Lappeenranta University of Technology
School of Engineering Science
Software Engineering
Master's Programme in Software Engineering and Digital Transformation

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ANALYSIS OF BI IMPLEMENTATION IN RUSSIAN COMPANIES

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ABSTRACT

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Analysis of Business Intelligence Implementation in Russian companies

Master’s Thesis

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Business Intelligence (BI) systems are regularly implemented as balanced and dynamic solutions requiring considerable human and financial resources, and offering support to the decision-making process by gathering, elaborating and analyzing information. After Russian business have realized the value of data, BI systems have become the new "core" of IT companies of all sizes. Whole data management chain is built around them, including accounting systems, innovative IT tools, as well as tools for storing, transferring and using data. Nevertheless, for prevailing number of users, the enthusiasm and hopes about BI implementation quickly turn into disappointment because of the complexity of such projects, mismatch between expectations and results, as well as the ineffectiveness of further use. This research seeks to investigate and analyze levels of BI competence according to technologies, tools, methods used and Critical Success Factors (CSF) influencing BI systems implementation success in Russian companies compared to European experience.

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LIST OF SYMBOLS AND ABBREVIATIONS

BA	Business Analytics
BI	Business Intelligence
CRM	Customer Relationship Management
CSF	Critical Success Factors
DMS	Database Management Systems
DW	Data Warehouses
EAI	Enterprise Application Integration
EII	Enterprise Information Integration
ERP	Enterprise Resource Planning
ETL	Extraction, Transformation and Load
KPI	Key Performance Indicators
OLAP	Online Analytical Processing
RDMS	Relational Database Management Systems
SOA	Service-Oriented Architecture
SQL	Structured Query Language
TEC	Technology Evaluation Center
SMB	Small-Medium Business

1. INTRODUCTION

1.1 Background

In the past years Business Intelligence (BI) has become an important area of study for both practitioners and researchers, reflecting the significance and impact of data-related problems to be solved in contemporary business organizations (Chen, et al., 2012), and Russia is not an exception. While huge amount of data appears to be more and more complex, messy, uncertain and at the same time required for many companies regardless of their size and area of activity, the problem of managing this data and therefore using and implementing a Data warehouse (DWH) and BI systems becomes very urgent. In order to stay competitive and sustainable companies measure, monitor, and analyze their performance.

Business Intelligence systems are regularly implemented as balanced and dynamic solutions requiring considerable human and financial resources, and offering support to the decision-making process by gathering, elaborating and analyzing information (Zamecnik & Rajnoha, 2015). After Russian business realized the value of data, BI systems have become the new "core" of IT companies of all sizes. Whole data management chain is built around them, including accounting systems, innovative IT tools, as well as tools for storing, transferring and using data. Nevertheless, for the prevailing number of users, the enthusiasm and hopes about BI implementation quickly turned to disappointment from the complexity of such projects, mismatch between expectations and results, as well as ineffectiveness for further use (cnews.ru, 2017, [22]). This research seeks to investigate and analyze levels of BI competence according to technologies, tools, methods used and Critical Success Factors (CSF) influencing BI systems implementation success in Russian companies comparing with European experience.

According to Gartner, global market volume of Business Intelligence platforms and analytical applications in 2017 reached $18.3 billion, and by the end of 2020 will exceed $22.8 billion(iot.ru, 2018, [21]). The volume of Russian BI contribution in world market constitutes from 1% to 5% , or from $180 to $700 million (iot.ru, 2018, [21]). Today, one of the development drivers of Business Intelligence tools in Russia is realization of their undoubted benefits for all categories of users. Analytics, forecasting, building working hypotheses on real data — all these features have become

available to the Head of Sales Department, Head of Production, economists and top management. And not only on the stationary workplace, but also on the mobile version. (iot.ru, 2018, [21])

The approach of Russian organizations in the BI systems implementation slightly differs from the European ones. Western customers are more often guided by a mature process approach and implement analytical platforms in order to be used by the whole company. In Russia, "partial automation" in some departments is more common, when the analytical system is set "for the tasks" of one or two departments (softline.rbk.ru, 2015, [6]). This trend was especially noticeable few years ago in the banking industry. On the wave of growing interest in Business Analytics, banks often ordered different systems for different departments. Yet implementing a BI system does not only entail the purchase of a combination of software and hardware, rather, it is a complex undertaking requiring appropriate infrastructure and resources over a lengthy period of time (Yeoh & Koronios, 2010). Hence, the question of measuring the success and outcomes of such budget-consuming implementation and comparing Russian practice with world-wide experience deserves due attention.

1.2 Research Questions

In response to above observations, this research sheds some light on the area of BI development and implementation methodologies used in Russia, concerning about how we can measure the success of such projects, the proficiency of methods and tools used during such projects and satisfactory level of architecture and outcome of system itself, as well as problems faced by development and management teams. The specific research questions addressed in this thesis work are as follows:

RQ1. What development methods, tools, techniques and architecture components of BI systems do Russian companies use?

RQ2. To what extent are end users satisfied with implemented products?

RQ3. What are the Critical Success Factors (CSF) and existing problems of these projects?

RQ4. How Russian practice in this field can be compared with European experience?

1.3 Research Methodology

Figure 1 illustrates key steps of research process, which is based on:

- Qualitative data collection during interviews with 5 analysts, 3 of them are currently working for a company - BI integrator and were participated in BI implementation projects during their work experience and 2 of them are internal employees of their companies and managed the implementation project ;
- Data collection from literature review of European BI implementation experience.
- Semi structured interviews in Russian companies. They are selected as the primary source of evidence to facilitate an examination of the organizations' experiences in relation to the level of BI proficiency and CSFs identified in the literature.

Fig. 1. Research Process

As it is shown in the Table below, various tools, methods & techniques as well as components of BI architecture, project problems and success factors of different Russian and European companies are identified through research process for the further analysis and comparison.

Table 1. Research methods

Purpose of research	Research methods	Data for gathering	Research Group
Identifying tools, methods, techniques, BI architecture, BI role in Russian companies	In-depth interviews	tools, methods, techniques, components of BI architecture, BI role in Russian companies, project success factors, problems	5 Russian analysts
Identifying tools, methods, techniques, BI architecture, BI role in European companies	Literature review	tools, methods, techniques, components of BI architecture, BI role in European companies, project success factors, problems	7 European companies from literature review

Despite the vibrant BI market and the complexities surrounding the implementation of BI systems, the critical success factors (CSFs) of BI system implementation initiatives remain poorly understood (Yeoh, W., & Popovič, A, 2015). Also, another limitation factor of this work is limited access to European companies, therefore they are analyzed from the existing literature resources. More specifically, on the basement of existing work and European examples from literature review, as well as in-depth Russian companies' analysis, this study offers a better contextual understanding

of global and Russian methods, tools, technologies used, problems and CSFs of implementing BI systems in Russia. In total, five large Russian BI implementation projects were examined, analyzed and compared with foreign practice.

1.4 Structure of Thesis

This Master Thesis work is structured as follows. In the Related Work section major components and objectives of BI systems are identified, providing deeper understanding of how global BI market expanded and evolved, architectural structure of data-driven systems, existing implementation methodologies and CSFs frameworks for evaluating implementation projects. The Research Framework section describes key aspects and dimensions of chosen framework for analysis. It is then followed by research findings pertaining to the analyzed European experience and qualitative study observing Russian examples and then comparison between them using framework. In the Conclusion & Discussion, the research contributions and further suggestions are highlighted.

2. RELATED WORK

2.1 The Developments in BI market

2.1.1 Global BI market

The term *intelligence* has been used by researchers in artificial intelligence since 1950s. Business intelligence became a popular term in the business and IT communities only during early 1990s. In the late 2000s, business analytics is introduced to represent the key analytical component in BI (Davenport 2006). More recently big data and big data analytics have been used to describe the data sets and analytical techniques in applications that are so large (from terabytes to exabytes) and complex (from sensor to social media data) that they require advanced and unique data storage, management, analysis, and visualization technologies (Chen, Chiang, & Storey, 2012).

The history of Business Intelligence & Analytics (BI&A) goes to the long-standing database management field, where data sets are mostly structured, collected and stored in commercial relational database management systems (RDBMS). Practitioners and researches consider such technologies as BI&A 1.0, when design of data marts and tools for extraction, transformation, and load (ETL) are essential for converting and integrating enterprise-specific data. Database query, online analytical processing (OLAP), and reporting tools based on intuitive, but simple, graphics are used to explore important data characteristics (Chen, Chiang, & Storey, 2012). Most of these data processing and analytical technologies have already been incorporated into the leading commercial BI platforms offered by major IT vendors including Microsoft, IBM, Oracle, and SAP (Sallam et al. 2011).

With the high prevalence of web-based technologies starting from early 2000s, Internet began to provide vast opportunities for research and development in BI field. This reflected in the ability to set up an online business and, thereby, interact with customers directly. In BI&A 2.0 the implementation of applications will be based on a service architecture using public solutions and active elements of Web 2.0 (for example, AJAX) and a functionally rich external interface. Standards for interaction and reporting will be improved and methods for providing on-demand analytical services, including through outsourcing, will be disseminated. The main hopes in BI&BA

2.0 are associated with service architecture (Service-Oriented Architecture, SOA) and open, standards-based technologies (Greg Marrow, 2018).

Unlike BI&A 1.0 technologies that are already integrated into commercial enterprise IT systems, BI&A 2.0 systems require the integration of mature and scalable techniques in text mining (e.g., information extraction, topic identification, opinion mining, question-answering), web mining, social network analysis, and spatial-temporal analysis with existing DBMS-based BI&A 1.0 systems (Chen, Chiang, & Storey, 2012). The set of algorithms offered by such technologies go well beyond what is offered as aggregate functions in relational DBMSs and in OLAP servers. Such analysis includes decision trees, market basket analysis, linear and logistic regression, neutral networks and more (Chaudhuri, S., Dayal, U., & Narasayya, V., 2011).

