main questionnaire consisted of 29 questions which were divided into three groups:

- Main
- Additional
- General

The structure of the Main questions for the inteview is in Figure 31. Additional questions were asked in the formal form before the Main questions. Information for the General questions was mainly collected from the internet and state resources and later confirmed by respondents. Different people in each organization who operate with enterprise software collectively evaluated their experience with it. At least two respondents answered from each organization. The respondents had two steps to define the scale (Table below).

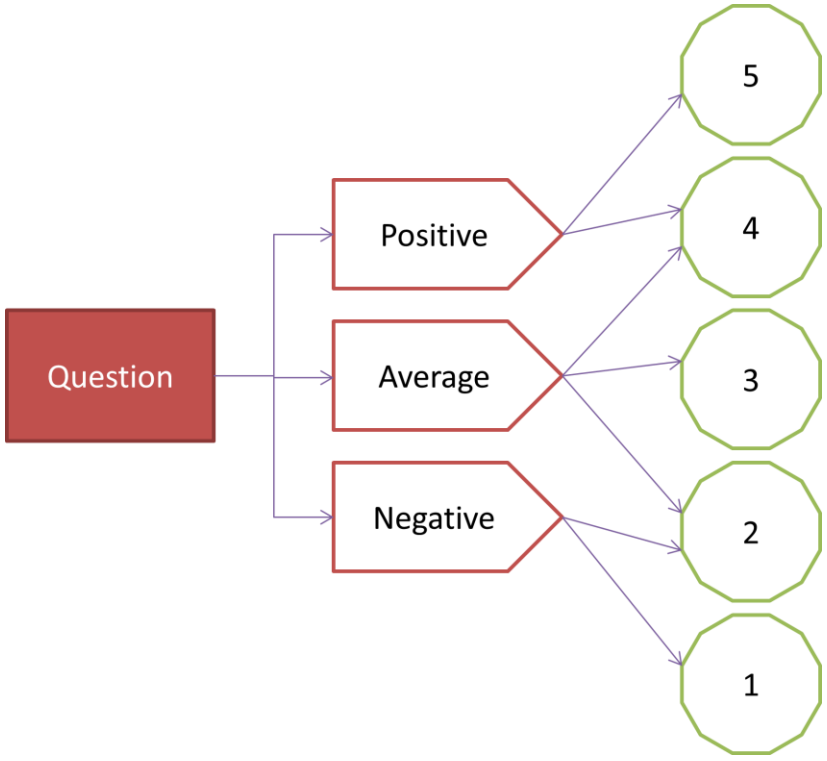

Figure 35 Scale defining, Source: own.

Tables below describes questions and the answer types to them.

Main questions	Answer type
Enterprise software existence	Yes/No
Software name	Arbitrary
Efficiency rate	1-5 scale
Understanding rate	1-5 scale
Satisfaction rate	1-5 scale
Software evaluation	Yes/No
Evaluation specialists	List
Evaluation frequency	List
Evaluation method	List
Reason of evaluation/no evaluation	Arbitrary

Table 11 Main questions, Source: own.

Additional questions	Answer type
Respondent range	Manager/Employee
Respondent type	IT specialist/End-user
Maintenance type	Internal/External/No
Ownership	Private/Government/Foreign
Future demand on specialists	Arbitrary
Software selection	TopM/ITdep/WorkDep/Collective/ExtCon

Table 12 Additional questions, Source: own.

General questions	Answer type
Organizations name	Arbitrary
Region	List
Industry	List
Phone contacts	Arbitrary
E-mail	Arbitrary
Website	Arbitrary

Short description	**Arbitrary**
Number of employees	**5-50/51-250**
Software description	**Arbitrary**
Software developers	**Arbitrary**
Software website	

Table 13 General questions, Source: own.

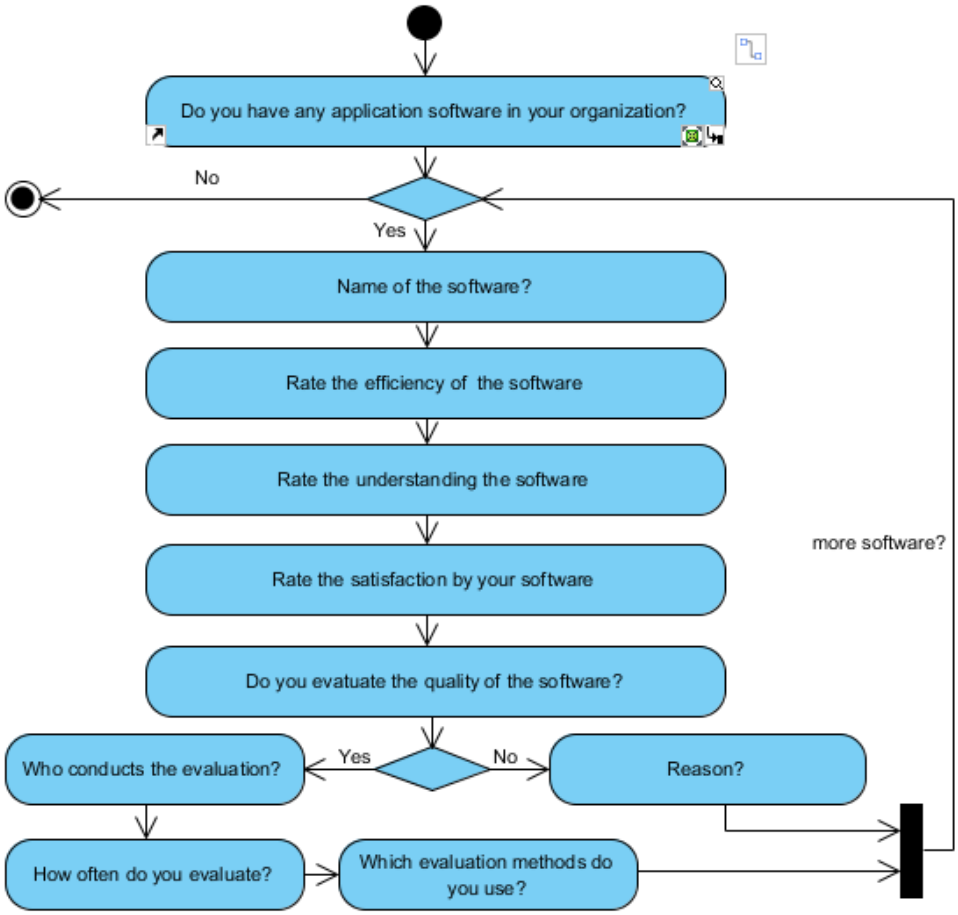

Figure 36 Structure of the main questions of the interview, Source: own.

Figure 32 describes the logic of asked main questions. There are two decision points where the respondent can turn to distinct direction. If the respondent does not have any software in his organization the arrow goes to exit.

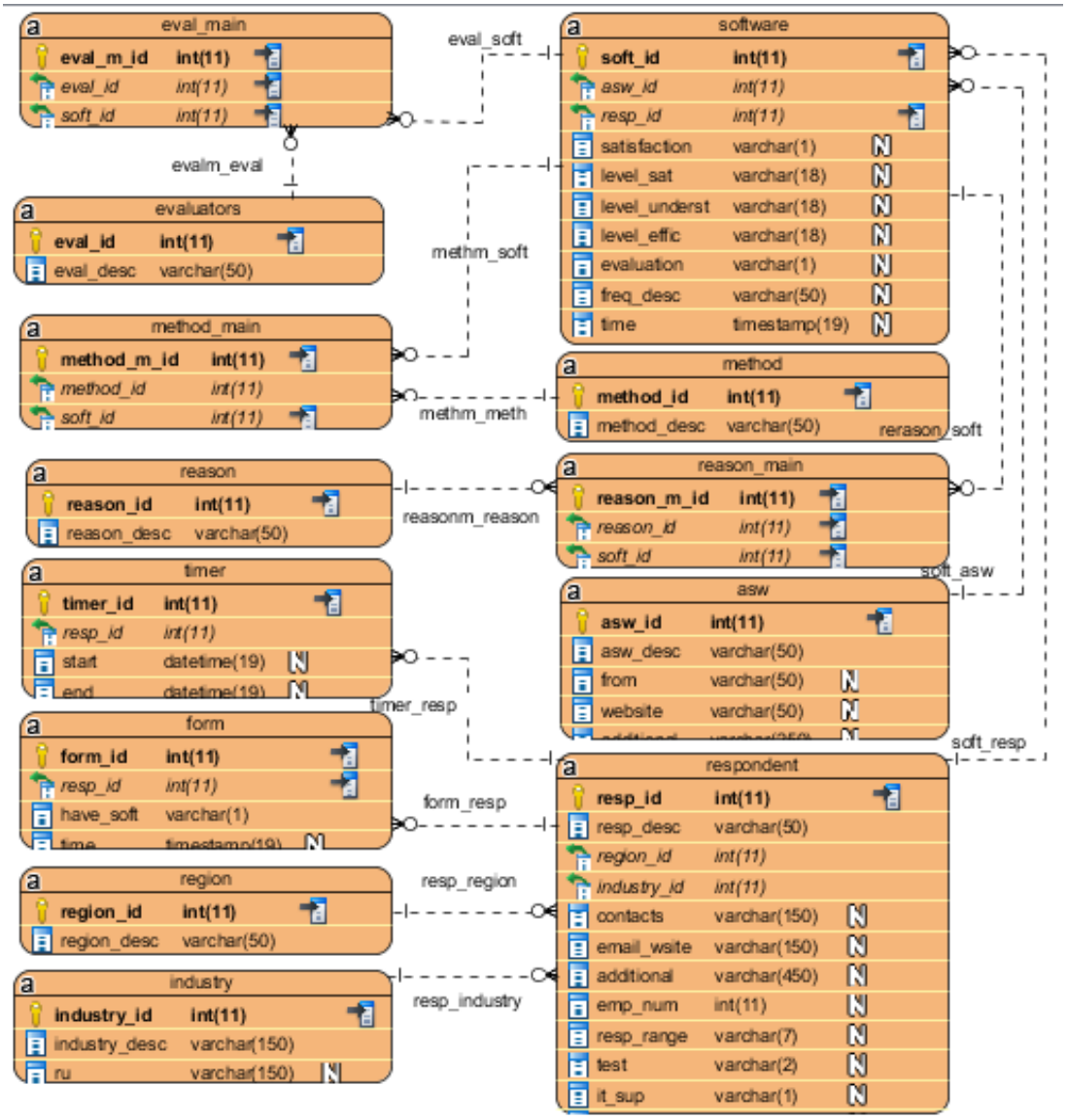

Figure 37 Table structure of the survey, Source: own.

Figure 32 describes the structure of the tables in the database of survey and relationship between them. The table Software contains the answers about the software. The table Respondents contains all information about the respondents.

The respondents were divided into two Groups: Group A - the managers and Group B – the ordinary employees. Each Group has been asked to rate their satisfaction with the enterprise software by answering to three prepared questions, which are an additional part of the main questionnaire. Additionally, organizations were divided into three Groups according to their service support Types.

Three indicators were evaluated by the respondents: satisfaction by software, understanding the software, efficiency of the software. Three Types of support were considered. The first where enterprises have IT department or person in charge and the users take the support continuously. The second Type which calls IT-outsourcing is the organization with external IT support where they have the state contract with external IT support Company. The third Type is the enterprise which also can have external support, but does not have defined IT support organization or persons in charge. They pay their bills only when issues occur. To study research findings, the statistical analysis such as t-test and ANOVA test were applied.

