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Technological and Human Aspects of a Successful Business Intelligence Project

JULIJA LAPUH BELE, TOMAŽ DULAR & ROK PIRNAT

Abstract This article is written as an attempt to help companies that have decided to introduce business intelligence (BI) methods or have already introduced them with unsatisfactory results. We will discuss the measures that should be implemented before a BI project is launched. The most crucial part of the process is diagnostics, which provides an assessment of the status of technology, operations and human resources' knowledge and skills in the company. In order to carry out efficient and precise diagnostics, we designed a questionnaire that helps us to understand the operational and technological aspects related to a project as well as the qualifications of available human resources. In the article, we enumerate all factors that must be assessed in individual BI projects, and those that must be changed in the organization in order to successfully implement such projects.

Keywords: • Business Intelligence • BI • Data visualization • Digitalization • Human Aspects •

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1 Introduction

The most successful companies constantly strive to achieve greater operational efficiency and to optimize their business processes. For this reason, both commercial enterprises and government entities are introducing methods of Business Intelligence (BI).

Managers who do not make use of BI methods tend to rely on data collected from Enterprise Resource Planning (ERP) systems and simple intuition. Good intuition is always welcome in business, but it is similar to talent in sports. It is no longer sufficient as a way of winning in a strong competitive field. Research has shown that companies that adopt BI methods early and make decisions based on the results generated by these methods do better than their market competitors in terms of profitability, quick decision-making, and implementation of operational decisions (Pearson and Wegener, 2013).

According to our experience, the management of many companies would like to increase operational efficiencies using BI methods, but fear that they are not sufficiently prepared and sense that the implementation of such projects might fail. Managers often wonder if the company is “mature enough” for the launch of such projects and what they should do in order to insure that such projects will be successful. These questions go directly to the point as international research shows that many BI projects fail. In addition to the predictable reasons for unsuccessful projects, many other factors lead to failure: ambiguously or unsuitably defined business goals, technological factors such as poor data, inadequate preparation for the transition, and insufficiently trained human resources (Sherman, 2015).

Necessary preparations are therefore the first important step on the path toward the successful implementation of BI projects. The task of project leaders and consultants is to run diagnostics and prepare the company and its human resources for the introduction of the project in order to facilitate the achievement of company goals.

This article is written as an attempt to help companies that have decided to introduce BI methods or have already introduced them with unsatisfactory results. It emerged on the basis of known facts, our experience and ongoing development of good practices introducing BI to several successful companies with whom we have collaborated.

At the beginning of the article, we describe the theoretical framework. In the empirical section, we present evaluations of the preparedness of organizations for the introduction of BI. We also present key areas that need to be researched before concrete projects are launched.

We designed a questionnaire that we use to systematically perform diagnostics and generate a list of necessary steps to take in the preparatory phase of the BI project. We combine information gathered from the questionnaire with our own expertise to help clients avoid the obstacles and correct the problems that often lead to project failure.

2 Theoretical Framework

In recent years, there has been much talk about digitalization.

The term digitalization not only means the transition from analogue to digital operations, which has been a continual process since the invention of the computer, but has acquired a deeper and more contemporary significance. Namely: digitalization is the use of digital technologies to change the business model and to provide new revenue streams and value-producing opportunities (Gartner, 2018).

Today BI offers the key methods and tools for digitalization. However, there is not yet a unified definition for BI, although certain concepts appear in most definitions, such as efficiency, optimization, and better or quicker management decision-making.

David Loshin (2003) defined BI as the processes, technologies, and tools that are necessary for the conversion of data into information, information into knowledge, and knowledge into plans, which leads to more efficient operations.

The following definition of BI is offered by the Gartner Report: BI is an umbrella term that includes the applications, infrastructure and tools, and best practices that enable access to and analysis of information to improve and optimize decisions and performance (Gartner, 2018).

BI is important for the improvement of decision-making on the basis of past results. However, statistical data and the analysis derived from them are not sufficient to forecast the future. The process should be enhanced by using data mining methods, which are essential for not only forecasting the future but also anticipating certain events that might occur.