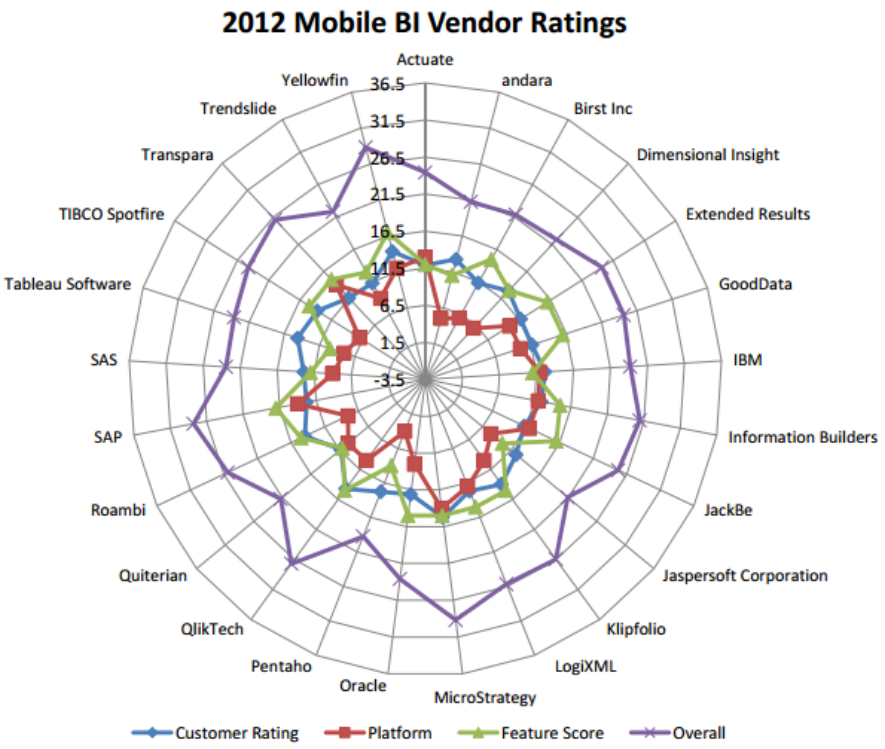
Whereas web-based BI&A 2.0 has attracted active research from academia and industry, a new research opportunity in BI&A 3.0 is emerging. With the spread of mobility in face of smart mobile phones and tablets, as well as sensor-based Internet-enabled devices equipped with bar codes or radio tags (the Internet of Things), the world today is on the threshold of new streams of innovative applications. Most of the academic research on mobile BI is still in an embryonic stage. Although not included in the current BI platform core capabilities, mobile BI has been included in the Gartner BI Hype Cycle analysis as one of the new technologies that has the potential to disrupt the BI market significantly (Bitterer 2011). Table 2 summarizes the key characteristics of BI&A 1.0, 2.0, and 3.0 in relation to the Gartner BI platforms core capabilities and hype cycle (Chen, Chiang, & Storey, 2012; Gartner 2017).

All business trends are pushing the BI market forward and implying the further development of this technology. In 2016-2017, these trends are only gaining momentum (www.jetinfo.ru, 2018, [39]):

- Using Big Data as the foundation for machine Learning algorithms;
- Need for Real-Time Analytics and Self-Service BI;
- Small-Medium Business (SMB) sector's interest in analytical solutions based on Open Source.

Table 2. BI&A Evolution: Key characteristics and capabilities (Chen, Chiang, & Storey, 2012; Gartner 2017)			
	Key characteristics	**Gartner BI Platforms Core Capabilities**	**Gartner Hype Cycle**
BI&A 1.0	BMS-based structured content • RDBMS & data warehousing • ETL&OLAP • Dashboards & scorecards • Data mining & statistical analysis	• Ad hoc query & search-based Bl • Reporting dashboards & scorecards • OLAP • Interactive visualization • Predictive modeling & data mining	• Column-based DBMS • ln-memory DBMS • Real-time decision • Data mining workbenches
BI&A 2.0	Web-based unstructured content • Information retrieval and extraction • Opinion mining • Question answering • Web analytics and web intelligence • Social media analytics • Social network analysis • Spatial-temp	• Data Source Connectivity • Admin, Security and Architecture • Cloud BI • Self-Contained ETL and Data Storage • Self-Service Data Preparation • Metadata Management • Embedded Advanced Analytics • Smart Data Discovery • Interactive Visual Exploration • Analytic Dashboards • Mobile Exploration and Authoring • Embed Analytic Content	• Information semantic services • Natural language question answering • Content & text analytics
BI&A 3.0	3.0 Mobile and sensor-based content • Location-aware analysis • Person-centered analysis • Context-relevant analysis • Mobile visualization & HCl		• Mobile Bl

The study of Dresner Advisory Services in 2013 looked at 25 key BI vendors offering mobile Analytics solutions. The results of the analysis of these systems are presented below, of the maximum 36.5 points, the highest result was shown by MicroStrategy, Yellowfin, SAP and QlikTech (Chen, Chiang, & Storey, 2012).



Pic.1. Study of Dresner Advisory Services, 2013

2.1.2 Russian BI market

The first attempts to introduce BI-systems in Russia are made in the late nineties of the last century. The demand for these technologies began to grow steadily since 2000, when many organizations have accumulated significant amounts of information and began to rethink the IT market in principle. In those years, BI-solutions based on systems offered by Microsoft and Navision Software are popular (TAdviser.ru, 2010, [10]).

The market of BI-products began to gain the highest rate of development in 2005, and by 2006 experts estimated the growth of implementation of such solutions among Russian companies at the level of 50% per year and more, while global growth was at the level of 11.5% per year (TAdviser.ru, 2010, [10]). The growth of the market of information systems in those years contributed to the acceleration of the process of integration of Russia into the world community. During these years, the market has gained transparency and clarity for customers. However, the Russian market of BI-systems even in its heyday was a small part of the world.

Nowadays the growth of mobile Analytics in Russia is accompanied by the growth of users ' interest in mobile versions of other classes of business systems. As the penetration of appropriate hardware in the corporate segment increases, this phenomenon will eventually become widespread. Today, every second client has a mandatory criterion - work on mobile devices - when choosing a BI-platform and solution.

As an example of mobile BI implementation, a mobile application for iPad based on Prognoz Platform can be cited, which is used by the management of the Federal tax service of Russia (TAdviser.ru, 2010, [10]). It displays detailed information about the activities of departments of the Federal tax service, operational indicators of tax revenues, debts, which are formed in the information system of the Department (TAdviser.ru, 2010, [10]). This application is the head of the tax service of Russia, in particular, is used for reporting to the Prime Minister of the Russian Federation.

2.2 Objectives and architecture of BI systems

2.2.1 Objectives of BI systems

BI systems may be analysed from different perspectives. Decision makers and organisations should predominantly associate BI with organisational implementation of specific philosophy and methodology that would refer to working with information and knowledge, open communication, knowledge sharing along with the holistic and analytic approach to business processes in organisations. According to Olszak and Ziemba (2007), BI systems are considered to be solutions that are responsible for transcription of data into information and knowledge and they also create some environment for effective decision making, strategic thinking and acting in organisations, as it is depicted on the Figure below.

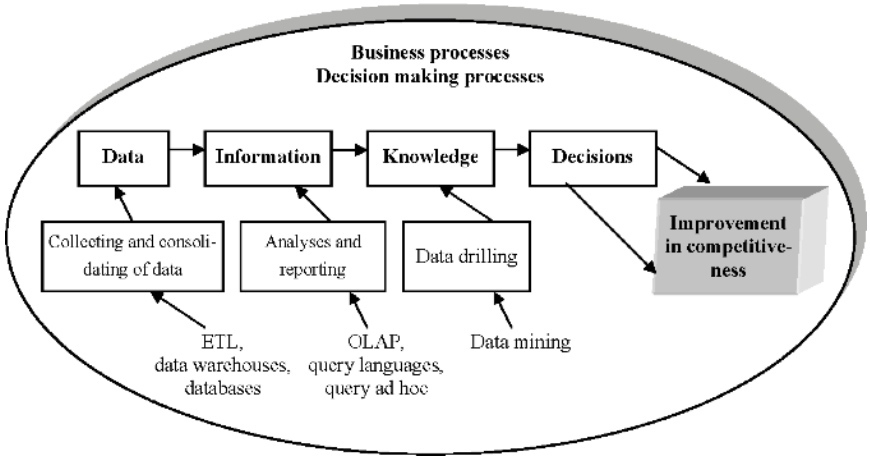


Fig. 2. The role of BI systems in decision making

Source: Olszak, & Ziemba, 2007

Observation of different cases of BI Systems allows for stating that the systems in question may support data analyses and decision making in different areas of organisation performance, particularly including the following (Hsu, 2004; Olszak, & Ziemba, 2003):

- Analysis of the company's financial activities, including cost and income analysis, calculation and comparative analysis of the company's income statements, analysis of the corporate balance sheet and profitability or loss, analysis of financial markets, risks analysis;
- A variety of marketing analyses that includes analysis of all sales revenues, sales profitability, profit, achieve sales targets, time of orders, actions of competitors, stock quotes changes;
- Analysis of customers and suppliers, which concerns the time and quality of contact with customers and suppliers, profitability from customers, modeling of customer behavior and reactions, customer satisfaction, etc.;
- Analysis of production control that allows you to identify production bottlenecks and pending orders, which allows organizations to examine the dynamics of production and to compare production results obtained by departments or plants, etc.;
- Logistics analysis to quickly identify the best supply chains;
- Analysis associated with wage data, including analysis of performance of employees, wages and salaries in breakdown by kinds of employment, payroll surcharges, personal contribution reports, analyse of average wages, etc.;
- Analysis of personal data, which include the study of employment turnover, types of employment, provision of information on personal data of employees, data security, etc.

2.2.2 Core components of BI architecture

BI requires analysts to deal with both structured and semi-structured data (Rudin and Cressy, 2003; Moss, 2003). The term semi-structured data is used for all data that does not fit neatly into relational or flat files, which is called structured data. While Data Warehouses (DW), Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), and databases mostly deal with structured data from data bases, the voluminous semi-structured data within organizations is left behind (Solomon Negash, 2004). To create business intelligence information, the integrated data are searched, analyzed, and delivered to the decision maker. In the case of structured data, analysts use Enterprise Resource Planning (ERP) systems, extract-transform-load (ETL) tools, data warehouses (DW), data-mining tools, and on-line analytical processing tools (OLAP).