The method to measure enterprise software

The measurement parameters are based on characteristics of already existing quality models which were described in the sixth chapter. A quality measurement procedure should be the eternal quality of SW products. The idea of the method is not to cover all aspects of software quality, but is to offer optimized method to the interested stakeholders. The intended users of the model were described in the eight chapter.

. After determining the basic parameters for the measurement, we can then choose the method to measure these parameters. The methods should be selected on the basis of our measurement model, which means that each measured parameter should have its maximum and minimum.

Before starting the measurement we must define parameters which must be measured. In the ISO 9126, they are known as characteristics or sub-characteristics.

Representatives from various levels and departments were chosen to answer to two questions:

What should the software do?
How should it perform?

Based on the results of the answers there was created a list of possible parameters.

The Organizations were given an overall score of 10 each to divide it between parameters. There are left eight shortlisted parameters (table below). The others had 0 or 1 score.

Parameter	Score
Functionality	6
Reliability	4
Interoperability	3
Usability	3
Safety	2
Effectiveness	2
Flexibility	2
Correctness	2

Table 14 List of shortlisted parameters, Source: own.

After the discussion, it was decided to unite some of the parameters. Reliability and safety were united into Stability. The attributes of other three parameters split between Functionality and Interoperability which become Coverage and Integration. Eventual parameters are:

- Coverage
- Integration
- Stability
- Usability

The following table describes measurement functions and quality measurement elements for chosen parameters.

Name	Measurement function and QMEs:		Method
Coverage of SME by enterprise software	$x_{cov} = \frac{c}{s}$	s= number of objectives of SME should be covered by enterprise software. c= number of objectives which covered by enterprise software. The value can be in double format.	Measure functional coverage
Stability of the system	$x_{st} = 1 - \frac{1}{d}\sum_{i=1}^{d} v_i$ Where : $v_i = \frac{1}{k_i}\sum_{s=1}^{k_i} w_{s,i}$	v-sum weight of errors d-monitored days. k=number of incidents. w-weight of error per day	Measure errors
Usability (Usability)	$x_{us} = \frac{c}{n * m * q}$	c-sum of answers scores n-number of interviewers q-number of questions. m-max point of questions.	Questionnaire
System integration	$x_{int} = \frac{Ps}{Pi}$	Ps-sum of integrated software pairs Pi- the number of software pairs which have to be integrated	Measure integrated pairs

Table 15 Parameters and formulas of the proposed method, Source: own.

The proposed quality measurement formula is:

$$q = \frac{x_{cov+}x_{st} + x_{exp} + x_{int}}{y}$$

Where:

-coverage by enterprise software SME's objectives

-stability of the system

-usability

-integration

y-number of measured elements (number of x)

As it can be seen that Coverage and Integration are based on organization's expectations, whereas the Stability and Usability are related to user experience.

There is a difference in scoring organization's expectation and experience. Expectation can point out the absence of some needed features, while user experience is more precisely considers what we already have.

There was the used principle which was described in SQuaRE that "every quality measure employs its measurement function which normalizes the value within 0.0 to 1.0 and makes it interpreted that the closer to 1.0 is better" [9].

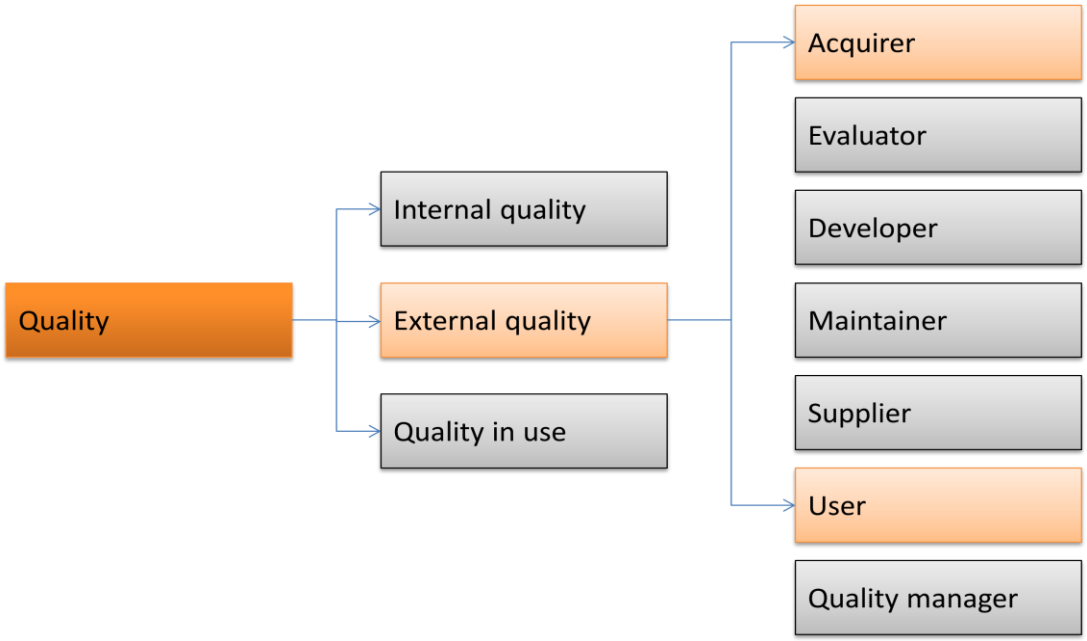

Figure 38The intended users of the proposed method, Source:own

In the graph above we can see the users of software who are supposed to use the proposed method. For the acquirers, the method can be suitable to use in a trial period of usage of software. Also, it is possible to examine existing software to avoid its limitations in the future acquisition. Also, only external quality of software was taken into account as main evaluation parameter for the users. The internal parameter is more suits to needs of developers. The parameters of quality in use have less relation with product quality itself, it mostly concerns with the influence of the software to the environment.

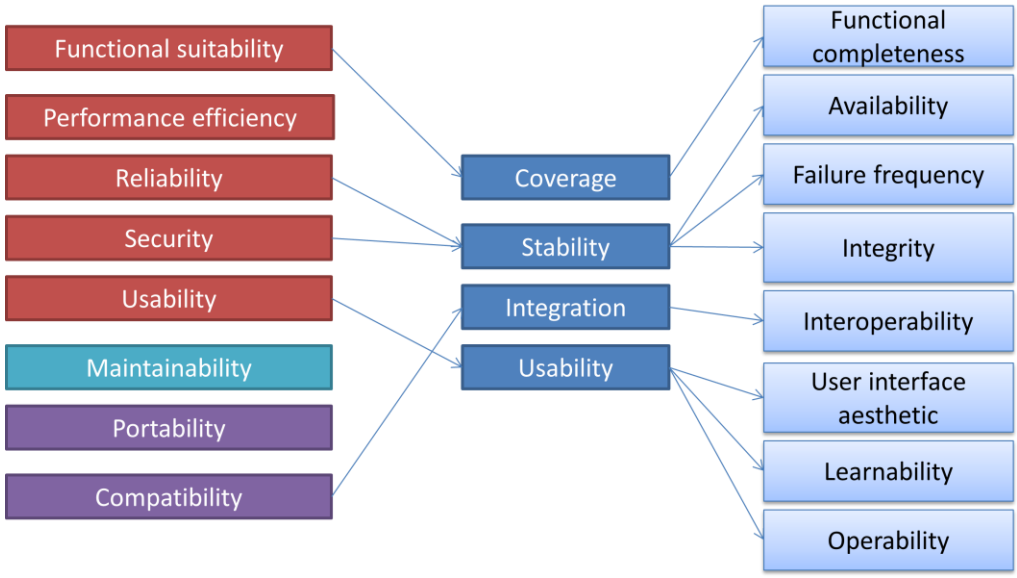

Figure 39 Relationship with characteristics of ISO 25000, Source:own.

In the graph above described relationship of current model with quality characteristics of ISO 25000. On the right side we see the subcharacteristics.

Coverage by enterprise software SME's objectives

This part describes functions and quality measure elements for four proposed measures. It also gives simple examples to given measures. The formula for coverage of SME by ASW needs variables of:

- number of objectives of SME should be covered by ASW (variables) and
- a number of objectives which are covered by ASW (variable c).

The range for this part of the work can be defined as initially planned processes in SME that should be covered by SW products. Coverage gives the value to only needed functionalities and the tasks which software does. We put overwhelmed software in the same conditions with fewer features. Our main goal is to define the needed features for the organization and realize how the software covers them. Definition of features varies. Sometimes it is difficult for the users to determine their needs and even if they can it is difficult to identify where that requirement belongs. It can be functionality, process, sub-process. In a hierarchy, we understand that process with many other activities has more influence than sub-process but for some specific reason sub-process can become more valuable for users.

$$x_{cov} = \frac{\mathrm{c}}{\mathrm{s}}$$

s= number of objectives of SME should be covered by SW.

c= number of objectives which covered by SW.

For example:

s=15

c=11

$$x_{cov} = \frac{11}{15} = 0.73$$

It is 0.73, which shows that the most objectives of the organization are covered, but still there are some objectives are uncovered.

Stability of the system

Stability of the system in the wide sense is taken to mean the reliability, availability as well as the maintainability of the system in question. These factors make the system stable contributing to its stability. The Institute of Electrical and Electronics Engineers (IEEE) defines Software Maintenance as “the process of modifying a software system or component after delivery to correct faults, improve the performance or other attributes, or adapt to a changed environment”[45].

In this part, we must track incidents related to the enterprise software. Later we analyze the incidents and define it as a problem or error which can be taken to be a fault that has occurred in the functioning of the system. Also, we analyze the log file of the software to add missed incidents.

All the incidents must be stored in the database. We have four tables. In ERROR table whereby error is taken to mean the faults that occur in the course of system functionality, we classify incidents as problems. It is important to have a database of enterprise software errors related to the organization.

The problems can be categorized into:

data issues
application issues
hardware issues
security issues

The main table is INCIDENTS REGISTRY where the trackers register their occurred incidents. For the first time of measurement, we should write the description of error into field UNKNOWN_ERROR, as the table ERROR is empty. After monitoring days is finished we use UNKNOWN_ERROR field to classify incidents into errors. For the next time of the measurement, we will have the “known errors” with the defined weight in the ERROR table. It allows us to avoid double-weighting. For the second measurement, we

write DATE and choose ID of the error from the ERROR table. If we cannot find an error in the ERROR TABLE we write a short description of the problem in UNKNOWN_ERROR field and leave ERROR_ID empty. When monitoring days is finished we repeat the operation of error classification.

The trackers can be the end-users or support-service. Also, we should use log files of software to analyze missed errors. Very often the SMEs users are not enough qualified. Therefore they do not have a strict command to identify the errors. They can write description into UNKNOWN_ERROR field when they have doubts.