In practice, we use predominantly statistical methods to conduct research into the data of a company and to generate visually transparent reports that offer management tools for a better overview of operational processes, better and quicker decision-making, and the optimization of operational processes.

Business and the achievement of business goals are clearly at the centre of the interest in BI.

Businesspeople see BI project results through their tool interfaces and dashboards (Sherman, 2015). Therefore, the following perspectives of a BI project must be considered in order to achieve the set of objectives: business, technology and human resources.

2.1 Business Perspective

Planning, setting goals and introducing changes are important tasks of management.

In order to monitor the implementation of plans and to provide clear visual presentations of the current state, it is essential that goals are measurable.

BI project results are reports that suggest necessary changes even when their introduction may be difficult. Many theoreticians and practitioners question why, despite numerous available methods, introducing changes is so often problematic and inefficient.

Organizations change slowly and with difficulty. Most often changes are introduced with the authority of top management, while lower-level employees show little enthusiasm for them. The basic condition for the successful introduction of changes is that participants understand why the changes are necessary. BI and its reports help to clarify and justify recommended changes.

Among the most frequent reasons that the companies with which we collaborate decide for BI projects is to create conditions in which a wider circle of employees will understand the state of the company, and the gap between the current state and defined goals, and will work enthusiastically to achieve the defined goals. In essence, BI is a way for top management to empower lower-level management and employees to work toward concrete results. It makes it easier to introduce changes and to monitor whether changes have a positive influence on business results. We observe that in organizations that have high-quality BI, more attention is directed toward looking for changes, inventions, and innovations in the area of products and business processes on all levels (Lapuh Bele et al, 2018).

In companies we usually use business-management software, which is typically a set of integrated applications that facilitates the collection, storage, management, and interpretation of data from several business activities, such as accounting, manufacturing, purchasing, sales, etc. This kind of application suite is called an ERP (Enterprise Resource Planning) system.

In recent times, managers have begun to expect better information from their technology than ERP systems generally offer. Namely, they expect efficient control over large amounts of data, continual oversight on the achievement of key performance indicators (KPIs), the detection of properties that are not easily observable, regular access to information (24/7/365) through various devices, including mobile devices, and clear reporting that provides key information and relevant visual data (Sherman, 2015).

On the basis of our research of a number of companies, we attempted to identify the most frequent goals for implementing BI projects. They generally have to do with the improvement or optimization of important operational processes, including the following:

- sales profitability,
- productivity,
- elimination of a bottle neck in operations that causes delays,
- reduction or elimination of damaged goods,
- reduction or elimination of errors,
- adjustments to activities that do not meet rules or standards,
- reduction or elimination of activities that do generate revenues,
- identification of returns/complaints and the reasons for them,
- introduction of intelligent planning of operational processes and cashflow,
- introduction of efficient inventory management (Lapuh Bele et al, 2018).

2.2 Technological Perspective

Technology is an important factor in digitalization and in all BI projects. Technology in this sense refers to data and the analytical methods and tools that help us glean valuable information to aid decision-making.

The three core technological building blocks of a BI project are: providing quality data, analysing data and presenting information.

One of the key deliverables in BI is providing consistent, comprehensive, clean, conformed and current information for business people to enable analysis and decision-making. Therefore, we need data that meets the 5Cs requirements:

- clean – without missing parts or incorrect entry;
- consistent – there should be no arguments about whose version of the data is the correct one;
- conformed – the business needs to analyze the data across common, shareable dimensions if business people across the enterprise are to use the same information for their decision-making,
- current – because up-to-the-day data is sometimes not current enough;
- comprehensive – all of the needed data is available (Sherman, 2015).

Company data are mostly saved in databases. For the use of BI, data should be suitably prepared, designed, and stored within data warehouses.

Firstly, we explain terms data warehouse and data warehousing.

Data warehouse (DW) is a central repository of integrated data from one or more different sources. The latest data from the company's transactional databases, summarized data, and data from older time periods are stored in the data warehouse. Current and historical data are stored in, to enable creating analytical reports.