A typical architecture for supporting BI within an enterprise is shown in Figure 3 (Chaudhuri, S., Dayal, U., & Narasayya, V., 2011). The data over which BI tasks are performed often comes from different sources — typically from multiple operational databases across departments within the organization, as well as external vendors.

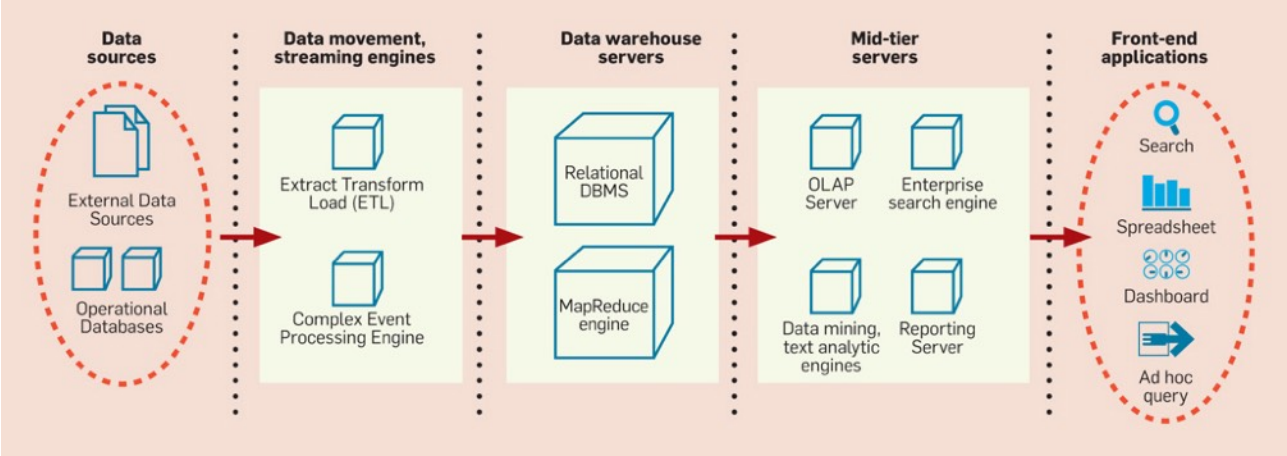


Fig. 3. Typical business intelligence architecture

Source: Chaudhuri, S., Dayal, U., & Narasayya, V., 2011

Data storage

The data over which BI tasks are performed is typically loaded into a repository called the data warehouse that is managed by one or more data warehouse servers. Data should reflect the current, real and complete picture of the business. Information in the data warehouse (including historical data) is collected from various operating (transactional) systems and structured in a special way for more efficient analysis and processing of requests (in contrast to conventional databases, where the

information is organized in such a way as to optimize the processing time of current transactions). Data warehouses contain huge amounts of information covering all available aspects of the enterprise and allowing to consider all aspects of the business in the aggregate. Subsets of data – the so-called data marts (data marts) - can be extracted from the common storage to solve narrower, specific tasks. The specific data needed for BI are downloaded to a data mart used by planners and executives. Outputs are acquired from routine push of data from the data mart and from response to inquiries from Web users and OLAP analysts (Solomon Negash, 2004).

Data integration

To form and maintain data warehouses, the so-called ETL tools are used – tools for data extraction (extract), data transformation (transform), that is, bringing them to the required format, processing in accordance with certain rules, combining with other data, etc., as well as for loading data (load), writing data to the storage or to another database. In addition to ETL, BI systems include SQL tools (structured query language) that allow users to access data directly.

To integrate data from disparate sources, modern BI systems use an intermediate, virtual metadata layer, which eliminates the need for business users to understand the intricacies of storing and processing information and facilitates changes. These tools do not require any physical operations to move and process data, which distinguishes them from ETL tools. The use of such a metadata layer, in principle, eliminates the need to organize expensive data stores (but it is necessary to take into account the issues of ensuring the necessary performance). This approach to integration of Analytics from TEC (Technology Evaluation Centers) is defined as EII (Enterprise Information Integration).

In addition, enterprise portals can be created for data integration to provide connectivity at the data and business process levels. Such portals implement only the external relationship, in other words- provide shared access to information. This implementation of the experts from the TEC was called EAI (Enterprise Application Integration).

Real-time data warehousing often relies on very fast ETL-style updating. Real-time analytics focuses on constant event monitoring and predicting as well as prescribing specific actions to be taken in order to take advantage of an opportunity or to mitigate a problem (Power, D. J., & Sharda, R.,2015).

Data Analysis

For a comprehensive analysis of data in modern BI used OLAP tools. They allow you to consider different data slices, including time, allowing you to identify different trends and dependencies (by region, product, customer, etc.). Various graphical tools are used to represent the data – reports, graphs, charts, customizable with the help of various parameters.

Blocks for deep data exploration (data mining) are included in the most advanced BI solution. Sometimes this term is mistakenly used to refer to tools that allow to present (display) information in a new way, but in fact these tools are designed to help in identifying hidden (non-obvious) patterns, models, forecasting. They are based on the scanning and statistical processing of huge amounts of data and are ultimately designed to facilitate the adoption of correct and informed strategic decisions through the analysis of various scenarios. Neural networks and decision trees are used as tools.

Data Visualization

Common means of data visualization in modern BI-solutions are information (control, instrument) panels (dashboards), where the results are displayed in the form of scales and indicators that allow you to monitor the current values of the selected indicators, compare them with the critical (minimum\maximum) values and thus identify potential threats to the business. Operational BI output often focuses on a dash board of performance metrics. Strategic BI is more likely to present managers a scorecard of key performances indicators with historical and goal comparisons (Power, D. J., & Sharda, R., 2015).

Control panels are considered one of the most convenient ways to present information about the "state of health" of the business. They allow you to fit on the screen all the important information about current operations, identified and potential problems. Control panels, as well as scorecards, are based on the analysis of key performance indicators (KPIs). However, as a rule, control panels show the current state of the General indicators, and indicator maps are designed to compare the current indicators with the planned, target, and display the dynamics of changes in these indicators over time. Scorecards are usually more personalized, customized depending on the roles and tasks of a particular user (financial management, procurement, sales, etc.). If necessary, all these indicators can be detailed with the help of additional reports, graphs and charts.

2.3 BI Implementation and Measurement approaches

2.3.1 Implementation phases

The development of a business intelligence system can be assimilated to a project, with a specific final objective, expected development times and costs, and the usage and coordination of the resources needed to perform planned activities. Figure 4 shows the typical development cycle of a business intelligence architecture (Carlo Vercellis, 2009).

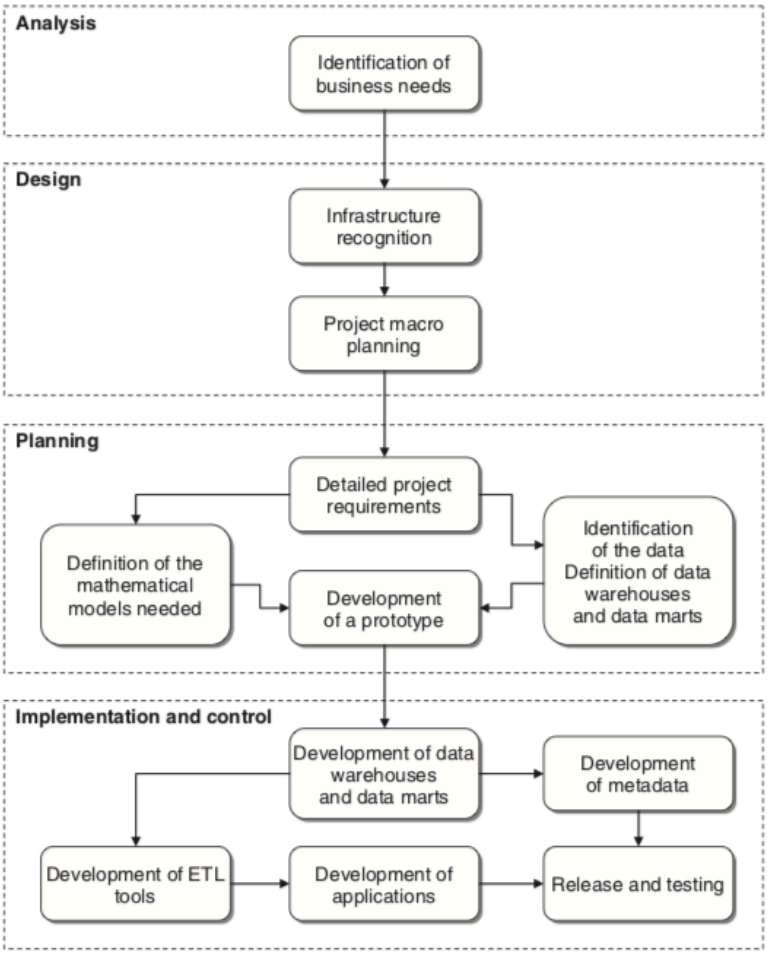


Fig. 4. Phases in the development of a business intelligence system

Source: Carlo Vercellis, 2009

Analysis

During the first phase, the needs of the organization relative to the development of a business intelligence system should be carefully identified. For this purpose various interviews are often conducted with key stakeholders and users, in which general objectives and priorities, as well as cost and benefits from the development of BI system are defined, analyzed and affirmed.

Design

The second phase includes two sub-phases and is aimed at deriving a provisional plan of the overall architecture, taking into account any development in the near future and the evolution of the system in the mid term (Carlo Vercellis, 2009). Firstly, the assessment of the existing information infrastructures is held and main decision-making processes that are to be supported by the business intelligence system are examined with the purpose of precise requirements determination. Then, using classical project management methodologies, the project plan will be laid down, identifying development phases, priorities, expected execution times and costs, together with the required roles and resources (Carlo Vercellis, 2009).