The formula of system stability:

$$x_{st} = 1 - \frac{1}{d}\sum_{i=1}^{d} v_i$$

Where :

$$v_i = \frac{1}{k_i}\sum_{s=1}^{k_i} w_{s,i}$$

Where:

x_{st}- stability of the system

v-sum weight of errors

d-monitored days.

k-number of incidents

w-weight of errors

Example:

Weights grouped by days:

Day	Weight
1	0,5
2	0,7
3	0,2
4	0,5
5	0,2
6	0,4
7	0,2
8	0,1
9	0
10	0,2
11	0,6
12	0,2
13	0,4
14	0,5
15	1,1
16	0,4
17	0,5
18	0,2
19	0,1
20	0,1
21	0,3
22	0,3
	7,7

Table 16 Example of incidents, Source: own**.**

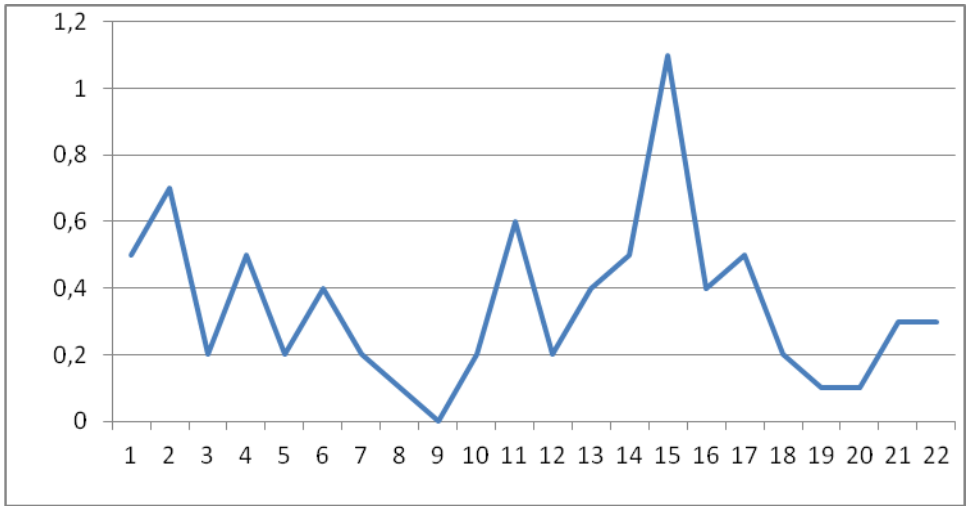

Figure 40 The graph above shows problems weight for each day, Source: own.

The following tables and charts provide us information about categories of problems and departments where problems are more frequently appear.

Departments		Categories	
Management	0,6	Data	1,9
Sales	2,5	Application	2,4
Accounting	1,9	Hardware	2,8
HR	1,8	Security	0,6
IT	0,9		
Total	7,7		7,7

Table 17 Errors by departments and categories, Source: own.

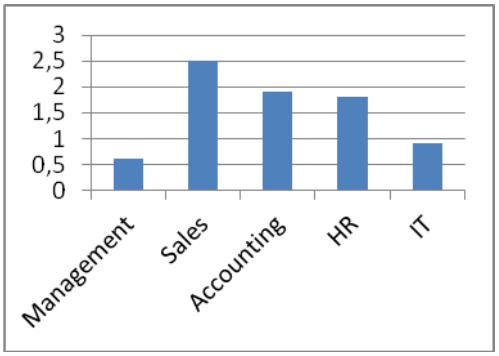

Figure 41 Errors by departments, Source: own.

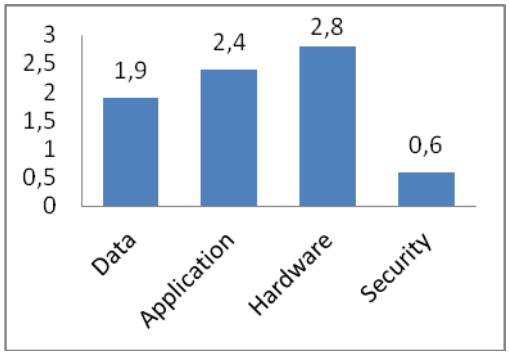

Figure 42Errors by categories, Source: own.

The stability formula:

$$x_{st} = 1 - \frac{1}{d}\sum_{i=1}^{d} v_i = 0.74$$

It recommends monitoring incidents at least for one month to cover all the activities where can jump in the graph.

Usability (Ergonomic)

ISO 9241-11 emphasizes that visual display terminal usability is dependent on the context of use and that the level of usability achieved will depend on the specific circumstances in which a product is used. The context of use consists of the users, tasks, equipment (hardware, software, and materials), and the physical and social environments which may all influence the usability of a product in a working system. Measures of user

performance and satisfaction assess the overall work system, and, when a product is the focus of concern, these measures provide information about the usability of that product in the particular context of use provided by the rest of the work system.

Name	ID	Description	Measurement function and QMEs	Method
Comfort scale	SCO -G-1	How comfortable is the user?	X = A/B A = questionnaire producing psychometric scales B = population average	Questionnaire

Figure 43 Measurement example in questionnaire from SQuaRE[9].

The effects of changes in other components of the work system, such as the amount of user training, or the improvement of the lighting, can also be measured by user performance and satisfaction.

While surveying the user experience we consider subjective opinions of employees.

The formula is:

$$x_{us} = \frac{\mathrm{c}}{\mathrm{n} * \mathrm{m} * \mathrm{q}}$$

Where:

x_{us}- usability

c-sum of answers scores

n-number of interviewers

q-number of questions.

m-max point of questions. It is 10 here. Each answer can have a scores grade from 1 to 10.

Example:

As an example, we have 6 interviewers.

Interviewers	Suitability for the task	Self-descriptiveness	Controllability	Conformity with user expectations	Error tolerance	Suitability for individualization	Suitability for learning	Total
Int1	6	9	4	7	7	6	7	46
Int2	8	10	5	8	4	5	6	46
Int3	7	6	5	7	5	5	6	41
Int4	5	8	5	6	4	6	9	43
Int5	7	6	3	4	4	7	8	39
Int6	9	9	7	6	6	8	7	52
Total	42	48	29	38	30	37	43	267

Table 18 Example with interviewers, Source: own**.**

The 7 indicators used were chosen on the basis of the manner in which they affect usability. This means that these factors are the determinants of usability in the real sense. In this case, the scale is 1-10.

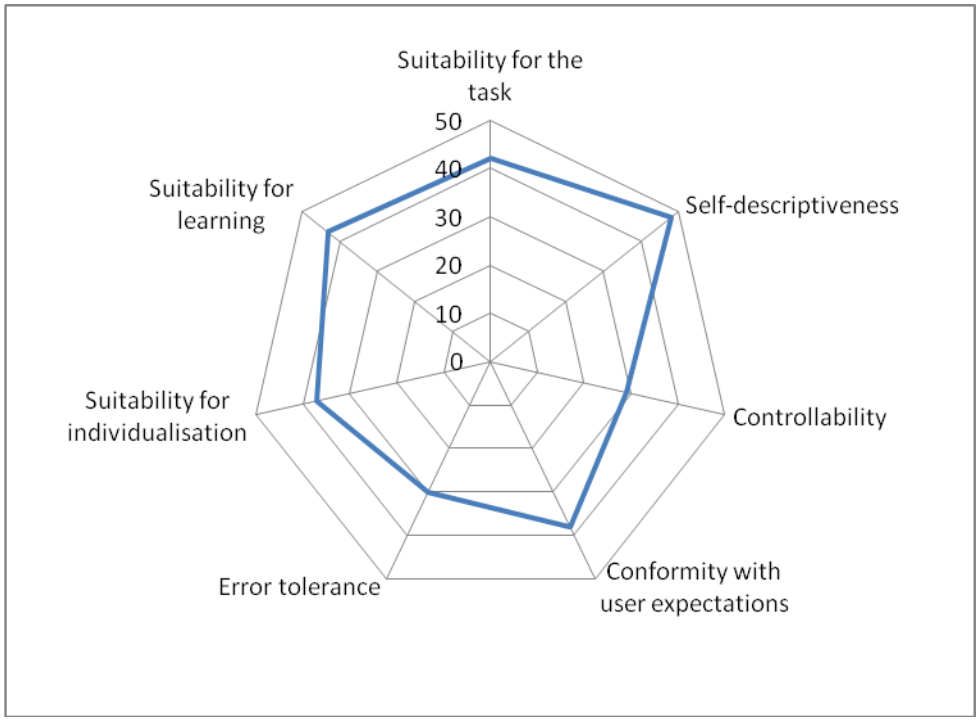

Figure 44 Scores of the interviewers, Source: own.

Thus it shows the level of users' satisfaction more than a half out of the total. Though, this result still needs further investigation and detailed analysis of users' scores to identify the weak areas of the system.

Integration

All the connections can be related to the enterprise software. The NAME refers to the specific task. As it shows in the table below, there can be internal and external connections. For example, if one functional task uses the results of another then there should be integration. The integration does not mean complete relationship. The tasks can be not integrated, but easy to do further actions on other legitimate software or system.

Example:

#	Internal		External			
	Task	name	Task	Governmental	Task	Non-governmental	Task
1	NAME		NAME		-		-
2	NAME		-		NAME		-
3	NAME		NAME		-		-
4	-		-		NAME		-
5	NAME		NAME		-		-
6	-		-		NAME		-
7	NAME		-		-		-
8	-		NAME		-		-
9	NAME		-		-		NAME

Table 19 Example of integration with other software and systems, Source: own.

The integration can be calculated with the formula below:

$$x_{int} = \frac{\text{Ps}}{\text{Pi}}$$

-system integration

Ps-sum of integrated software pairs

Pi- the number of software pairs which have to be integrated

Example (as per the table above):

$$x_{int} = \frac{6}{9} = 0.66$$

Ps=6

Pi=9

Thus it shows the level of interaction more than a half out of the expected total. Though, it recommends further investigation and detailed analysis of non-integrated pairs.

The average sum of quality system components can be found as follows

$$q = \frac{x_{cov+}x_{st} + x_{us} + x_{int}}{y} = \frac{0.73 + 0.74 + 0.63 + 0.66}{4} = \frac{2.76}{4} = 0.69(0.7)$$

Comparing to the perfect behavior for the enterprise (PBE)

$$PBE = \frac{x_{cov+}x_{st} + x_{us} + x_{int}}{y} = \frac{1 + 1 + 1 + 1}{4} = 1$$

Since the goal of each organization is to reach the maximum closest to PBE, the result shown above (q=0.7<1) shows that there are some limitations in enterprise software's operational process.

#	Organization	enterprise software	Quality
1	Firm M	X	0.69(0.7)
…	…	…	…

Table 20 The result of exampled organization, Source: own.

Application to collect the data (short description)

In this part application which was created to collect the data in organizations is described. The application was created just for simplifying data collection process to analyze it. It is not compulsory for the organizations to create such application to use this evaluation method.

To simplify the data collecting process the application has been created. The application is in Russian and it works through the local network. The users enter the data and it measures using our method.

Work on the software product began with the preliminary development of its user interface. The program must perform several data entering interface.

In the beginning, there was an idea to use web interface and hang it on the internet to have permanent access to data from Czech Republic where I was at that time, however, the problem occurred with the regular access of one of the organizations to the internet. So, it was decided to use application which will work on the local network. I used object-oriented programming, to develop the interface of our database. The database is on MySQL to have the opportunity to use the application through the net. Since I installed

web service in two other organizations. It gave me easy access to data through the net and track the data collection process. The other organization sent me its backup.

To open to the application user needs to have an access (figure below).