Bill Inmon (1992), known as the father of data warehousing, described data warehousing as the subject-oriented, integrated, time-variant, and continual collection of data to support management decisions. Data stored in data warehouses are usually read only.

In BI implementations, data warehousing is not necessary. It is recommended. In many projects that introduce BI, the importance of the data warehouse for quality analysis is overlooked or neglected, and this is later recognized as the principle cause of the project's failure (Loshin, 2012).

Of course, it is not enough to merely copy data from databases to a data warehouse. Firstly, data integration and data cleansing must be performed.

Often the same data are duplicated in several databases, which present a problem if they are not consistent. Therefore, the first step in data preparation is data integration, and the second step is data cleansing.

Well-prepared data is as important to a BI project as a good foundation is to a building. It is estimated that data preparation may represent 80% of the time spent on a BI project (Mueller & Massaron, 2016). We are often confronted with the problem of missing data that must be replaced with data from other sources or using statistical methods. Sometimes it is necessary to begin collecting certain kinds of data.

Sherman (2015) compares data integration to an iceberg. BI gets all the attention, just like the part of the iceberg that is visible. But the vast majority of the iceberg is below the waterline, just as the vast majority of the work in a BI project is designing and developing data integration processes. As much as three quarters of time is devoted to data integration when new data sources are added to data architecture.

Readying data for storage in a data warehouse is a demanding task, to be performed by IT experts with special training in this field. Such experts are called data architects.

After providing quality data, we perform analysing data and data visualization.

There are two approaches in analysing and presenting data: corporate BI and self-service BI.

Corporate BI is a traditional approach suitable for large projects. A BI project starts with managers' requests for new reports. Managers submit a list of business requirements in order to obtain the information they need for business decisions. Data scientists and IT professionals control access to data and deliver reports using BI tools and methods.

Dashboards and various charts are extremely meaningful for BI reports. Data visualization has a huge role in presenting a BI project's results to managers.

Data visualization is a general term that describes any effort to help people understand the significance of data by placing it in a visual context. The main goal of data visualization is to communicate information clearly and efficiently to users. To convey ideas effectively, both aesthetic form and functionality must go hand in hand, providing insights into a rather sparse and complex dataset by communicating its key-aspects in a more intuitive way (Friedman, 2008).

2.3 Human Perspective

Human resources are of the utmost important in implementing any BI project. Sometimes we are concentrating too hard on products or technological aspects of a BI project. In today's society, people often assume technology is going to magically solve their problems. However, a solution's critical success factors lie

within the three Ps: people, politics and policies. Politics and policies also depend on people. Successful BI projects focus on business needs, not IT needs. The business people expect to get the right information to do their jobs in the right way. One of the biggest reasons BI projects are considered failures is because they do not meet expectations (Sherman, 2015).

The human factor in BI projects means IT experts, managers, and other users of BI solutions. All of these must work together on the BI project as partners. Managers as well, not just IT experts from the project group, must understand the professional and technological requirements and challenges that must be solved before launching the project.

The human resources allocated to implementing, and later maintaining and using the results of a BI project, must be properly trained.

3 Business Intelligence Readiness Diagnostics

According to our experience, we must discover if the company is sufficiently prepared, and what it is necessary to do at the beginning of the project in order to maximise the possibility that all activities in the project will be well directed and managed.

On the basis of the existing theoretical framework and our experience from numerous projects for successful Slovenian companies, we created a questionnaire that helps us to assess the preparedness of companies for the introduction of a BI project. The diagnostics phase involves intense conversations with all relevant participants. In addition to doing diagnostics on the state, it is also important to prepare the entire ecosystem of the company for new methods of decision-making on the basis of information delivered using BI methods.

During the diagnostics phase we dedicate special attention to the following three area:

- Operations: goal-directed management, operational goals and client's expectations, change management

- Technology: data about key processes, planning data, data sources (ERP system and other business software)
- Human resources: management, business analysts, data architects and IT experts

Successfully implemented BI projects require understandable and measurable indicators of operational success (KPIs), goal-directed leadership, high-quality data, and that management and other employees are trained in the principles of the BI project, and in providing data and analytic services.