Another important stage of designing BI involves building a data warehouse that is supposed to perform two functions: of a repository for further analyses, and of a base for the BI system (Inmon, 1992). This process has to be carried out in compliance with the following rules (Hackathorn, 1998, Olszak & Ziemba, 2007):

- Setting a scope of data stored in the Information System that are important from a perspective of a given organisation;
- Defining interconnections between data that are to be found in different systems and that are of the same importance. As a result of such activities, a set of data will be created and the data in question will allow for designing a target database (a repository) where data from source bases will be sent;
- Creating a design of a data warehouse that serves as a basis for loading a BI system. Such a design should be created in order to provide easy configuration of database related re- porting and querying mechanisms. The design is suggested to aim at reaching a model of ‘a star’ or ‘snowflake’ that simplifies further implementation of data warehouse mechanisms including OLAP or data mining.

Planning

The planning stage often includes a sub-phase where the functions of the business intelligence system are defined and described in greater detail. Thereafter, all existing and required data are evaluated. Also, central data warehouse and some satellite data marts are designed on this stage. Together with the recognition of the available data, mathematical models to be adopted are set, concerning about the efficiency of the algorithms and their relevance for the magnitude of the resulting problems. Finally, it is useful to create a system prototype, at low cost and with limited

capabilities, in order to uncover beforehand any discrepancy between actual needs and project specifications.

Implementation and control

The last phase consists of five main sub-phases. Data warehouse and each specific data mart represent the information infrastructures that will feed the business intelligence system. Then, with the purpose of explanation the meaning of the data contained in the data warehouse, a metadata archive is created. Moreover, ETL procedures are set out to extract and transform the data existing in the primary sources, loading them into the data warehouse and the data marts. The next step is aimed at developing the core business intelligence applications that allow the planned analyses to be carried out. Finally, the system is released for the test and usage.

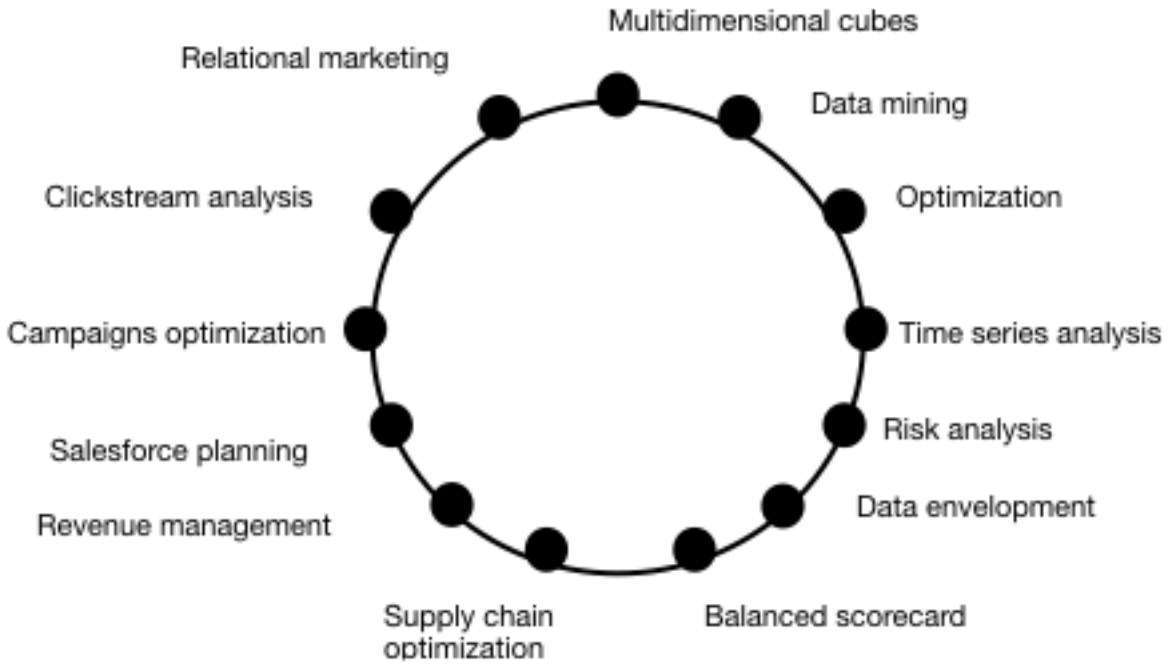


Fig. 5 Portfolio of available methodologies in a business intelligence systems

Source: Carlo Vercellis, 2009

Figure 5 describes a set of main methods that may be included in a business intelligence system (Carlo Vercellis, 2009). Some of them have a methodological nature and can be used across different application domains, while others can only be applied to specific tasks.

2.3.2 Critical Success Factors

The implementation of a BI system is not a conventional application-based IT project (such as an operational or transactional system). According to Ericson (2003), not all of BI solutions succeed in all organizations, and, there are signs, before a project begins, that could indicate whether the project will succeed, struggle, or fail and it is important that organizations understand the key indicators of success, so as to overcome the challenges that are associated with the BI project during its implementation (Thamir & Poulis, 2015).

While the BI market appears vibrant and the importance of BI systems is more widely accepted, it is necessary to identify Critical Success Factors that affect the implementation success. The concept of identifying success factors in business is first identified by Daniel (1961). He discussed these factors at the macro level whereby each industry would be reliant on three to six factors to an indicator success or failure. The tasks associated with these factors are required to be completed exceedingly well for a company to be successful (Hawking, & Sellitto, 2010). In the literature there are several definitions of critical success factors (CSFs) (Amberg, Fischl & Wiener, 2005). For example Rockart (1979), presenting one of the most frequently cited definitions, uses ideas from Daniel (1961) as well as Anthony, Dearden and Vancil (1972) in defining CSFs as "the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization" (Celina M. Olszak and Ewa Ziemba, 2012). According to the author, there are four key sources of CSFs:

- industry-based factors;
- competitive strategy, industry position, and geographical factors;
- environmental factors;
- temporal factors.

According to Williams and Williams (2007), common mistakes that are made while establishing and managing BI programs are:

- using ad hoc practices to select and fund BI projects;
- providing inadequate governance for the BI program management;
- establishing de facto program governance based on the initial BI project;
- failing to strategically position BI in the business organization;

- not providing adequate resources and funding for supporting efforts needed for a successful BI initiative.

Thus, the issue of understanding and identification of BI implementation project outcomes using CSF becomes very appropriate. Several research methods can be used in order to identify the relevant CSFs, and they comprise the analysis of relevant literature, case studies, Delphi technique, group interviews, multivariate analysis, questionnaires, scenario analysis, and structured interviews (Turban et al., 2001).

There are already a number of studies on BI success factors. For example, Ariyachandra and Watson (2006), analyzing CSFs for BI implementation, take into account two key dimensions: process performance (i.e., how well the process of a BI system implementation went), and infrastructure performance (i.e., the quality of the system and the standard of output). According to Yeoh and Koronios (2010), CSFs can be broadly classified into three dimensions: organisation, process, and technology. In contrast, Eckerson (2005) focuses more on integration flexibility issues, such as support all users into integrated BI suits, robustness and extension of platform or integrations with desktop and other operational applications.

In the Yeoh and Koronios (2010) vision, Organizational dimension includes such elements as committed management support and sponsorship, a clear vision, and a well-established business case. In turn, the process dimension includes business-centric championship and balanced team composition, business-driven and interactive development approach and user-oriented change management. Technological dimension regards such elements as business-driven, scalable and flexible technical framework, and sustainable data quality and integrity. Table 3 summarizes the critical success factors for BI system implementation which are mentioned in the literature and can be valuable for understanding the success of implementation outcomes.

Table 3. CSFs for BI implementation by various authors			
Eckerson (2005)	**Wise (2007)**	**Imhof (2004)**	**Yeoh and Koronios (2010)**
• Support all users via integrated BI suites • Conforms to the way users work • Integrates with desktop and operational applications • Delivers actionable information • Foster rapid development • Provide a robust, extensible platform	• Identifying the business problem • Determining the expectations of use • Understanding delivery of data • Rolling out of training initiatives • Choosing a vertical – or horizontal based solution	• A dependable architecture • Strong partnership between the business community and IT • A different kind of methodology • Well-defined business problems • A willingness to accept change	• Committed management support and sponsorship • Clear vision and well-established business case • Business-centric championship and balanced team composition • Business-driven and iterative development approach • User-oriented change management • Business-driven, scalable and flexible technical framework • Sustainable data quality and integrity

Sources: (Celina M. Olszak and Ewa Ziemba, (2012); Yeoh and Koronios (2010))

3. RESEARCH FRAMEWORK

The research process of this Master Thesis work includes in-depth interviews of Russian analysts who implemented BI systems throughout their working practise, as well as observing European experience from literature review. After the data collection steps are finished, unstructured data is analyzed and examined from the CSFs point of view. The framework of Yeoh & Koronios (2010) which describes Critical success factors for implementing BI systems through three dimensions of interest is taken as a basis for structuring and exploring data, as well as detailed and precise analysis of data obtained from different angles of view. Based on this fact, their work is analyzed primarily to understand the methods, tools and techniques that are used in Europe, then, following the same approach and technique experts from Russia are interviewed. This framework is chosen as giving the most complete picture of the analysis of BI systems implementation from both technical and business sides and supporting the interests of all stakeholders in the success of implementation process. Table 4 elaborates three dimensions: organization, process and technology and their influence on the end result, all interviews are taken concerning these critical success factors.

Table 4. Critical success factors for implementing BI systems (Yeoh & Koronios, 2010)

Dimension	Critical Success Factors
Organization	Committed management support and sponsorship A clear vision and a well-established business case
Process	Business-centric championship and a balanced team composition Business-driven and iterative development approach User-oriented change management
Technology	Business-driven, scalable and flexible technical framework Sustainable data quality and integrity

Yeoh & Popovicˇ (2015) in their work «Extending the understanding of critical success factors for implementing business intelligence systems» fulfilled the proposed framework with Success Criteria from Infrastructural and Process performance points of view. As illustrated in Figure 6, this research framework outlines how a set of CSFs contributes to successful implementation of a BI system and assessed through infrastructure performance and process performance. In the proposed framework, fulfilling Yeoh and Koronios's (2010) CSFs is considered a requirement in order to ensure a successful BI system implementation (Yeoh & Popovicˇ, 2015).