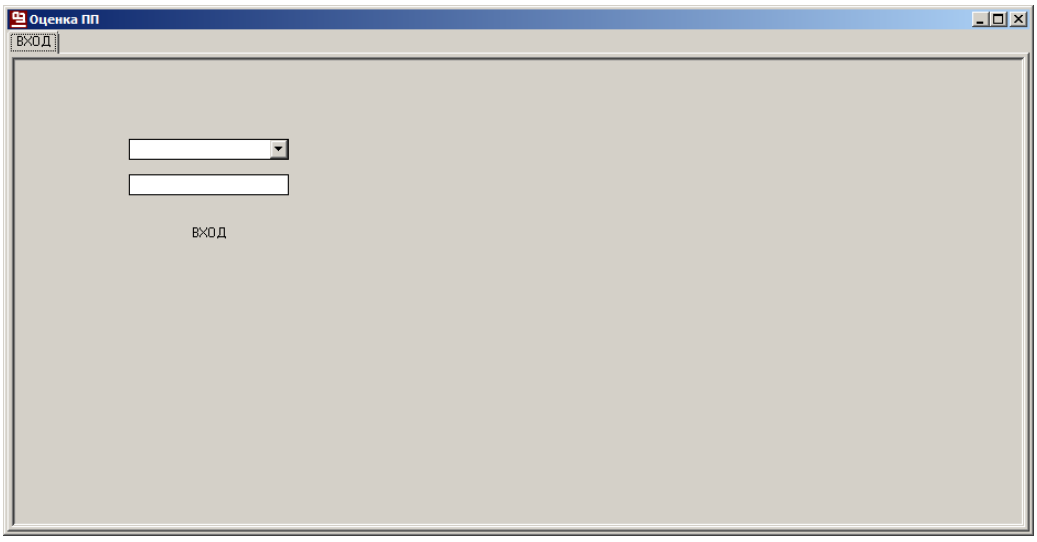

Figure 45 Access window of the application, Source: own.

The administrator can have an access to window in the figure below. On the left part of it is seen the part where users can be edited or add a new one. Every user has fields: login name, password, position, access, and department. In the access field can be typed: C, I, E, S. Each of the letters gives access to specific tab:

C – coverage;
I – integration;
E – Usability;
S – stability;

For example, managers mostly will have an access to coverage and integration, when users will have an access to Usability and stability. This is not a strict rule. The roles can be discussed and decided among the users by the users.

On the right part is the window with the evaluation circles. The administrator can stop current circle and begin a new circle whenever he decides. It was suggested to keep one month for every circle.

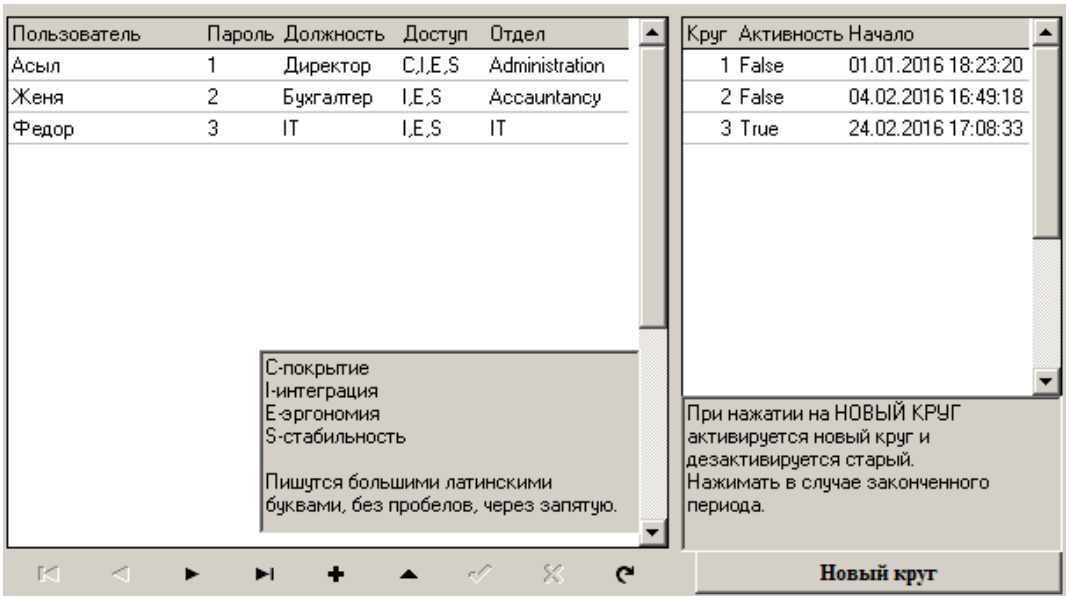

Figure 46 Admin window, Source: own.

Data addition to the Coverage

In the figure, bellow can be seen the Coverage window (tab). On the right top, there is a link using which users can get information what should be done in this window. Here are three fields to be filled: process, weight, and description.

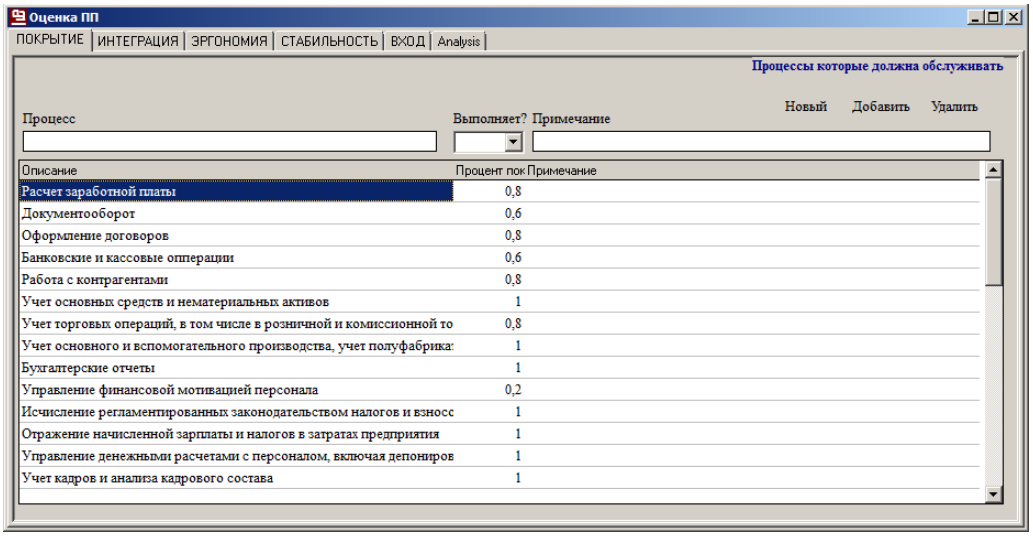

Figure 47 Coverage tab, Source: own.

In the figure below description of the process.

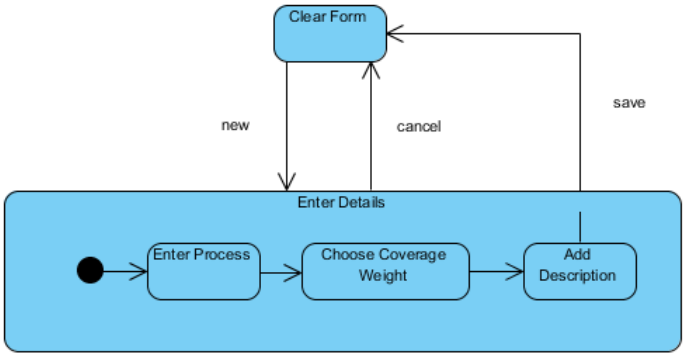

Figure 48 The process of data addition in the Coverage tab of the application, Source: own.

Data addition in the Integration

In the figure, bellow can be seen the window of data addition into integration table. There are also three fields to be filled: task, concurrent application/system, relation.

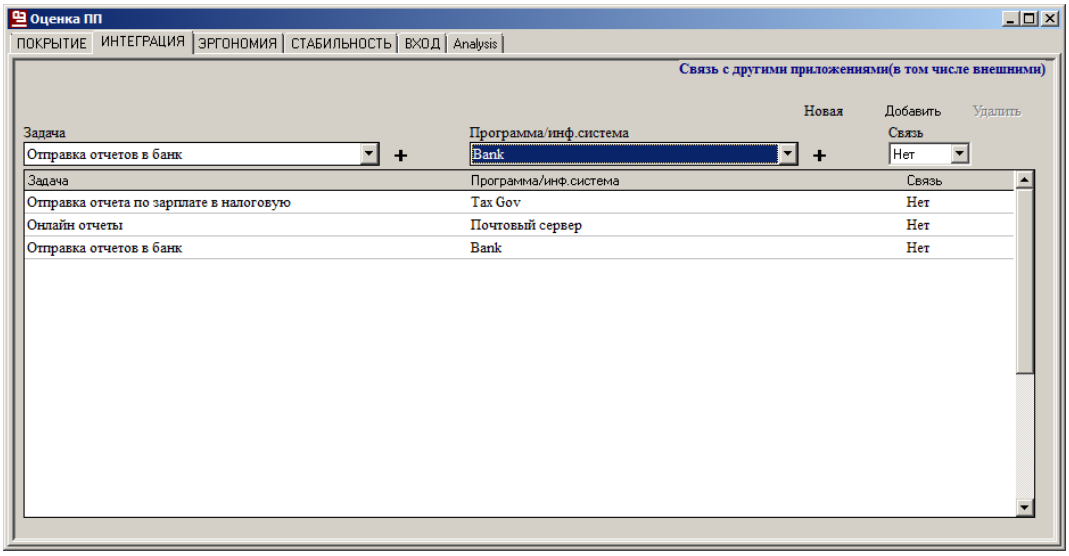

Figure 49 Integration tab, Source: own.

Data addition in the Usability

The next part is where users can estimate the application by answering to seven given questions. They give scores from 1 to 10. They even can miss some questions if they think they are not ready or do not understand the answer.

The window for this part is shown below. On the top on the right, there is a link if with an explanation about this page. The user can go there if he is not sure what to do. In the window, there is a question and short explanation to it bellow. Then there is a radio button with the scores. Bellow on the left the questions and the user's answers. The user can always go back and change the score using the arrows above the answering button.

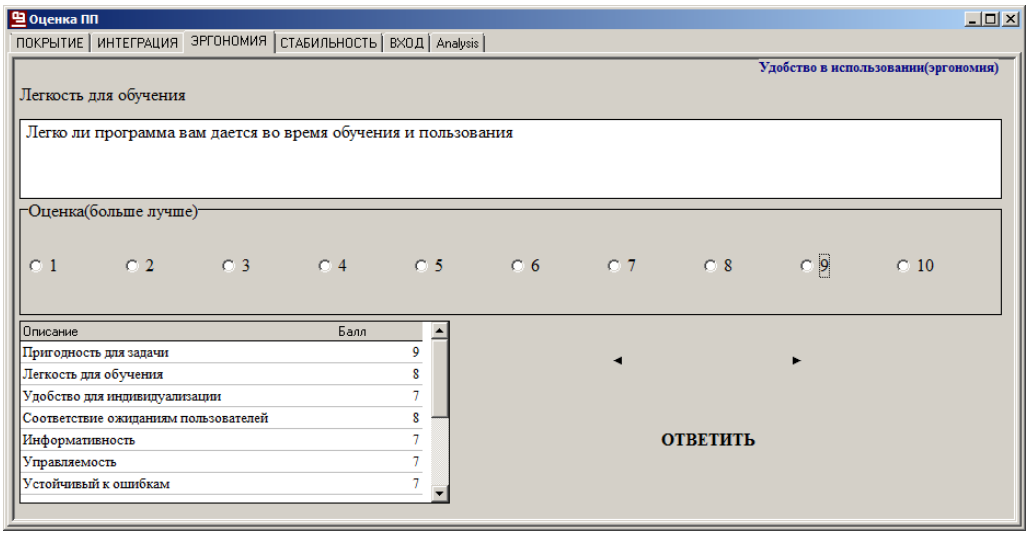

Figure 50 Usability tab, Source: own.