The purpose of the diagnostics phase is to generate a detailed understanding of the client: its activities, organization, business, its needs, challenges, strategic goals, its human resources training, level of information and communication technology, the state of its data infrastructure, and previous experience in BI. The omission or superficial implementation of the diagnostics phase can lead to a discrepancy between client expectations and results, which can cause even well implemented later phases and resolutions to not achieve client goals.

The questionnaire helps the project consultant to understand the general state of the company. It is also important to interview key participants with the goal of acquiring answers to essential questions and discover as much relevant information as possible that will provide the foundation for high-quality project preparation. Because the time of both the project consultant and the client is valuable, the interviews should be well prepared. The goal of the good consultant is to find out the client's needs and expectations in order to achieve the greatest business success.

The result of the diagnostics phase is a report that contains general context, identifies gaps or missing BI elements in the environment, defines KPIs, a data warehousing plan, and access metrics. Once we perform the diagnostics phase, we determine which of the client's goals cannot be realized without certain changes.

Using the questionnaire, we are focused on operations, technology and human resources.

3.1 Operations

The operational area is the starting point for the analysis of the company's needs as well as its current state. All processes must be directed toward the final goal, the final goal being suitable management support for quicker and better decision-making for the introduction of measures that will lead to ongoing improvement in all operational processes.

It is important to ascertain if the business has specific, clear, realistic operational goals that are also defined in terms of when they should be achieved. The goals must also be defined in such a way that their achievement can be measured. First, we assess whether KPIs have been defined and written in a suitable way. We also try to assess whether, to the contrary, the company has goals that have not been defined in a suitable way, and, if this is the case, we rearticulate them and also identify measurable KPIs.

Another key element for the successful implementation of a BI project is that specific employees or departments are responsible for each KPI. We need to know who is responsible for the achievement of individual operational goals, and responsible parties must have sufficient authority to achieve success (typically the authority of personnel in lower management).

It is extremely important at the very beginning of the project to define and understand the client's expectations. It frequently happens that certain goals need to be developed and expanded in the preparatory phase. Sometimes it is necessary to collect more data, or at least to start the process of collecting that data. Together with the client, we also define additional KPIs if necessary, which will help us to both achieve and measure the expectations and goals of the company.

It also happens in certain cases that there are too many indicators and we have to decide which are the most essential and will be included in the project. Certain clients may decide to start with specific and narrow goals, for example with the optimization of production and sales, and will later expand BI to cover other areas.

Although it may appear that determining the expectations and goals of a company is simple, it often happens that clients fail to express themselves in a clear manner, or the project consultant fails to understand. This relates to the level of knowledge of human resources and the ability of the project consultant to conduct interviews in a way that reveals and clarifies the client's expectations and goals in cases where they are not clearly expressed.

During the diagnostics phase of the project, we take a particular interest in the culture of the company and how employees in position of authority introduce changes. A well-managed BI project will inevitably demand changes in operational processes. For this reason, it is very important that the management team is aware of the significance of and reason for proposed changes, and that they are ready and able to carry them out.

3.2 Technology

In terms of technology, we are mostly interested in data. We have identified three specific areas: ERP systems data, planning data, and data about key processes.

In most BI projects, the first step is to calculate the most important KPIs. The data for the calculation of most indicators can usually be found in the ERP system, which is why it is one of the main data sources.

We often encounter the problem that key operational processes have not been digitalized. In order to introduce BI in production processes, for example, there needs to be a structured method for collecting data about production quantities, number of quality pieces produced, number of non-quality pieces produced, etc. Only with this data can indicators, such as Overall Equipment Effectiveness (OEE) and scrape rate, be correctly calculated.

During the diagnostics phase, we must evaluate whether the existing data collections provide all data necessary for analysis. We must also evaluate the technical accessibility of the data collections, and the obstacles or limits related to transferring data to the data warehouse.