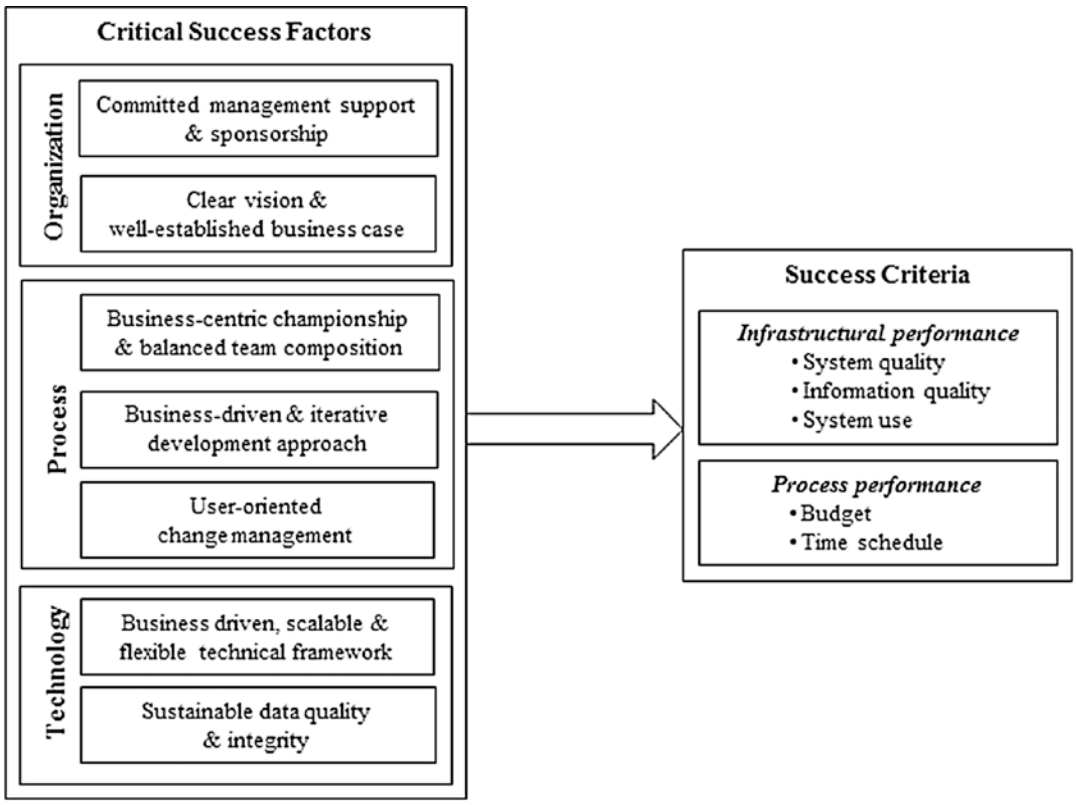


Fig. 6 Research framework

Source: Yeoh & Popovicˇ, 2015

According to the updated approach, the study participants also assess the quality of the system, the quality of data, the use of the system, as well as everything related to more administrative issues: the budget and the time frame of the project. This allows researchers to get a more complete picture of the external and internal factors that can affect the success of a project.

4. EUROPEAN BI IMPLEMENTATION ANALYSIS

4.1 Data collection

For the European experience observation, Yeoh & Popovič chose 7 cases of organizations, all of these companies are selected from one industry, focusing on engineering asset management organizations such as electricity, gas, water utilities, and railway companies (i.e., organizations with critical engineering infrastructure and engineering asset management business) (Yeoh & Popovič (2015)). For the purpose of non-disclosure of personal data, all organizations participating in this study received an identification letter in each case. Data on the size of organizations, their annual income, as well as the generalized result of the study are presented in the table below. In order for the study to be filled with qualitative data, the researchers conducted 26 face-to-face interviews, lasting 1-2 hours, with various project participants, both from business and IT sides. Data collection from both technical and organizational side of all stakeholders, both those who implemented the BI system, and those who used it in future, allowed researchers to obtain sufficiently deep data on each case and achieve the goal of their study.

Table 5. European case background. Source: Yeoh & Popovič (2015)

Case	Type of organization	Annual revenue	No. of staff	Implementation success level
R1	Rail network access provider	M	M	Successful
R2	Passenger rail transport and rail freight provider	L	L	Successful
E1	Electric and gas utilities	L	M	Successful
S1	Shipbuilder and maintainer	M	M	Partially successful
W1	Drinking water, wastewater and storm water service utilities	L	M	Successful
W2	Water, sewage, recycled water utilities	M	M	Successful
W3	Bulk water supplier and water infrastructure provider	M	S	Unsuccessful

Note. The case descriptions have been disguised slightly to preserve the anonymity of the participants. Small (S)=<USD $100 million, Medium (M)=USD $100 to $1000 million, Large (L) = >USD $1 billion. Small = <1000 staff, Medium = 1000–5000 staff, Large = over 5000 staff.

During the interviews, the researcher is additionally provided with a variety of project-related documentation in order to help the research process, such as project reports, business cases, planning documents, and training manuals. Additional documents such as organization structure charts, position descriptions, policy manuals, and annual reports are used to complement and substantiate evidence from other sources (Yeoh & Popovič (2015)).

4.2 Results of CSFs analysis in European companies

During the interviews, the participants were asked to rate the degree of success of their BI system implementation, the results this rating can be seen in Table 6. Adopting the same qualitative measures used by Poon and Wagner (2001) in their executive IS success study, in Yeoh & Popovič research a "Good" rating means that all informants agreed the measure was well-achieved, a measure rated as "Acceptable" refers to a somewhat satisfactory performance of the success measure, whereas a "Poor" rating indicates that the success measure was not well-achieved, as viewed by most informants (Yeoh & Popovič (2015)).

Table 6. Implementation success criteria for European cases. Source: Yeoh & Popovič (2015)

Success measures	**Case code**	**R1**	**R2**	**E1**	**S1**	**W1**	**W2**	**W3**
Infrastructure performance								
1 System Quality		✓	✓	✓	✓	✓	✓	N/A
2 Information Quality		✓	✓	✓	✓	✓	✓	N/A
3 System Use		✓	✓	✓	A	✓	✓	N/A
Process Performance								
4 Budget		✓	✓	✓	✓	A	✓	X
5 Time schedule		✓	✓	✓	✓	A	✓	X
	Overall	S	S	S	P	S	S	U

Note. ✓ = good, A = acceptable, X = poor, S = successful, P = partially successful, U = unsuccessful.

As a result of the research and interviewing, we can understand that 5 out of 7 companies show notable success in the implementation of BI system in their enterprises, one company achieved complete success and one faced failure in such kind of project. In the case of a moderately successful project, it is noted that it nevertheless faced relatively uncontrolled external factors when implementing its BI system. In addition, the main application of its BI system is not similar to the standard application of such systems in standard commercial enterprises. As a result of this project, the main goal was not to reduce costs or amount of personnel, but to achieve quality and safety

standards. The firm, which experienced a failure of implementation, was in such situation because of business issues at an early stage of the implementation process. According to researchers statements, different versions of truth were often met in this company, which caused that overall picture had always evolved in different ways, as well as business requirements were not clearly defined.

For a more accurate comparison of each situation in each case within the framework of the provided CSFs, the researchers suggested informants to rate with ✓ a CSF that was fully addressed, with P a CSF that was partially addressed, or with X a CSF that was ignored. The summarized results of such rating for all 7 cases are described in Table 7.

Table 7. Summarized rating of CSFs. Source: Yeoh & Popovič (2015)

Success measures	Case code	R1	R2	E1	S1	W1	W2	W3
Committed Management Support and Sponsorship		✓	✓	✓	✓	✓	✓	X
A Clear Vision and a Well-Established Business Case		✓	✓	✓	P	✓	✓	X
Business-Centric Championship and a Balanced Team Composition		✓	✓	✓	P	✓	✓	X
Business-Driven and Iterative Development Approach		✓	✓	✓	P	✓	P	X
User-Oriented Change Management		✓	✓	✓	X	P	✓	X
Business-Driven, Scalable, and Flexible Technical Framework		✓	P	✓	✓	✓	✓	P
Sustainable Data Quality and Integrity		✓	P	✓	✓	P	✓	P

Note. ✓ denotes a CSF that was fully addressed; P denotes a CSF that was partially addressed; X denotes a CSF that was ignored.

Thus, their research has shown that some of the traditional CSFs in existing literature sources, such as notable management support, clear vision of business case, balanced team composition and experienced team, definitely influence the implementation of BI systems, therefore confirming the existence of a common set of CSFs for implementation of BI systems. Authors of this work recommended companies to hire experienced system integrators, use iterative development approaches to track all tasks in advance, have a business-focused view in planning and designing BI system to avoid costly and unnecessary pitfalls and therefore support the success of implementation projects. The empirical findings from the seven case studies observed by researchers concludes that

the CSFs do indeed have a direct, positive and significant influence on the BI systems implementation.

4.3 Methods, tools, techniques in European practise

This study of Yeoh & Popovič focuses primarily on informants and companies that had experience with commonly used products such as SAS Institute, IBM Cognos, Oracle, Microsoft, and SAP Business Objects. In this study, there is no mention of specific implementation techniques, except that most of the companies used an iterative approach, or project management tools, as well as communication within the team and with customers, as it is based on identifying the relationship between the specific criteria of the process and implementation infrastructure and the success of such projects. Moreover, authors of this work try to broad clear understanding between various cases of using conventional online transaction processing (OLTP)-based systems and large-scale online analytical processing (OLAP)-based systems, like BI systems.

5. RUSSIAN BI IMPLEMENTATION ANALYSIS

5.1 Data collection

In selecting the number of cases for study, some scientists recommend that the sample of cases be considered adequate after the patterns appear, and then the study is considered to have reached "theoretical saturation" (Eisenhardt, 1989). However, some researchers are of the opinion that four cases are the minimum to achieve a theoretical generalization (e.g., Eisenhardt, 1989; Miles & Huberman, 1994; Yin, 2014) and no more than 15 cases allow a comfortable understanding of "local dynamics" (Miles & Guberman programs, 1994). Five cases are selected for this study, which fits within the recommended range. They include various large organizations in Russia. The basis of the study is the data obtained from the company BI consult (www.biconsult.ru, [38]), based in St. Petersburg. This company is an implementer of BI systems, carrying out implementation projects both throughout Russia and abroad. This study involved analysts of companies from different fields and with different activity profiles, thus allowing to differentiate and trace various goals and criteria for the success of the BI system implementation. This research focuses mainly on organizations in the pharmaceutical industry, but also touches oil and gas industry, and optical retail.