Data addition in the Stability

This part is a well-known part for the software maintainers. The goal of this part is to collect information about the incidents and errors which happens during the software functioning.

In the beginning, it was planned to collect the data in three ways:

User tracks the data

IT assistant collects the data

We use log files to the software

I used a combination of first and last points. Firstly, users track the data, and then I got the log files of the software and analyze what the users could miss. The application

always tracks errors which happen to it, but there is always a missed part when the user uses the application and faces the problems which sometimes won't be pointed out in the log files. This can be an even problem with understanding of the application.

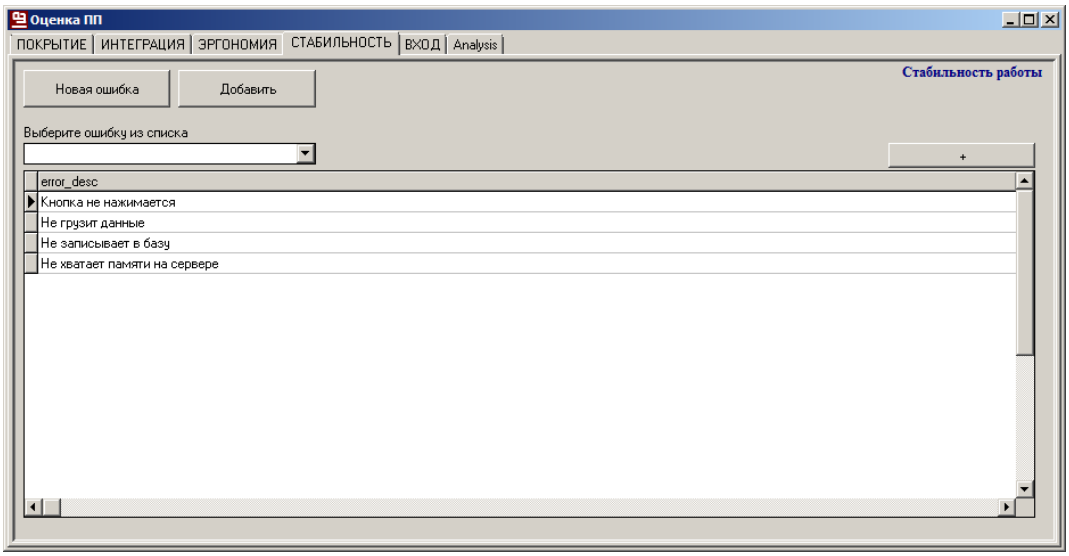

Figure 51 Stability tab, Source: own.

In the figure above we can see the window of stability part. Here the user just chooses the incident or error from the list. If he cannot find it on the list he can add it using the + button on the right.

And the last part is the part with the analysis of entered data where application overall information entered into the application and the charts (figure below).

As you can see in the figure below there can be more than one round of measurement. The graphs are given in two ways: for every circle separately and for all of them in comparison.

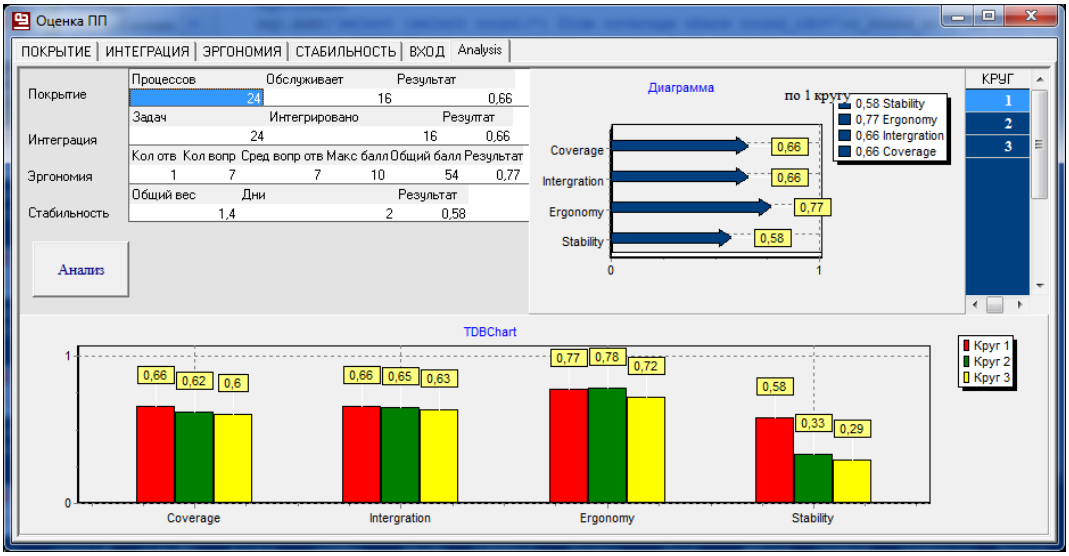

Figure 52 Screen of Application, Source: own.

Database for application

In the database, we have eleven tables. In the figure below, all the tables and relationship between them is described. There are 4 main tables:

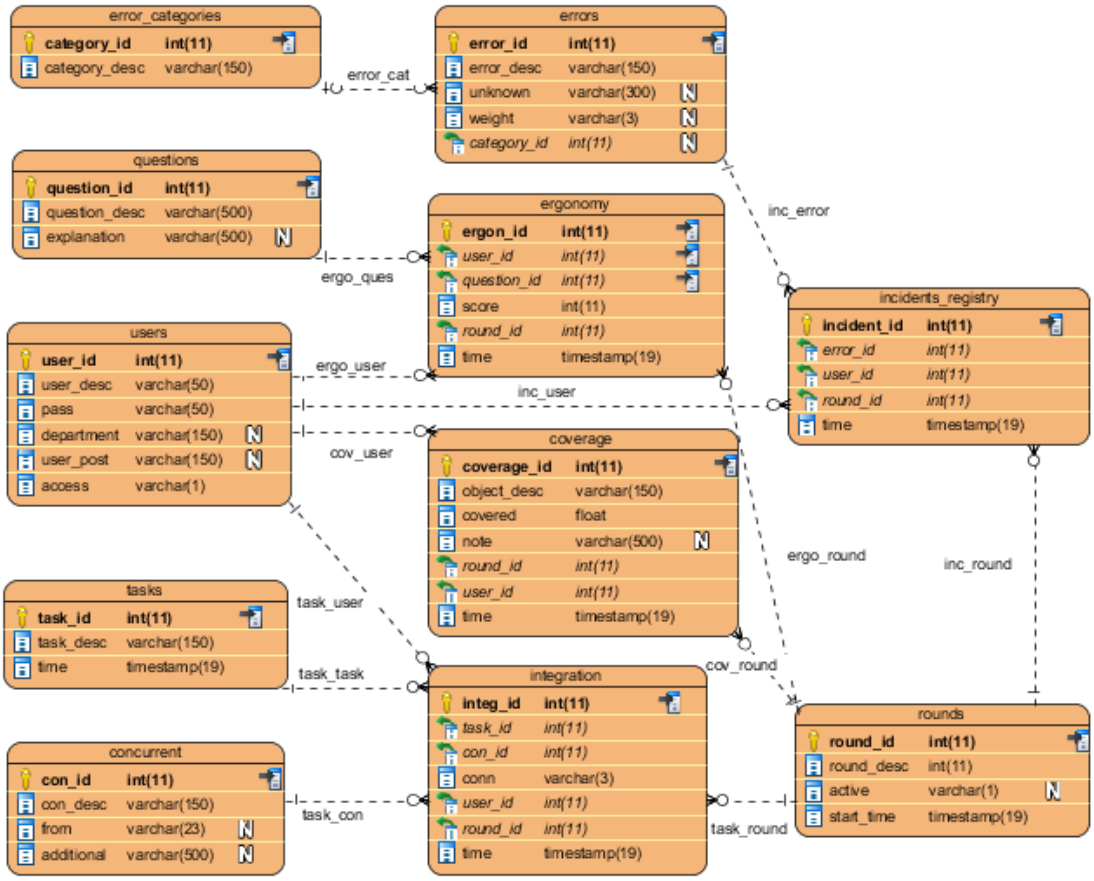

Figure 53 Structure of the tables, Source: own.

Experimental part

This chapter consists of the practical or the experiment part of the paper where the survey was conducted for the purposes of proposition a quality evaluation method to improve enterprise software use. in SMEs in Kazakhstan. The results of the survey are discussed in detail in this chapter.

Survey results 1: Software evaluation by SMEs in Kazakhstan

The initial step of the experimental part was to clarify the SME's attitude towards enterprise software evaluation.

Table 22 shows us call statistics. One of third of organizations agreed to participate in the survey. Average speaking time with each person was about four minutes. Time which was spent to identify the right person was not counted. Speaking time for main

questions was less than three minutes. The same time they were questioned and were explained the questions.

Number of respondents answered	64
Number of organizations contacted	187
Average call time with participated respondents:	-00:04:03
Average time of answers to the main part of questionnaire:	-00:02:42

Table 21 Call statistics, Source: own.

The figure below shows that the most used software in surveyed SMEs is the software for accountancy. The second place takes ERP. Hence, we can see that 11.5 % of respondents do not use any enterprise software.

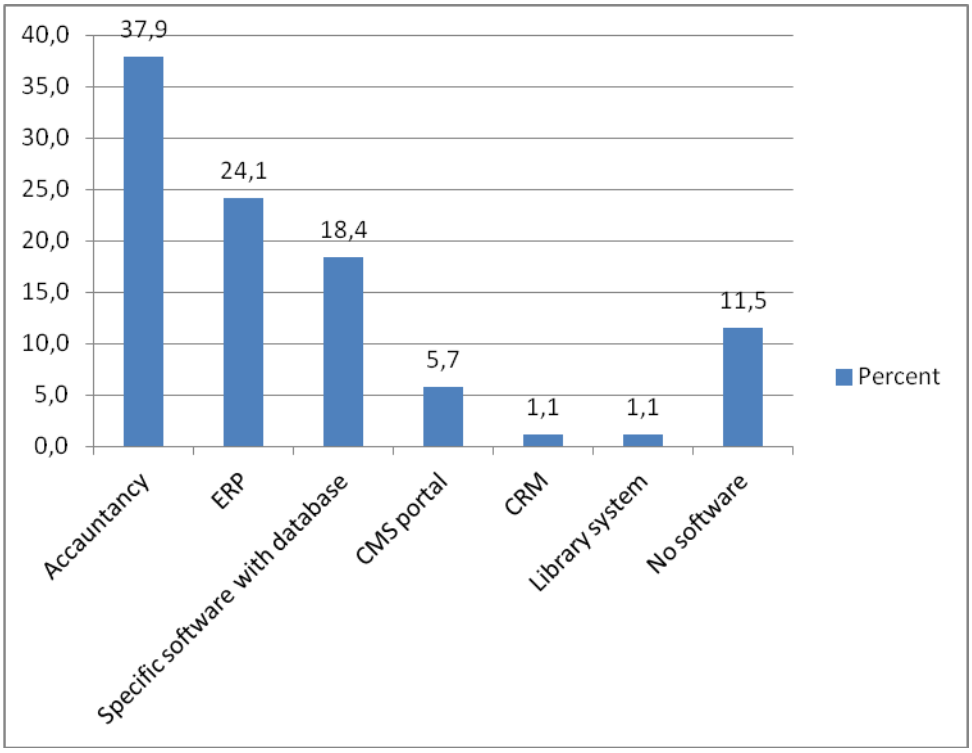

Figure 54 Software usage, Source: own.