We often encounter data collections that permit unsupervised correction of past data, or contain only partial data reflecting conditions at a given moment (for example, inventory levels), which cannot be cross checked with transaction documents. The preparation of data from such sources requires additional verification, and results derived from them are often of questionable value.

It is important to verify if the data source are also IOT devices, how data is stored, and if their quality is suitable as input to analysis.

We also evaluate data collections and their normalization levels. It is important to ask whether the organization implementing the project has a data warehouse or not, and if it does, whether the warehouse contains all the data necessary for the successful implementation of the project.

Planning data is usually generated with Excel, the ERP system, and other applications. In order to calculate KPIs, we need data with comparable values. In order to calculate KPIs on the company level, it is sometimes acceptable that plans are divided into separate timeframes have just two dimensions (time and quantity or amount), but for the best decision-making it is necessary to go into greater depth. In this way, we can recognize deviations within indicators. In order to visualize these deviations in depth, in the case of sales, we must have complete plans that include data on buyers, articles, and month. With certain companies, it is necessary to have more detailed plans, in others less, but all must be clearly defined in the diagnostics phase.

We have discovered that in the first year of implementation of a BI project, companies tend to give little attention to the defined plans. This is often because the plans are poorly prepared. Seasonal components have not been considered, and comparisons with forecasts and actual results are relatively rare. Most participants prefer to use data from previous years in comparative studies.

Most companies that decide to implement a BI project have extensive and efficient ERP systems. However, we have experienced difficulties in project implementation with even the most successful companies. Certain clients have their ERP systems adapted to specific needs, and this specificity prevents the upgrade of the system. If we conclude on the basis of initial results that the implementation of a BI project requires changes to the ERP systems and that

these systems cannot be upgraded, this can become an obstacle to changing operational processes. For this reason, finding resolutions for such situations should take place before problems occur.

Because BI projects require changes in organization and processes, and this includes data processing, it is essential that the ERP system is able to accommodate these demands. In our experiences, most BI projects end up requiring the collecting of additional data. The condition for the collection of high-quality additional data is that the company's ERP system is both flexible and up-to-date.

Many companies have information solutions that support key operational processes separated from ERP systems. These systems usually contain a large amount of transactional data that do not include any financial valuation, and this can limit their use in analytics.

We have to research applications that support key business operations and the data these operations use and provide.

3.3 Human Resources

Questions related to human resources are usually associated with availability, knowledge (or skill base), and experience. The level of knowledge and experience must be assessed in the following employees: managers, analysts, data architects and custodians of data collections.

Although it may seem that management's knowledge in the field of BI is irrelevant, this is not the case. If managers understand the significance of structured data collection, are able to distinguish between data for transactional work and data for analysis, understand the importance of the data warehouse and know how to use analytical tools to the extent that they can clearly express demands, the planning and implementation of the project will proceed much more quickly and efficiently than in cases where management employees do not possess this knowledge and skill base. In cases where management do not possess these skills and do not receive appropriate training, and only receive it once the BI project is already underway, there are often delays in the project, additional demands for changes, as well as conceptually incomplete or even illogical demands.

Most companies employ analysts that perform business analysis but do not necessarily master BI tools. Also here, many levels of knowledge must be assessed. The first and most basic question is whether analysts master the concept of merging many data sources and conducting analysis with pivot tables. The next skills we verify among analysts are direct networking with data sources, modelling data, and the mastery of state-of-the-art analytical languages (such as DAX and MDX). At the highest level, we evaluate skills in the field of data mining, advanced statistical methods for forecasting, profiling, extracting hidden properties of data, and the explication of pattern-consequence structures from the past.

Because useable data are especially important, we need to find out if the organization has employees that can perform the structured preparation of data for analysis. It is essential that the company has employees with knowledge of a range of programming languages for data extraction through various interfaces, and are versed in system skills related to server infrastructure. The results of this discovery process should provide information as to what extent it will be necessary to rely on consultants and external data architects in the phase of data preparation.