Semi-structured interviews are selected as the primary source of baseline evidence to facilitate the study of organizations ' experiences with critical success factors identified in the literature. The basic structure of each questionnaire can be found in the Appendix of this study. Face-to-face interviews with BI analysts and implementors are conducted at the scheduled time at the companies. Each interview is conducted by the researcher herself, it was recorded on audio and lasted approximately 1 hour. In some cases, during the interview, Sergey Gromov, General Director of BI Consult, provided the researcher with a variety of project documentation, such as project scope, business cases, internal data architectural structure, implementation methodologies. The case background and implementation success level for each participating organization is presented in Table 8. The size of small, medium and large businesses were adjusted according to Russian realities.

Table 8. Case background				
Case	**Type of organization**	**Annual revenue**	**No. of staff**	**Implementation success level**
F1	Pharmaceutical company	M	M	Successful
F2	Pharmaceutical company	M	M	Partially successful
F3	Biotechnological company	M	M	Partially successful
G1	Gas and oil company	L	L	Partially successful
L1	Optical retail chain	S	S	Successful

Note. The case descriptions have been disguised slightly to preserve the anonymity of the participants. Small (S)=<USD $50 million, Medium (M)=USD $50 to $500 million, Large (L) = >USD $500 million. Small = <1000 staff, Medium = 1000–5000 staff, Large = over 5000 staff.

The participants are mostly drawn from analytical and managerial functional areas of their respective organizations and included BI system integrators (analysts), project managers, system architects. This study tries to catch both «technical» and «project-related» roles of informants in order to receive deeper understanding of infrastructure performance and process performance in each particular case and provide the adequate reach and richness of the case information to meet the research objective. Table 9 summarizes the key informants' characteristics, to be more accurate, their position, project role, and function within the organization. Some informants combine 2 or more roles within their position in organization.

Table 9. Summary of data sources			
Case	**Position of informant**	**Project role**	**Function**
F1	BI analyst	System integrator Programmer Designer	IT
F2	Project manager	Project manager Consultant	IT
F3	Director of department	Project Initiator Project Manager	IT/Business
G1	Programmer	System architect Programmer	IT
L1	Director	Project Director	IT/Business

5.2 Results of CSFs analysis in Russian companies

All cases in this study are analyzed through 3 dimensions of interest: organization, process and technology. As it was described in the research framework section, that describes the Yeoh & Koronios (2010) approach, each dimension has its own Critical Success Factors through which the answers of all informants are received and subjected to further analysis. Moreover, this research does not collect or produce any quantitative data. In all cases, the absence or presence of a particular CSF are examined and considered from the logical point of view.

In order to identify the suitability and level of proficiency in each case, as well as compare results of Russian experience with results of European practice, a set of same research framework criteria are applied and all cases are categorized as Successful (S), Partially successful (P) and Unsuccessful (U). Following the supplemented Yeoh & Popovič (2015) approach, the extent of implementation success is preliminary examined through two key indicators: infrastructure performance, which is considered through the lens of system quality, information quality and system use, and process performance, which involves budgetary considerations and time-schedule measures.

Like in their research process, during the interviews, the participants are asked to rate the degree of success of their BI system implementation through these dimensions, the result of their rating is shown in Table 10. Adopting the same qualitative measures used by Poon and Wagner (2001) and Yeoh & Popovič (2015), a “Good” rating means that all informants agreed the measure is well-achieved. A measure rated as “Acceptable” refers to a somewhat satisfactory performance of the success measure, whereas a “Poor” rating indicates that the success measure is not well-achieved, as viewed by most informants. Depending on the context, interviewers are allowed to make a related assessment if they have doubts about a particular indicator.

Table 10. Implementation success criteria for cases						
Success measures	**Case code**	**F1**	**F2**	**F3**	**G1**	**L1**
Infrastructure performance						
1 System Quality		✓	✓	✓	A	✓
2 Information Quality		✓	A	A	A	✓
3 System Use		✓	✓	A/X	A	A
Process Performance						
4 Budget		A	X	✓	✓	A
5 Time schedule		✓	X	A	✓	A
	Overall	S	P	P	P	S

Note. ✓ = good, A = acceptable, X = poor, S = successful, P = partially successful, U = unsuccessful.

As a result of informants' rating we can say that two of five examined project implementations are considered to be successful, while the rest of them are defined by BI stakeholders as reached only partial success. Almost all participants depicted their respective BI systems as stable, high-quality and flexible product and the system usage as user-oriented and fulfilled in meaningful way. The most problematic issue is budget, as BI implementation projects are mostly high-loaded and hard to predict from financial point of view. Almost all informants could say that implemented system fulfills the set goals, helps to achieve clarity in accounting, cost reduction and more optimal production workload.

Background to Implementing the Business Intelligence Systems

Following Yeoh & Popovič (2015) framework, before analyzing the CSFs of any BI implementation, the background and global goal of such implementation are firstly requested and defined. The results of this identification are described in Table 8. Accordingly, all informants mentioned that any BI system is implemented to improve transparency so that all employees have access to the data. The end user always settles their algorithms in the work during the implementation of the system and receives a so-called «single version of the truth», that can combine data from different departments and produce clear vision of on-going processes in a company. Anyway, the primary request for the implementation of BI system always comes from top management, who wants to get the organization's key performance indicators in a convenient form.

Table 11. Background to and motivations for implementing the BI systems	
Case	
F2	*The main customer was the HR Director of the whole company *The main function of future system was providing information to managers and business users in the company
F3	*Historically speaking, the initial request was from 2 departments, HR wanted to assess the efficiency of employees, and request for analyzing the work in the internal kanban system was arrising
G1	*The system was supposed to solve the issues of fraud tracking at the enterprises in the first place, as well as in related systems where the equipment is recorded
L1	*In my opinion, the main plus and aim is that the end user always settles their algorithms during the system implementation project, and the company gets a unified view of things. *The owners wanted to see transparently how their network operates in Russia

According to Yeoh and Koronios's (2010) definition of each CSF, there was determined whether a particular CSF was present and fulfilled in a meaningful way for each case organization. For this purpose an evaluation of the seven CSFs was conducted and rated with a summary rating of ✓ (for a CSF that was fully addressed), P (for a CSF that was partially addressed), or X (for a CSF that was ignored). When all elements of a CSF are present, the CSF was rated as "Fully addressed." In a situation when only some elements are present, the CSF was judged as "Partially addressed." Finally, when a CSF is absent, it is judged as "Ignored".

Committed Management Support and Sponsorship

Customer involvement in the project is often a key factor in the success of the project, so the interview about the organization case begins with this topic. Within these case organizations management support is described by informants as on the required level. Some top management executives often have assigned person from their side to manage and control project, often such situation occurs in the successful project, participants from cases F1 and G1 confirm this dependence. Participator from partially successful case F2 underlined that there is some kind of project information transmission chain through assigned people, instead of direct communication with management, which proved to be a difficult moment of successful interaction within the project.

«Usually the client has a number of people, some of them are actively involved in the implementation project, some deny innovations. Naturally, those who are involved much less than

those who deny. Therefore, in each project we are struggling with some resistance from the customer side» - says Sergey Gromov, General Director of BI Consult, a company-BI integrator.

Table 12. Committed Management Support and Sponsorship	
Case	
F1 ✓	*There is big support from departments. Now it has come to a situation where all departments have understood the benefits of the product and do the formulation of different tasks on a daily basis.
F2 P	*There was practically no communication with the main customer, basically we communicated with his assigned person for this project and the Heads of other departments *Further information about the project was transferred to the main customer and was shown without our participation, probably this is one of the most difficult moments of this project.
F3 P	*I can not say that there was a lot of support, especially since we make the budgeting for projects for the year ourselves. But the entire top management clearly understood why we do it.
G1 ✓	*A special Project manager was assigned for this project from the customer side, one of the specialists of this unit. There was enough support, he actively connected when his help was needed. *Specialists from other departments were involved to consult us on any issues.
L1 P	*Usually such people as Owners made the decision, allocated money, signed the contract and further are seldom involved in the project. Then they join the project at the very end to control what is done. *On their part, it was the Head of the internal audit Department. It was in his interest to ensure the transparency of the company.

Note. ✓ denotes a CSF that was fully addressed; P denotes a CSF that was partially addressed; X denotes a CSF that was ignored.

A Clear Vision and a Well-Established Business Case

The informants from three organization cases (F1, G1, L1) highlighted the presence of clear vision and precise understanding the inside features of a project. Participant from case G1 mentioned that it is quite easy to define project scope and scale at the first stages, when is the design of future system. The situation is a little different in the case of F3, where the system is originally developed as a monitoring and during the first year of the project's life, its vision changed very much. However, this fact did not prevent its success and achievement of goals, perhaps due to the well-coordinated work of the team. At the same time, in one partially successful project F2 system requirements were formulated very blurry and inaccurately, which caused great difficulties in the management of the project and the definition of its clear boundaries. Due to this fact, BI analysts had to redo most of their work to reach required level of understanding and expectations. This

situation only confirms the importance of well-establishing a single business case for all project participants in order to avoid wasting time on reworking tasks. Such CSF is judged as ignored in this case.