In the table, bellow described data of evaluation by organizations of their software as well as their estimation of their software in three given aspects.

Evaluation	**Organizations**	**Software**	**Satisfaction**	**Understanding**	**Efficiency**
Yes	6	7	4,1429	4,4286	4,2857
No	49	70	4,1429	4,0429	4,1286

Table 22 Evaluation of software by the organizations, Source: own.

Table 23 shows that understanding of their software is much higher in the organizations who evaluate their software.

Most companies who do not do any software evaluation consider this process as "not needed".

Selection	count
Top managenment	15
ITdepartment	13
Working Departnment	13
Collective	23

Table 23. Software selection in the organizations.

The table above describes ratio in software selection organizations. Most of the organizations in the list pointed that they collectively choose the software. But on the other hand, we can see that Top management chooses which software to use in more cases than the department which directly works with that software or even IT department which will maintain that software.

Survey results 1: Discussion

According to results of the survey, the overwhelming majority of the small and medium enterprises use their software for accountancy needs. There is no significant difference in responses provided by SMEs, which do the software evaluation and those who do not run the software evaluation, to the main questions of the survey.

Another important outcome of the survey is that organizations who evaluate their software do not use international standards. Furthermore, most of the organizations use their own staff and own methods to run the evaluation process. Practically, no one from the list of the respondents does not use external specialists to evaluate their software or information systems.

The main part of the survey provides information that vast majority of SMEs in Kazakhstan practically do not evaluate their software. Even if there is no statistically significant difference between two groups, the evidence shows that companies, which evaluate their software had shown a higher understanding of their comparing to those who do not evaluate. However, this is only the fact for 55 organizations, which participated in the survey.

Survey results 2: Enterprise software support in SMEs of Kazakhstan

The objective of the second step was to assess the satisfaction of the users with the enterprise software support in the small and medium enterprises (SMEs) in Kazakhstan.

In the table below the respondents are categorized by Types of software support services. Despite the fact that enterprises were chosen randomly, the distribution of organizations by support Type turned up to be almost the same. The number of software decreases from Type X to the Type Z. This is due to the size of the companies. The majority of the respondents of Type Z are small enterprises, whereas the Type X dominated by medium-sized enterprises (Table 25).

Types	Description	Number of organizations	Number of software
Type X	With IT department or person in charge	18	31
Type Y	With contract of external support	19	27
Type Z	With not defined IT support	18	21

Table 24 Types of software support, Source: own.

The number of people in Group B is more than the number of people Group A because the usual number of managers in the companies is less than employees (Table 26).

	Description	Number of surveyed
Croup A	Managers	18
Group B	Employees	37

Table 25 Groups of surveyed, Source: own.

The means for all analyzed indicators: satisfaction by software, understanding the software, efficiency of the software show higher results for Group A (Table 27).

	Group A Mean	Group B Mean
Satisfaction by software	4.31	4.06
Understanding the software	4,38	4,19
Efficiency of the software	4,31	4,13
	4,33	4,13

Table 26 Results of Type X, Source: own.

For the Type Y satisfaction by software, the Group B showed the higher result. The other two indicators are turned out to be the highest rated by Group A (Table 28).

	Group A Mean	Group B Mean
Satisfaction by software	4,10	4,12
Understanding the software	4,10	3,94
Efficiency of the software	4,20	4,06
	4,13	4,04

Table 27 Results of Type Y, Source: own.

The third Type Z software support for Group B has shown the lowest rate for "Understanding the software" indicator (Table 29).

	Group A Mean	Group B Mean
Satisfaction by software	4,17	4,13
Understanding the software	4	3,87
Efficiency of the software	4,17	4,07
	4,11	4,02

Table 28 Results of Type Z, Source: own.

According to the t-test Type X has a significant difference between two Groups. As for other two Types, there was no significant difference obtained. Summarized t-tests and p-values are shown in the

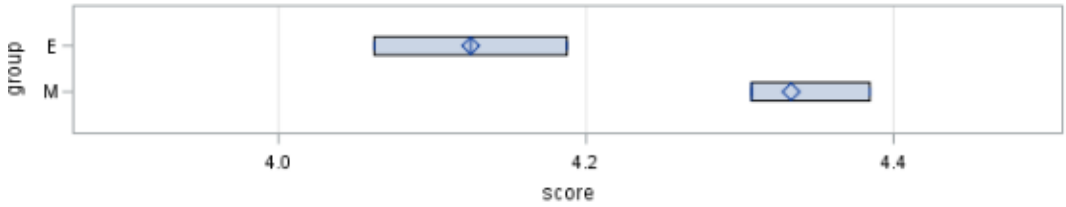

Figure 55 Result of Type X, Source: own.

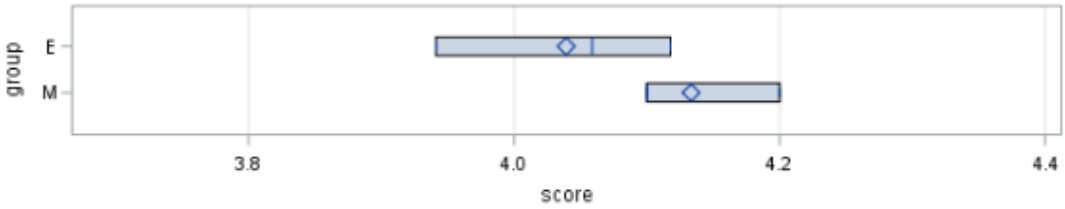

Figure 56 Type Y, Source: own.

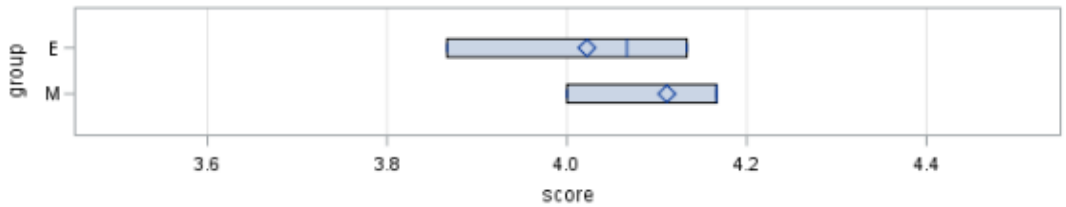

Figure 57 Type Z, Source: own.

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Results of the three Types are shown below. M - managers, E – employees.

	T-statistics	P-value	Results
Type X	4,706789709	0,00926168	Significant
Type Y	1,52699788	0,22420248	Not significant
Type Z	0,911857756	0,413428047	Not significant

Table 29 The result of t-test for Group A and B, Source: own.

The ANOVA test for the means of the three Types of software support(X, Y, and Z) is not statistically significant.

F Value	**F Critical**	**P-value**
1,57	9,55	0,34167687

Table 30 ANOVA of Three Types, Source: own.

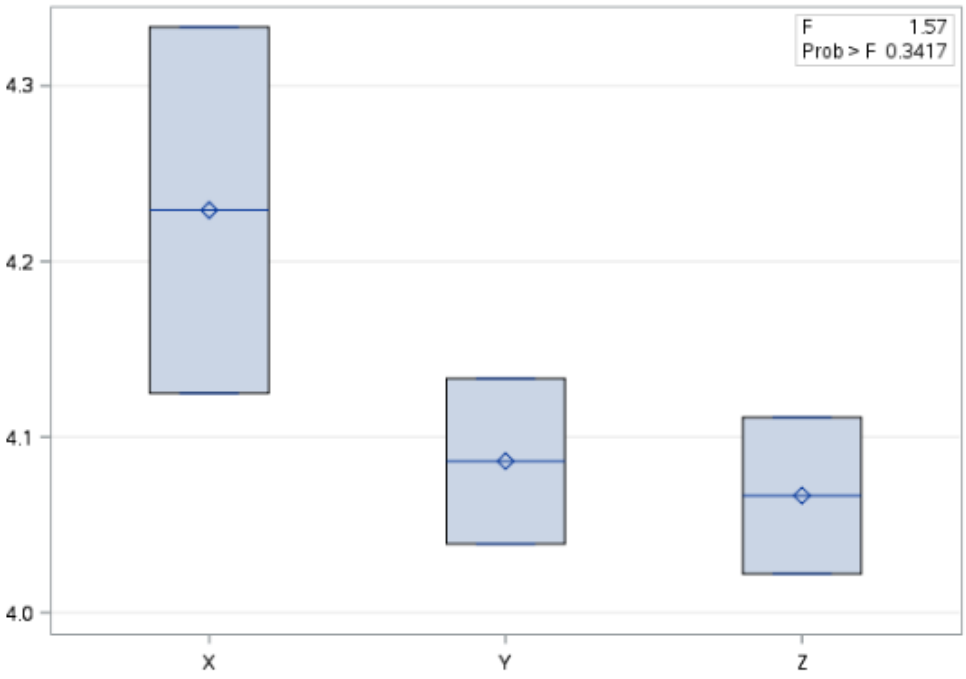

Figure 58 Comparison of three Types of support, Source: own.

In Figure 52 we can see that Type X has wider evaluation variations and higher rates than other two. Also, it can be seen from the Figure 52 that Y and Z Types of support have close rating levels.

Survey results 2: Analysis of data

One of the preliminary findings of the current study has shown significant results variation between two Groups in one of the three Types of software support. However, despite the fact of some variation of the rates provided by two Groups, statistically, this difference is considered to be not significant for the three Types of support.

All of the organizations were selected randomly and it shows the proportions of enterprises of three Types of IT support service are about the same. It can be seen from the results of the survey that the difference between three Types of support services is not significant.

Despite the overall high ratings for the Type X, the managers (Group A) performed significantly higher rating than the employees (Group B), this is also confirmed by the t-test results. One of the explanations can be their decision-making position in the software procurement process. Also, the managers have a main role in the selection of the Type of support service.

The Type X software support, with IT department or person in charge, has the highest rate among the other Types. This represents the fact that company's staff has regular access to the IT professionals and can receive their assistance at any time without breaking the daily workload, which contributes to higher productivity and better work performance.

The almost similar rating for Types Y and Z explain that there is no significant difference either company has a defined outsourcing IT contractor receives just a random external IT support. The only deviation in results for these two Types may occur because Type Z software support mainly consists of small enterprises, whereas Type Y is representing more medium-sized enterprises.

Overall, it can be observed that almost all respondents were satisfied with their software. There were only a few respondents who rated the statements bellow three out of five.

