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Strategic Insights: Navigating Business Intelligence Implementation - Phases, Tasks, and Risks: A Case Study on an International Manufacturing Company

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Abstract:

Purpose: *This article aims to present a comprehensive case study of implementing a business intelligence system in the manufacturing company. Therefore, a comprehensive understanding of key implementation aspects and associated risks is vital for meticulous planning before investing in information systems.*
Design/Methodology/Approach: *Through qualitative research, the study will identify the main implementation phases, assign key tasks, and highlight the potential risks encountered during the process. By examining the case study, readers can gain insights into the effective implementation of a business intelligence system in manufacturing company, enabling them to better navigate similar ventures a significant input for researchers to create an implementation model.*
Findings: *Having accurate and timely information is a crucial asset for businesses, influencing their competitive advantage. Information is essential for decision-making, enabling organizations to identify opportunities, threats, strengths, weaknesses, and changes. Business Intelligence (BI) solutions cater to these needs by automatically transforming data into actionable information. However, due to the wide array of tools available in the market, the implementation process of BI can be complex.*
Practical Implications: *The findings from this article's case study can serve as a foundation for proposing an implementation model for business intelligence systems.*
Originality/Value: *By analyzing the challenges, key phases, and risks identified in the case study, future research can develop a structured framework or model that outlines the necessary steps, considerations, and best practices for implementing BI systems specifically tailored to manufacturing industries.*

Keywords: *Business Intelligence software, implementation procedure, decision support systems, manufacturing company management, data-oriented systems.*

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1. Introduction

In a business context, having good quality information on time is a valuable, strategic resource which affects competitiveness on the market. It influences on ability to create an added value and support realization of strategic, tactical, and operational goals (Bembenek and Piecuch, 2009). Information also plays a significant role in decision making process since is a first link in the chain (Komorowska 2021).

As an intellectual capital can guide in accurate identification of opportunities, threats, strengths and weaknesses of the organization, precise definition of problems and diagnosing their causes, proper assessment of the current situation of the enterprise and provide better understanding of various changes (Bembenek and Piecuch, 2009; Tyagi *et al.*, 2023).

Therefore, increasing number of enterprises put strong attention to development of information systems which especially concern processes related to data collection, storage, processing, presentation, and transmission (Al-Hashemy, 2021). The ability to transform data into high quality, useful information becomes indispensable as a key success factor in company management (Pyrek, 2005). The information can be presented in the form of dashboard compost of set of key performance indicators presented in visual graphs or maps.

Business intelligence systems covers above needs and support in obtaining mentioned benefits (Pancić *et al.*, 2023). Utilization of business intelligence enables companies to gain a comprehensive grasp of organizational processes, effectively respond to competitor behavior, and identify the demands of international customers through the establishment of an optimized value chain (Golestanizadeh *et al.*, 2023).

By utilizing the system, companies can effectively adapt to the dynamic technological landscape, opening possibilities to foster more profitable relationships with customers and suppliers, reduce expenses, and mitigate risks (Pica and Mihai, 2022; Yiu *et al.*, 2021; Velinov *et al.*, 2023).

However, the level of profits that might be obtained, depends on the effectiveness of the information system used. Investing in a system without taking into consideration aspects related to proper implementation or criteria of effective use may not provide expected outcomes (Trieu *et al.*, 2022). Hence, before such an investment it advisable to acknowledge the key implementation aspects and plan the whole venture (Zafary, 2020; Thalassinos *et al.*, 2023).

In the context of international manufacturing company management, decision-making holds significant importance due to its specialized nature. The complexity of processes and their dependencies between different units poses challenges to this process, making the implementation of a business intelligence system in this domain

highly advantageous and beneficial. Obtaining benefits from the use of business intelligence solutions is possible only with proper implementation.

There are many technical, organizational, and human aspects to be considered in this venture. The process must be carefully thought out and neatly prepared. Experience in this area will undoubtedly be helpful, as it will support to take care of the key aspects of such an undertaking. Therefore, all sources that share practical knowledge of this type of implementation are very helpful by highlighting the most important issues and risks, supporting to understand the entire process.

The aim of the research is to identify the implementation phases of BI solutions and associated crucial risks. While there are numerous scientific resources related to BI concepts, its structure, and benefits, there is limited research about the required implementation steps. This, together with the identification of risks, can help achieve better results in similar ventures and become a significant input to create an implementation model.

2. Literature Review

2.1 Business Intelligence Contest and Implementation Phases

Due to the increase in IT technologies and their availability, the number of data gathered by manufacturing companies has significantly increased in all manufacturing sectors. But gathering a significant amount of data does not mean an increase in the effectiveness of the company's performance and competitive advantage.

The key players that want to set aspirational targets need good quality information allowing them to make the right decisions based on facts (Chaudhry and Dhingra, 2021). In this case, it is possible to name information all indicators, charts, maps presented in the form of a visual interactive report, also known as a dashboard (Lin *et al.*, 2009).

Business Intelligence is a set of technologies, tools and methods used in the process of transforming the data into useful information supporting management in taking key decisions and control of the business processes (Ahmad *et al.*, 2020; Zafary, 2020).