Table 13. A Clear Vision and a Well-Established Business Case

Case	
F1 ✓	*In each case there was a clear vision of the project. Generally speaking, there was a specific desire that the data were unified, all sources were verified and everything could be found and analyzed in one place. Then, each area had its own tasks.
F2 X	*The requirements that the customer wanted to see in the system were formulated very blurry. The difficulty arose in the fact that it was necessary to redo the work very often: either we did not understand what they wanted, or the customer was not satisfied with the result. *There was no clear vision, initially, when we entered the project, we did not understand what was expected from us
F3 P	*I do not believe in such stories, it is more important to understand what is here and now. Since the start of the project a year ago, the vision of project and how it will develop changed dramatically. At first, it seemed that we are developing as some kind of monitoring, then we realized that not all employees are ready for such work, then we began to work as an institutional center, so as not to clutter everybody up with all that dashboards.
G1 ✓	*At the first design stage, all project participants had a clear vision of the project, its scope and scale. The only thing at that time we did not fully imagine how many nuances will be hidden in the details.
L1 ✓	*In this case, there was a clear vision of the project, but in the prevail number of projects it is absent

Note. ✓ denotes a CSF that was fully addressed; P denotes a CSF that was partially addressed; X denotes a CSF that was ignored.

Business-Centric Championship and a Balanced Team Composition

For the process dimension of business-centric championship and a balanced team composition, prevail number of informant agree that leadership qualities of Project Lead plays key role in the project success. Nevertheless, informants from cases G1 and L1 mention that technical proficiency of any leader in IT projects is no less important, and sometimes has even more weight. From their point of view, the Manager must understand what is at stake and understand the details quite well. The successful cases demonstrated that commitment has to come not just from management but also from a competent BI team with appropriate business and technical skills.

In successful case F1 informant underlines great influence of leadership skills in any project, especially in the Business Analytics field. Sometimes a company has very diverse areas of activity,

and the ability to identify necessary indicators and make a business intelligence solution not for someone but for everyone is critical here. At the same time, regardless of the overall success of this project, there are only two BI specialists in case organization, who combine roles of BI analysts, programmers and designers at the same time, and informant mentioned lack of staff for such a large organization.

«Any Project Lead wants to see a highly qualified, motivated, expert team. This also applies to the project Manager. Leadership qualities, of course, influence on the speed of the project and the results. But, practice shows that within any company there is very small number of such «star» people. The rest have either problems with motivation or with subject knowledge.» - Sergey Gromov describes the issue of Balanced Team.

Table 14. Business-Centric Championship and a Balanced Team Composition

Case	
F1 ✓	*This is certainly important, especially in Business Analytics field, the ability to identify necessary indicators is critical. *If the leader did not have leadership skills, nothing would have gone. *There are only two BI specialists in company, me and my colleague. We play roles of developers, designers and analysts in one face.
F2 P	*Our team consisted of 3 people: Lead Architect, Developer and Project Manager. *Leadership skills are important in BI project.
F3 ✓	*When web development started, at first it was 2 developer, then around 4 at the peak of development process. The guys on the project are very initiative, I have been working with them for a long time, we understand each other well. This was a remote team from Novosibirsk.
G1 P	*On the first stage there were 2 specialists: me and Business Analyst. On the second stage there were 4 people: Business Analyst, Architect and 2 Developers. *I think that leadership skills are important, but what even more important is technical qualification, the Manager must understand what is at stake and understand the details quite well
L1 ✓	*There were around 5 people: Project Lead, Project Manager, around 2-3 developers and testers. * Leadership qualities, of course, influence on the speed of the project and the results.

Note. ✓ denotes a CSF that was fully addressed; P denotes a CSF that was partially addressed; X denotes a CSF that was ignored.

Business-Driven and Iterative Development Approach

In order to reach business-driven solutions, informant from case F1 had to meet with colleagues from departments and work out common concepts and terms from business to achieve a common

vision of certain tasks. Speaking about the choice of the development methodology, participant from organization case F2 mentions that they often rest on the fact that the legal side and the methodology of the project do not coincide with each other. For example, there are usually tenders for the governmental projects, which require strict regulations and requirements to the project plan and scope, therefore eliminating the possibility of iterative approaches.

«I believe that BI projects can be effectively used iteratively. This approach allows us to give users something working as quickly as possible, thus the confidence to the system and interest in the final product are built, further work is held easier, because the users themselves are already involved and everyone understands what we will get at the output. When there is a waterfall development, users have no idea what they will get. They are engaged to give consultancy, information, some requirements, but they do not understand how it will look. And when they receive a ready-made solution at the output, many moments do not suit them, they make a large list of improvements, and the customer has to pay for these large improvements in the system.» - says the informant from case G1, where the cascade model is used.

Table 15. Business-Driven and Iterative Development Approach

Case	
F1 P	*Regarding the scale, we are still buying more licenses, as initially did not know how much demand will be. *The project is very informal and live, we do it on our own, actually, the development approach is close to SCRUM in its cyclicity.
F2 P	*The project development methodology was fully agile. From the legal point of view, the methodology is not entirely correct, but from the project and team point of view, it is correct.
F3 ✓	*The development approach was iterative, initially we worked using classic SCRUM, now we are more close to KANBAN, there are no restrictions on sprints, there is just a line of tasks. Since the development was quite smooth, I think that the implementation methodology was chosen correctly.
G1 X	*We worked using waterfall model, because the customer had strict requirements for the project plan in the framework of the tender. Project had standard waterfall model stages: design, development, testing, productive use.
L1 X	*In this project we used the waterfall model. The development methodology, which is based on a plan and breakdown tasks. Of course, this plan changes, usually once per week, after that there is an adjustment of the plan and this way we come to the end of the project.

Note. ✓ denotes a CSF that was fully addressed; P denotes a CSF that was partially addressed; X denotes a CSF that was ignored.

User-Oriented Change Management

With regard to user-oriented change management (Table 16) informants from cases L1 and F1 underline that nowadays all lead to the simplification of the systems and its usage understanding without any in-depth instructions. Also, the demand for mobile Business Analytics is increasing today, almost all BI projects include such functionality.

In the case F3, the BI system in company has the functionality and the ability to configure reports, but no one have used it for a year. Therefore, now they have an ideology where there is a team work: an analyst who displays the metrics, the department of operational management, which together with the user analyzes his needs, and the project management department, which tells you where everything is located from an architectural point of view.

Table 16. User-Oriented Change Management

Case	
F1 ✓	*Our system is intuitive, but often need more fine-tuning, sometimes users do not see the filters that are imposed. *We often hold a live meeting, go through the applications that are needed for this employee.
F2 ✓	*During the project, as well as after it we conducted an educational 2 hour seminar
F3 P	*We knew from the very beginning that we would need training, so we immediately dropped the course of data analysis, designed together with hr. But it all came down to the fact that they just looked at their own metrics or their friends' metrics, but did not build an effective monitoring of the processes of employees.
G1 ✓	*The end users of our system were operational specialists, they needed a simple and understandable tool, but even the use of such a tool had to be trained.
L1 ✓	*We teach users after the project is completed. People come for 1-2 days and teach directly how to work in developed solution.

Note. ✓ denotes a CSF that was fully addressed; P denotes a CSF that was partially addressed; X denotes a CSF that was ignored.

Business-Driven, Scalable, and Flexible Technical Framework

As we can understand from the participants experience with creating reliable and flexible technical framework (Table 17), all the respondents have required level of integrity. Informants from cases F1, F3, G1 and L1 mention that they had some integration problems but all of them are solved from the technical point of view with the use of different approaches. Since the project in case G1 is associated with a security system, there are certain requirements from the client's part that have to be met. In particular, direct connections to databases are prohibited, which does not contribute to the flexibility of the system. Nevertheless, their project is judged as successful, what makes us

understand, no matter how inflexible and technically complex the system is, it does not interfere with achieving its goals.

Informant from the case L1 underlined, that usually the problems are not from the technical side, how to draw the data, but from the methodological side - what we are doing and with what purpose. Writing a detailed technical specification is much more important in this case, because it is necessary to take into account all the nuances.

Table 17. Business-Driven, Scalable, and Flexible Technical Framework

Case	
F1 ✓	*ERP system (Axapta), 1C, SCADA, Excel - those systems that are used as a data source. There were difficulties with integration with SharePoint and SalesForce.
F2 ✓	*There were 2 main systems: Global and Excel. A special data warehouse was prepared for us. We did not have any problems with integration.
F3 ✓	*We have an engine that allows us to collect data from anywhere. Architecturally, we have separate data collection components, separate visualization components and individual components of the calculation of the information we collect. We also collect data from ERP system.
G1 ✓	*As for the modules of the BI system itself, we had the data extraction level, the data transformation level, the interface module, where the data representation was implemented. Within the framework of the last module, additional subsystems were implemented: reporting, tracking of alarming events, the module of economic efficiency. *There were 4 system for refuelling stations control, 6-7 1C systems, 2 CRM systems, system for processing of banking operations, MES system, system tracking vehicles - we collect and analyze data from all of them
L1 ✓	*In this case, there were qualified technical specialists from customer's side who helped us to pull the data.

Note. ✓ denotes a CSF that was fully addressed; P denotes a CSF that was partially addressed; X denotes a CSF that was ignored.

Sustainable Data Quality and Integrity

Lastly, with regard to the CSF of sustainable data quality and integrity, the case studies show that most organizations are committed to achieving and maintaining a high level of data quality and integrity (Table 18), as it is one of the advantages of the BI systems including the data validation. For example, in organization case L1, a company received the first effect of the implementation even in the second week of the project. Before auditors came, they visually saw a bunch of checks printed with wrong period and, therefore, excluded the situation of issuing a fine and all other consequences associated with such errors. Participant from this case mentions, that now modern fast tools are on the high demand, comparing with such systems including data cleaning like SAP or

Oracle BI solutions, as working with data quality is a fictitious work for IT specialists. Based on his longstanding experience, the more data a company has - the better, and somehow, there is always something to work with, because we live in an age of huge amounts of data.

Table 18. Sustainable Data Quality and Integrity	
Case	
F1 ✓	*We have a multi-level data conversion system *We have come to the conclusion that the person who is responsible for the quality of data is the person of the Department.
F2 ✓	*On the first stage, when the data was loaded, it was raw. We prepared a test tables for loading it. *There was a competent specialist on the customer's side who quickly made adjustments to the system, where needed.
F3 ✓	*It depends. I think there's only one base that is clean. And in principle, this is the only base that can be taken as is, all the rest require post-processing. In many systems, validation is not well thought out. *Every analyst who collects data is responsible for data quality.
G1 ✓	*We developed rules for each system, how to get data.
L1 ✓	*In this project we had good data, we could work with it. Data assessment is always on the client's side.