Survey results 2: Discussion

The devaluation which recently happened in Kazakhstan greatly reduced financial capabilities of many companies. At the moment, with the onset of problems in the

economy of Kazakhstan many companies are looking for a way to reduce costs. The survey shows that the assessment of the difference between the internal, external and not defined software support is generally not large. Though, among three types of support, those organizations with ongoing support are more satisfied. Surely, the use of internal IT support implies them to spend more money than the respondents with no permanent support.

This study can assist small and medium enterprises in determining to what kind of support service, they may prefer. The main point in the choice of the Type of support software is the cost. Also for some companies because of their size and the rare use of software applications, there is no need for constant support of their applications. Correctly selected type of support can help a company find a balance between cost and quality. It should be understood that in some cases, in the pursuit of savings may suffer quality of work. Companies that constantly need support can seriously disrupt their business processes trying to reduce costs through savings in IT maintain.

Applying measurement method in the organizations

This part represents organizations participated in research and displays some analysis. In the beginning, organizations reveal one by one, in the end, there is common analysis for organizations.

It was agreed with three organizations that the method will be used in their organizations. Finding suitable participants took about five months. Each organization agreed to present 3 circles of evaluation. As it was said before one circle takes about three months.

The organizations selected for the research are operating in Kazakhstan. The choice of organizations was based on the procedure of approaching a contact person within that organization, determining if the organization was appropriate to study and requesting permission to run the research in that organization. In exchange for access to certain firms and discussion of their processes, which required commercial confidentiality, I agreed to hide real names. Therefore the firms will be represented by abbreviation. The various types of firms were studied in order to increase the number of practices chosen by a variety of organizations.

Short description of organizations

The table below describes short information about the participants. Since mainly participants asked for privacy the names of organizations were substituted into abbreviation consisting of O- which means organization and the two letters from the industry which they represent. The second (OED) and the third (OAG) organization use many seasonal workers. Therefore average annual figures were taken as the number of employees.

#	Name	Industry	Employees	Persons involved in research	Enterprise software	Test applying date
1	OIT	IT	11	3	1C Enterprise	07-2016 to 10-2016
2	OED	Education	55(approx)	5	1C Enterprise	08-2016 to 11-2016
3	OAG	Agriculture	70(approx)	5	1C Enterprise	12-2016 to 03-2017

Table 31 Description of the organizations, Source: own.

8.3.2. Results from organizations

The participants are from various regions. The First organization (OIT) from the table above is from Almaty region, quite developed region. It works in IT industry, an area of providing internet to clients. It is a small enterprise with eleven employees in total. The results from OIT are shown in the graph below.

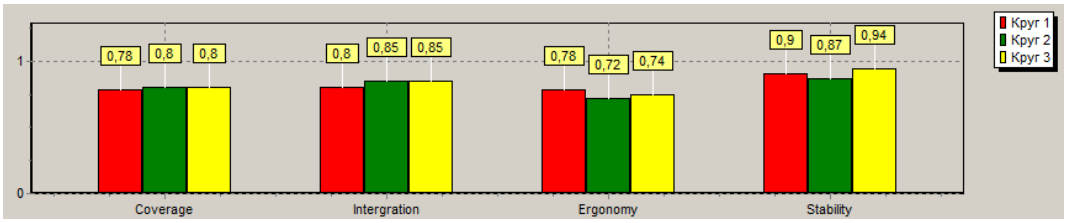

Figure 59 Analysis tab of first organization, Source: own.

Their end result for three rounds of the evaluation showed that they estimate the behavior of their software quite high. Most of the values spin around 0.8. The performance was estimated higher than other measures. The Usability showed the less result. In the coverage, they indicated 24 needed processes and the software covered 19.4 of it. Unfortunately Integration part was with very few records. Accordingly, the result was 7 needed and 6 solved. The Integration part faced some difficulties. Therefore, it will be discussed at the end of this chapter.

OED – is the organization medium in a number of employees, but in fact, small in assets organization. It is a college. It operates in education area and provides services for students.

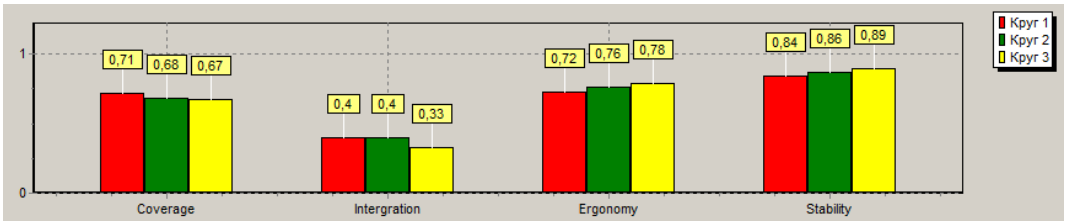

Figure 60 Analysis tab of the second organization, Source: own.

Their estimation results (table above) are less than previous organization's example. They also estimated stability very high. However, they estimated integration very low. The rest graphs are much better. In particular, estimation of Usability goes up circle by circle.
In the last round, the number of needed processes is 38 and estimation of their coverage are 25.6, which gives result 0.67. It is not a bad result. However, it is not a desirable result.

The last organization OAG is from the agriculture industry. A number of employees are not much more than OED but in comparison its assets suits to medium

organization requirements. It is mainly aimed in animal breeding. Also, it is engaged in plant growing.

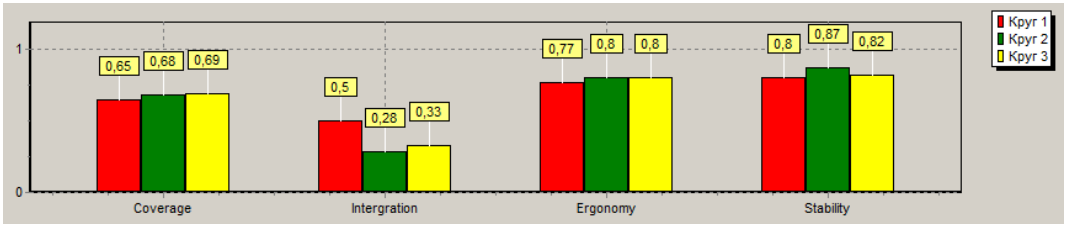

Figure 61 Analysis tab of the third organization, Source: own.

The table above describes results received from OAG. The first thing to notice is that the results from the graph are very similar to previous organizations results. Nevertheless, we have got more entered data from this organization. For example, processes added are 93 it is three times more than from previous organization. Furthermore, all the users entered the data in every circle, whereas in OED some users stopped entering data after the first circle.

Overall the results given from organizations indicate that they are mostly satisfied with their enterprise software.

Organizations

Round	OIT		OED		OAG	
	Count	Average	Count	Average	Count	Average
1	21	0,78	16	0,71	31	0,65
2	3	1	19	0,66	25	0,74
3	-	-	3	0,53	37	0,7

Table 32 Processes entered by rounds, Source: own.

The table above shows how many processes organizations entered into the database and mean for the processes in every round. All responses are above average.

According to discussion with organization's representatives, the coverage part was a most needed part. As it was expected the number of needed coverage functions increased according to the size of organizations. First two organizations filled out needed-functions in the first two rounds. The last organization filled it consistently.

In, the table bellow data from integration part is represented. This part is fairly questionable. Despite the fact that organizations insisted on the importance of this part, there were quite a few responses from responsible persons. Collected responses revealed less satisfaction with this parameter.

	Organizations					
	OIT		OED		OAG	
Round	Yes	No	Yes	No	Yes	No
1	4	1	2	3	2	2
2	2	-	-	-	-	3
3	-	-	-	1	1	1

Table 33 Integration pairs, Source: own.

The integration part was quite poorly data entered. But this part is interesting how the respondents filled the required fields. The OIT filled the integration fields with more advanced terms, while the others mentioned only reports and other simple requirements to their enterprise software. For example reports to Tax-officials. OIT on his side pointed out some universal integration instruments as an important value. The main reason to that is that OIT is from the more developed region and represents Information Technology field.

		Organizations					
Round	User numbers	OIT		OED		OAG	
		Summ	Average	Summ	Average	Summ	Average
1	3	110	7,8571	252	7,2	271	7,7429
2	5	94	7,2308	160	7,619	283	8,0857
3	5	156	7,4286	165	7,8571	281	8,0286

Table 34 Usability comparison for all organizations, Source: own.

In the table above can be seen results from Usability part where end-users estimate software they use. The average number is well for all of the organizations. The ergonomic part was filled by organization's end-users. Overall 13 people from our three organization participated in the estimation. Most of the results showed increases in that the responses

round by round. To clarify some moments a small discussion after all three rounds took place. In the discussion, respondents explained score increased by additional experience with the software.

	Organizations					
	OIT		OED		OAG	
Round	Days	Average	Days	Average	Days	Average
1	27	0,9	40	0,84	44	0,8
2	27	0,87	21	0,86	35	0,87
3	27	0,94	25	0,89	30	0,82

Table 35 Comparison of incidents from three organizations, Source: own.

The table above describes results duration of incidents registration and average results for the organizations. The stability part showed the highest response from all three organizations. As it was mentioned, the reliability part presented highest results. These days most of the commercial enterprise software works with very few errors due to the better development process, but the incidents happen. The reasons vary. In our case, we have seen some incidents, not through the fault of the software, but also poor understanding by users their software. Also, there were some errors related to the environment. For instance in, one of the organizations there were many errors associated with the network. The organization had poor network infrastructure.

Assumptions and limitations of the method

It is just a matter of time of decaying of quality of any software. Quality of software must develop together with the changing world. Software must suit to many factors to keep quality in high level. It totally depends on the goal of stakeholders[3]. It is like a sandwich between running forward business and technology. If it will fall behind one of them then it won't get high quality. That is why quality control of software is important, however, we must also not forget about the business which uses it. Does software which organization utilized suits to its expectation? Do users satisfied with it? These are the main questions in this method.

Surely this method has it is own limitations. Larger organizations have more comprehensive requirements and this method can be not sufficient for them, but SMEs can find a lot of benefits from it such as time-saving in formulating initial requirements and lack of complicated documentation.

The method will certainly give a positive impact to organizations because it is based on their expectations and the needs of users in the organization. It highlights that organizations decide what they need, not the vendors or developers. In many cases, vendors sell products with many non-needed functions which just will take place in hardware and memory, and the non-used functions can have influence in the quality evaluation process. This moment must be avoided when organizations want to evaluate their software and get more close to real results for their organizations.

For the enterprise, the introduced method would bring benefits through the possibility of learning and understand their enterprise software in the process of evaluation. Organizations can determine their requirements not only in the beginning but also in the process of evaluation. It gives them flexibility.

The main advantage of this method is that organizations do not need to describe all the processes. They can just specify the processes which they need at this moment and over the time if the problem will not be solved it will stay in the list as non-solved, and it will not give an additional credit to software.

Only experience and suggestions of three organizations were taken to build this method. The graphs from that organizations shows that the organization from developed area had less problems with defining their goals in the first month. Whereas, organization from rural zones had issues with that task.

Conclusion

Nowadays, enterprise software is attracting more and more organizations because of their usability, simplicity, and effectiveness. These characteristics can support cost reduction for user training. But for organizations with less financial and human recourses capacity, a less complicated and less costly enterprise software evaluation method is an advantage.