It is also important to evaluate the skill and knowledge of personnel in charge of data collections. Some data collections are extremely complex. If the data warehouse is to contain only correct and useable data, it is necessary to establish certain rules and recognize details in the data entry process. The search for data and the effort to understand its content can result in excessive use of time during project implementation.

3.4 The Analysis of Results

Company participants fill out the questionnaire and are interviewed.

The questionnaires are then analysed. In cases where there is a lack of clarity or discrepancies in the answers, additional interviews are conducted. On the basis of the diagnostic analysis, we evaluate the preparedness of the company for the BI project, which we present in graphic form (see Figure 1). In this process, we consider the insights of both external and internal participants, that is of the consultant and client respectively.

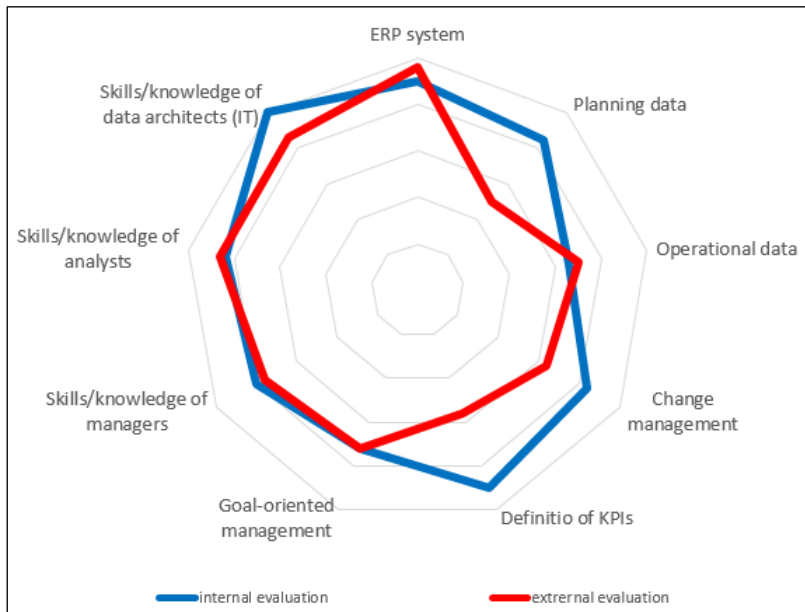


Figure 1: Example of evaluation of the company's preparedness for the development of its business ecosystem and the implementation of a higher level of BI

Once diagnostics have been carried out, it is necessary to present the results to management along with conclusions about necessary changes in areas of the company where there are indications that business goals would not be achievable.

The content of the project, its timeline, and the product set are determined on the basis of this assessment.

Both the client and the consultant must agree on the company's current state, what segments of their business require special attention, and what specific changes or activities need to be introduced. The diagnostics phase is essential in order to avoid the traps and delays that hinder many such projects.

4 Conclusions

In successful companies, managers are generally aware that, in order to maximize business efficiency, it is necessary to adopt BI technology and make use of all of the company's available information. Some companies have made the initial decision to implement a BI project; others have already begun implementation

and have encountered difficulties and challenges. In either case, skills, knowledge, and experience of good practices are extremely important for the company to successfully implement the project. It should not be necessary to repeat the mistakes that others have already made and learned from.

We have written this article with the intention of encouraging and helping interested companies to thoroughly prepare for BI projects so that all participants will be satisfied with the results. If companies are to implement a successful BI project, it is necessary to undergo appropriate preparations either in the case of a wide-ranging project or a more specific project. We call this phase diagnostics and its purpose is to first evaluate the current state of preparedness of the company and second to introduce necessary changes prior to project implementation.

We have concluded that successful project implementation requires a sufficiently developed business ecosystem that includes three main areas: operations, technology, and human resources. We present problems from practice and pose questions that help us to assess how well-prepared an organization is for the implementation of BI, and what elements are necessary to upgrade or improve before the project is launched in order for successful implementation and fulfilment of the goals of the company.

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