Note. ✓ denotes a CSF that was fully addressed; P denotes a CSF that was partially addressed; X denotes a CSF that was ignored.

5.3 Methods, tools, techniques in Russian practice

Due to the fact that the majority of the interview participants (three out of five) worked in BI consult, which in turn implements solutions of QlickView, this product takes a leading position in this study (Table 19). In the case of the F3 organization, a self-written data Analytics system is created, which makes this case interesting for research. However, participants from F1 and L1 cases emphasize that more flexible solutions, such as Microsoft BI or Qlick Sense, are becoming very popular and occupy a leading position in the market due to their adaptability to any software and ease of implementation. In Russia such solutions are more often implemented within a certain Department, but not on all organization.

As for the implementation methodologies, in Russia, most companies still use a cascade approach in the implementation of BI systems, often this happens in cases where the requirements for the system are strictly regulated and clear at the very early stages, as well as when BI implementation projects are held within the tender, where all stages and requirements must be prescribed in

advance. All participants of such projects confirm that they lack flexibility, but from a legal point of view, this approach eliminates the company-implementer from possible problems associated with misunderstanding of stages and requirements. Three of five participants in the interview used an agile implementation methodology, which is prevailing number in this study. They emphasize the convenience of an iterative approach, the importance of a sufficient level of communication, both within the team and with the customer, and a sufficiently high speed of tasks and development cycles.

Project management is a time-consuming process, that requires appropriate knowledge and skills. Project management is based on the use of control levers that allow you to influence the achievement of optimal project results of the highest quality in the shortest possible time and with minimal costs. It is impossible to carry out management activities without the use of special tools. According to this research, most participants use JIRA to help and facilitate everyday project management routine. In case F3, where KANBAN is leading project methodology, KANBAN dashboard with tasks contributes to their rapid implementation.

One of the most important factors of success or failure of an it project is communication. Effective communication can be a challenge, especially when a project involves many professionals with different backgrounds, levels of responsibility and authority. The problem is aggravated when the participants involved in the project belong to different organizations with different working styles. Almost all informants of this study use Skype as primary communication tool with their customers, in case F1 there is a self-made helpdesk to create and track any task.

Table 19. Methods, tools, methodologies in Russian practise

Case	BI system	Methodology	Project management tool	Communication tool
F1	QlickView, Power BI	SCRUM	Self-made helpdesk	Email Helpdesk
F2	QlickView	Agile	Microsoft Visio JIRA	Skype Email
F3	Self-made BI system	KANBAN	Confluence KANBAN dashboard	Skype Telegram
G1	QlickView	Waterfall	JIRA	Skype
L1	QlickView	Waterfall	JIRA	Skype

6. COMPARISON

In the course of this work, the Russian and European experience of BI systems implementation is studied and analyzed through the prism of critical success factors of such projects. Despite the fact that there is limited access to data from European companies and the data has to be studied from literary sources, the use of the same framework makes it possible to compare two data sources with each other. Using the same approach to interviewing participants, as well as the same vision of the success factors of IT projects implementation gives an advantage in the subsequent analysis of the initial data.

The complexity of evaluating IT systems, especially such complex as BI systems, lies in their very nature. In principle, the IT system consists of three components: a person, a business task and IT, between which there are complex relationships. A business task defines the requirements for IT capabilities and performance, as well as the qualifications of the staff. In turn, IT determines the permissible freedom of action of business task carriers and the way they perform. Determining the appropriate methods of performing business tasks, a person also puts his / her requirements to it. Managing these requirements, as well as project expectations, is a major and perhaps the most complex task.

Based on the data obtained, we can say that most of projects in both European and Russian practice are either successful or partially successful. The main difference between the two studies is that the European colleagues managed to collect data on the failed project, which is more interesting from a scientific point of view. Yeoh & Popovič in their description of the failure of such implementation project note the large focus of business on costs, lack of global vision of the project, use of an inexperienced team and unclear formulation of initial requirements for the system. On the Russian side, participants from partially successful projects also mention low level of involvement of top management in the project, as well as the lack of leadership skills of project managers. A summary table of partially successful or failed cases with estimated factors that influenced the outcome is presented below. On the basis of the alleged reasons for the different kinds of failures a specific list of where specialists need to pay more attention is formed on order to help all future BI implementation projects.

Table 20. Comparison of unsuccessful cases		
Source	**Partially successful or failed case**	**Alleged cause**
European study	W3	Strong focus of business units on costs, lack of commitment and sponsorship
European study	W3	Focus primarily on the technology, neglecting the core requirements of its organization
European study	W3	Absence of global vision of the project
European study	S1	The BI initiative was not primarily constituted at the organizational and strategic level, but mainly driven by its key defense client.
European study	W3	Decision to avoid using experienced external consultants
European study	W3	Incompatible legacy IS applications and siloed ERP modules
Russian study	F2	Problems with communication between company-integrator and management of customer
Russian study	F2	Requirements were formulated very blurry and inaccurately
Russian study	F2	Absence of global vision of the project
Russian study	F3	Low user involvement in the final product
Russian study	G1	Cascade approach to implementation

Both studies mention that the involvement of end users does not affect the success of the project in any way, because in most cases users already know the benefits of implementing BI systems, or begin to feel them during the project, so they are often actively involved in its life cycle. There are also more conservative employees, but they have to put up with the company's IT policy and over time get used to new processes in their work. In both cases of implementation projects, the architecture of IT systems is quite complex and complicated, mainly data are drawn from ERP, CRM and other systems, data cleaning systems are used. Almost each of the projects has no difficulties with obtaining data, but from the Russian side, participants note SAP and SalesForce as a particularly inflexible in terms of obtaining data. All successful examples clearly demonstrated that the right approach to all three pillars of successful systems implementation, in terms of

organization, process and technology dimensions, is the cornerstone on which they successfully base the implementation of their BI systems.

From the usage point of view of certain systems, methods, techniques and tools, it can be noted that in Europe, often used heavy BI system with complex architecture as SAP BI, solutions from Oracle or IBM. In Russia, on the contrary, there is a clear tendency to use flexible universal systems that easily adapt to any IT architecture, such as Microsoft Power BI or Qlick Sense. Very often they are implemented for a specific Department-customer. As for implementation methods, the only thing that is clear from the two studies is that a cascade approach to project management is still popular in Russia, while Europe always adheres to the iterative option. There is a lack of data from the European side to draw any conclusions on the use of communication or project management tools.

7. CONCLUSION & DISCUSSION

Modern Business Intelligence technologies allow managers to make informed decisions that determine the further development of their business. In turn, the use of the concept of business intelligence enables businesses to make more informed and timely decisions, increasing the share of their business in the market, as well as the efficiency of marketing campaigns, opening up new horizons and, ultimately, providing more products and services to more customers.

Implementation and realisation of BI technologies allow organizations to effectively use their financial, human and material resources. Business Intelligence methodologies and related applications allow systemically integrating the company's development strategy with key processes and operational objectives, as well as communicating the management's vision to employees and promptly monitoring their performance and contribution to the achievement of business goals in the management decision-making process (Golovina et. al, 2014).

However, the implementation of BI systems is slightly different from the implementation of any other IS and has its own nuances. This study contributes to a common understanding of the existing success factors of implementations, as well as gives an idea of the level at which such initiatives take place in Russia, in comparison with European experience. It reveals that Russian companies often use a cascade approach to the implementation of BI systems, although agile approaches like SCRUM or KANBAN are not an exception. One of the key factors of the project is communication, both within the team and with the customer, so communication tools such as Skype, self-written helpdesks or various messengers are often used during the project. We can not say that the architecture of BI systems in Russia differs greatly from the European ones, the data are also accumulated in the accounting systems, then it is gone through the process of transformation, cleaning and analysis and displayed to the user via convenient dashboards.

This study shows that both in Russia and in Europe, certain success factors, like presence of strong leadership, balanced and technically experienced team or clear project vision are critical for any implementation, while others do not affect the end result as much. In this work, there is a great focus on enterprises in the field of medicine, for which any technological innovations will give a tangible advantage over competitors. The study shows there are always employees who tend to be more conservative in their vision, but most BI system users are satisfied with implemented product

and feel real outcomes and benefits of its usage. Since in most cases Russia still uses a cascade approach to project management, from the future research point of view the topic of agile BI implementation and its outcomes seems promising. Also, with the high trend to flexible solutions, the theme of Open Source BI, CSFs of its implementation and its use in the Russian market can be very useful for shedding light in this area and common understanding of how convenient this approach could be for small and medium businesses.

8. LIST OF TABLES

9. LIST OF FIGURES

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APPENDICES

APPENDIX 1: Interview Questionnaire

1. What is the name of the company that implemented the product, its profile and size?

2. What was your role and functions in the project?

3. For what purpose was the business intelligence system implemented? What functions should it perform?

4. Who was the main customer? Division of the company, top management? With whom did the main communication take place during the implementation? On whose side was the main support and whether there was at all? Who was the customer's team?

5. What can you say about your implementation team? How many people participated in the implementation on your part? Who was in charge of the project? How much do you think his leadership qualities influenced the success of the project?

6. Do you think that all participants had a clear vision of the implementation project from the point of view of the business case?

7. How do you calculate the scale of the project demands? How many stages did the project consist of? Was there any project management system to help?

8. What implementation methodologies were used? Do you think they are chosen correctly?

9. What can you say about the level of communication within the project? What communication tools were used?

10. What can you say about end-user engagement? Was it necessary to train users to work with the system? And support after implementation?

11. Now a little about the technical side of the project. What were the key components of the system architecture? What systems were used to collect data (ERP)? Were there any problems with integration? Were there any situations when you had to make complex architectural decisions? How flexible was the architecture and data model? Was there a need for mobile Analytics?

12. What can you say about the quality of the data? Maybe some kind of data cleaning and transformation system was introduced? Is there now a person on the customer's side responsible for the quality of data?

13. Did the project meet the allocated time frame? If there was a delay in delivery of the project, how much?

14. Did the project meet the allocated budget framework? If there were deviations, how much?