The experimental part showed that most of the software of SMEs in Kazakhstan is used to support business processes. From this research, we can conclude that most of the SMEs in Kazakhstan do not evaluate their enterprise software.

At the same time, we found that respondents who evaluate their enterprise software find themselves able to better understand their software. Also, the applied evaluation method showed that understanding of their software increased after the software evaluation.

The survey highlighted the problems of software quality measurement in SMEs of Kazakhstan. Most of the respondents considered the software evaluation as “not-needed”. In this work, the framework for software service evaluation for better integration of enterprise software was proposed. The group of organizations with enterprise software understood the benefits from the evaluation and changed their corporative strategy about software evaluation. Practically, SME organizations quite often do not understand in depth their enterprise software. Sometimes, they consider existing functions as non-existing. The evaluation process gives them more understanding of their software. They can clearly sort out what they have, what they need and the ways to achieve the required level.

In conclusion, some limitations must be mentioned. The organizations that participated in the research were volunteers so the results from them really depend on what they wished to say. Also, data from only three organizations that have the same enterprise software were used.

Research has been carried out in the quest of improving the various models with reference to ISO to aid the various SMEs for better understanding of their enterprise software.

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List of abbreviations and dictionary

SME	Small and Medium Enterprises
ICT	Information and Communication Technology
ITSM	Information Technology Service Management
ITIL	Information Technology Infrastructure Language
ASW	Application software
ISO	International Organization for Standardization IEC - International Electrotechnical Commission
ERP	Enterprise Resource Planning
DB	database
SAP	Application - Product in data processing

Outsourcing - managing the operating system (platforms, applications, etc.) by a third person

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NAME	REGION	INDUSTRY	ADDITIONAL
Agromean	Almaty region	Agriculture, forestry and fisheries	Agroproducts
Zernovoi Pul Kazakhstana TOO	Kostanay region	Agriculture, forestry and fisheries	Grain storage
Lugovskoi Konny Zavod TOO	Zhambyl region	Agriculture, forestry and fisheries	Agro farm
AVGRUPP	Karaganda region	Manufacturing	Production of food
Kondiz TOO	East Kazakhstan region	Manufacturing	Confectionery
3D Decor TOO	Astana city	Manufacturing	Outdoor advertising
ADS UNION	Karaganda region	Manufacturing	Metalworking
GOSS TRADE	Almaty city	Manufacturing	Manufacturing sales of cotton products
Geo Engeneering	Karaganda region	Mining and quarrying	Geodesys
360 Professional LTD	Astana city	Constrtuction	Construction and materials
ABS GROUP	Astana city	Constrtuction	Constructing
Absalut Ecology	Karaganda region	Constrtuction	Development and construction of industrial plants for cleaning

			emissions
ADC-System	Almaty city	Constrtuction	Construction and repairs
AIG company TOO	Almaty city	Constrtuction	Channel washing cars, roller, pump stations, pumps for dewatering equipment for pipe rehabilitation
ALA CARTE KAZAKHSTAN	Almaty city	Constrtuction	Half-timbered houses, terraced Floor, decking, decking, bioclimatic architecture, building houses, glued beam houses, eco-construction
ACADEMY DESIGN PLUS TOO	Almaty city	Constrtuction	Construction and repairs
ALEM SAUDA LTD TOO	Almaty city	Constrtuction	Rental of machinery, sales of machinery, dump trucks, excavators, graders, loaders, loader-excavator, bulldozers, cranes, trawls, trucks, motor graders, road rollers, working pits, excavation, trenching, road construction, road maintenance
ALIAN-MARKET TOO	Almaty city	Constrtuction	Sale of building materials
ALMAT CONSTRUCTION TOO	Almaty city	Constrtuction	residential containers, residential trailers, modular buildings, modular unit containers, wagons shower, lavatory, a mobile clinic, mobile bath, sauna, mobile, insulated containers

AMAN SHEBER TOO	Almaty city	Constrtuction	Construction and repairs
KEY SOLUTION TOO	Almaty city	Constrtuction	As a representative of a major European architectural bureau in Kazakhstan, offers services in designing private houses.
MAXILIVE	South Kazakhstan region	Manufacturing	Manufacturer of aluminum profiles and structures in the Republic of Kazakhstan and Central Asia with a complete, closed-modern technological cycle of production, carrying out decoration and anodized aluminum on the Italian technology.
SIPHOME TOO	Almaty region	Constrtuction	It specializes in the construction of houses on the Finnish technology.
REF CARGO TRANS	Karaganda region	Transportation and storage	Trucking, cargo from 1 cubic meter, cargo up to 120 cubic meters
KAR SPEC SERVICE	Karaganda region	Wholesale and retail trade, repair of motor vehicles and motorcycles	The company operates in the market of equipment and parts. It is the official dealer of companies SDLG, XCMG, Changlin, Lonking in Karaganda region.
DELTA EQUIPMENT	Karaganda region	Wholesale and retail trade, repair of motor vehicles and motorcycles	We supply genuine spare parts for equipment for cranes, for asphalt.

CMU-TRANS-SERVICE	Karaganda region	Transportation and storage	It offers services in the organization of cargo transportation from 1 cc / m to 120 cu / m cities of Kazakhstan, the CIS countries, the European Union.
007 Avtokompleks	Karaganda region	Other activities	Dry cleaning machines, car polishing, preparation of the car for sale, car electrician, motor oils, gas engine oils, gear oils, hydraulic oils, greases, pastes, functional fluids, service products, aerosols, alarm installation
4x4 IP	Almaty city	Wholesale and retail trade, repair of motor vehicles and motorcycles	Performs repair FIELDS VAZ 21213, 21214, 2123. Complete repair of chassis, assemblies manual transmission, gear (axles).
ALMATY INTERNATIONAL LOGISTIC PARK	Almaty city	Transportation and storage	AILP Group specializes in creating logistics infrastructure
Merkury	Astana city	Accommodation and food services	Accomodation
Koktobe	Almaty city	Accommodation and food services	Accomodation and restourant
ELCOM-SERVICE	Karaganda region	Wholesale and retail trade, repair of motor vehicles and	Copiers, printers, scanners, computers, laptops

		motorcycles	
5-Element	Zhambyl region	Other activities	Advertising and production agency
PARDES TOO	Akmola region	Wholesale and retail trade, repair of motor vehicles and motorcycles	Products and services security systems: video surveillance, fire alarm, access control, automatic gates, sectional, barriers, alarm systems, intercoms, fire-fighting equipment, GPS-monitoring
Profy-style	South Kazakhstan region	Wholesale and retail trade, repair of motor vehicles and motorcycles	Cosmetic products
INFORMATION TECHNOLOGIES INVEST GROUP TOO	South Kazakhstan region	Information and communication	IT-services
1000 VOLT	East Kazakhstan region	Wholesale and retail trade, repair of motor vehicles and motorcycles	
PHYTO-APIPHARM	South Kazakhstan region	Wholesale and retail trade, repair of motor vehicles and motorcycles	Cosmetic balms, honey balms, salves, oil, mineral-sorbents, antiulcer Phyto, Phyto tonic, anti-Phyto
B2B-SERVICE	Almaty city	Wholesale and retail trade, repair of motor vehicles and	It specializes in the wholesale and retail office products. Internet-shop provides on-line sale of office products in the

		motorcycles	region
BERGHOFF-CENTRAL ASIA	Almaty region	Wholesale and retail trade, repair of motor vehicles and motorcycles	Distributor Bulgarian company BergHOFF Worldwide "in Kazakhstan. The company is engaged in the development and production of kitchen and tableware
BEST	Astana city	Education	Language school
CENTRASIA TRADE TOO	West Kazakhstan region	Wholesale and retail trade, repair of motor vehicles and motorcycles	Emergency and rescue equipment, ship equipment, berthing, mooring equipment, aids to navigation, marine chemistry, marine agency, marine geophysical research equipment, fire equipment, rescue equipment, marine engines, marine diesel generators, fenders, bollards, buoys, marine navigation aids , charts, rigging, anchor ropes, tow ropes Deltex, corrosion inhibitors, paints and varnishes, water treatment products, products for tank cleaning
CERAVIT-CERAMIKS	Almaty city	Wholesale and retail trade, repair of motor vehicles and motorcycles	Salon furniture, paintings, rugs, children's furniture, home textiles, design services for interior design
CENTRAL ASIA COMPANY	Almaty region	Wholesale and retail trade, repair of motor	The company is engaged in wholesale deliveries of technological materials and

		vehicles and motorcycles	equipment for the metallurgical, oil and gas industry
ALAKHAN SAT	Kostanay region	Information and communication	It provides services to access the Internet
ISKER MEDIA	Almaty region	Information and communication	Publisher "Isker Media" offers media projects financial and economic issues: the interactive information and analytical resource www.and.kz, the business newspaper "Biznes & Vlast" business magazine "The Real Business of Kazakhstan"
PROFI ESCORT IP	Kostanay region	Information and communication	It provides services for automating business processes
EAST HOUSE IP	Astana city	Real estate operations	Real Estate Company, provides services for the design of real estate transactions.
LINSAT	Karaganda region	Real estate operations	Provides a full range of services for the sale, purchase, exchange, lease of houses, apartments and commercial properties in the city of Karaganda, Karaganda region, as well as the purchase and lease of real estate in Turkey, Bulgaria, Thailand, Italy, France, Switzerland, Spain, Monaco, United Arab Emirates and other countries.
RENT REALTY	Almaty region	Real estate operations	Real estate agency, rent of commercial real estate, luxury real estate, commercial real estate, real estate services, real

			estate, real estate management
REST PROPERTY	Almaty city	Real estate operations	Estate Agency with more than 10 years of experience in the Turkish market as well as the developer, which offers apartments in residential complexes on the Mediterranean coast: Antalya and Alanya
SOGLASIE LTD	Almaty city	Real estate operations	Evaluation of real estate, movable property appraisal, assessment of securities, valuation of collateral, equipment evaluation, assessment of construction in progress
VALUERS	Aktobe region	Real estate operations	Estimation of the real estate, Assessment of movable property, valuation of intangible assets
GOLDEN AGE	Almaty city	Financial and insurance activities	The main activity is the issuance of short-term loans on the security of the population
GRANDES KSJ AO	Almaty city	Financial and insurance activities	The company provides services for life insurance in the form of compulsory and voluntary insurance.
DENT-LUX AO	Almaty region	Health and social services	The network of dental clinics in Kazakhstan
LS-CLINIC	Almaty city	Health and social services	Private medical clinics, providing medical and diagnostic assistance to the

			population.
Local History Museum	West Kazakhstan region	Arts, entertainment and recreation	Museum
Jailau	Kostanay region	Arts, entertainment and recreation	Sanatorium
Academia Rosta	Astana city	Education	It works in the sphere of additional vocational education, providing training in various fields and professions that are in demand in today's job market.
COLLEGE K.Nurgalieva	East Kazakhstan region	Education	Training, specialty Production of building components and structures, training, specialty Traffic, training in law, education, specialty Organization of service hotel management, training, specialty Accounting and Auditing, training, degree in Economics, teaching in the specialty Tourism, specialty training Computing equipment and software
MEDICAL COLLEGE Astana akimat GKPP	Astana city	Education	Nursing, medical, pharmacy, dentistry
KAZAKH SECONDARY SCHOOL #38	Aktobe region	Education	Education