Scientific research proves that implementation of the BI system brings a lot of benefits, including the increase of efficiency, effectiveness, quality of resources planning or optimization of company’s costs (Jalil *et al.*, 2019; Grigorescu *et al.*, 2020). The advanced potential of big data technology and predictive analytics is evident in the field of BI, particularly in the realm of decision-making (Chen *et al.*, 2022).

The concept of Business Intelligence, originating from Decision Making Systems, represents one of the fastest-growing technologies. It involves a structured sequence of activities aimed at transforming company-collected data into useful information, which, in turn, becomes the foundation for knowledge-based decision-making processes and action definition.

The initial phase involves data acquisition through collection and consolidation techniques, employing tools like ETL (Extract, Transform, and Load), data warehouses, or databases. Subsequently, collected and structured data undergo analysis and are presented in graphical reports, thus transitioning into information. Solutions such as OLAP (On-Line Analytical Processing) or query languages are applied in this stage.

The final step, data mining, translates information into knowledge, forming the basis for decision-making processes (Effah *et al.,* 2018). Time is a crucial element in the operation of a BI system. The information used as a foundation for business decisions must not only be of high quality and specifically chosen for a particular purpose but also be accessible in the shortest timeframe possible (Lin *et al.,* 2009).

The later a decision is made, the diminishing value of the business decision and the decreasing value of information. Factors causing delays in this process are primarily associated with data preparation and analysis, necessitating the automation of these stages. To achieve this, a carefully chosen architecture for the BI System is essential (Bojar *et al.,* 2014).

In the structure of the Business Intelligence system, three main layers can be distinguished: data integration and storage, analytical processing, and presentation and sharing of results. These layers form a functional and technological connection, corresponding to the subsequent stages of data processing to obtain final information (Januszewski, 2008).

The first layer involves raw data stored in various systems where transactions from different business areas occur daily. Sources may include CRM (Customer Relationship Management), HRM (Human Resource Management), ERP (Enterprise Resource Planning) databases, or other databases tailored to the company's operational needs. The detailed data, such as sales or purchase transactions, are stored in tables, serving as a storage form. Extracting useful information at this stage is challenging (Insight software, 2022).

Integration is crucial in the initial data transformation phase. When dealing with data from disparate systems, the need arises to combine tables from various databases for comprehensive information. ETL solutions and data warehouses play a vital role in this process. ETL tools facilitate the extraction, transformation, and cleaning of data from diverse sources, ensuring conformity with the company's data standards. The prepared data is then loaded into the target repository.

Data warehouses store integrated, structured, thematically organized, time-variable (incremental), and non-volatile data (Ul Hassan *et al.*, 2018; Manickam and Rajasekaran Indra. 2023). The second layer of BI involves analytical processing. With selected and structured data, the next stage is analysis—a process that transforms data into meaningful information, providing a comprehensive view of the organization's historical, current, and future (predictive) business condition (Djerdjouri, 2020; Maaitah, 2023).

The layer of presenting and sharing results is another component in the BI structure, aiming to present complex information in a simple and aesthetically pleasing manner. Tools for graphical data representation are utilized to create dashboards with visualizations, showcasing critical information for the organization. These results of the analysis are then shared, with the scope and level of aggregation tailored to the end user (Yee *et al.*, 2022).

Having a robust BI system architecture is critical to achieving your organization's goals. A correctly defined process of data transformation into useful information passing through all layers of a business intelligence system is the basis for effective implementation (Ong *et al.*, 2011).

According to the concept described in the book "Decision-making systems", the BI system implementation project has been divided into 6 parts: needs assessment, planning, analysis, design, implementation and operational application. In the initial phase, the company assesses its needs and sets business goals. This involves financial considerations, the current access level to information, the company's readiness for a new system, and an evaluation of risks, costs, and return on investment.

The planning stage focuses on building the system infrastructure, considering technical and non-technical needs. The analysis identifies business needs, source data, metadata repositories, and involves creating an application prototype. The design phase focuses on source data structure, defining the ETL process, and designing the metadata repository.

Implementation involves operationalizing previous stages, launching ETL processes, applications, repositories, and data mining. Testing confirms the system's proper functioning. The final step is implementation, starting with user training, system deployment, and concluding with an assessment of project objectives achievement.

The authors of the BI system implementation concept described above also pay attention to three conditions that must be met before starting this type of project. The first is to have an experienced design and implementation team who will have substantive knowledge in this field. The second condition is the need for continuous cooperation between the implementation team and users throughout the system implementation period.

The third requirement is to use an appropriate implementation methodology that will divide the project into smaller stages (Bojar *et al.*, 2014).

Another implementation concept was presented by the authors of the publication „A Business Intelligence Platform for Portuguese Misericórdias". During the implementation of the BI system in Portuguese „Misericórdias" project was divide into eight stages: project planning, business requirements definition, technological architecture definition, dimensional modeling, definition of the physical structure of the system, design and development of ETL data, extension of analytical tools, implementation and development.

During the planning phase, tasks for the project were identified by analyzing the current data state and outlining the future solution. The analysis of business needs focused on understanding performance indicators and defining organizational needs. Technological architecture was established, specifying BI solutions and tools for each layer. Dimensional modeling resulted in fact tables in three dimensions.

A physical model was designed to support the data model, consisting of data source, repositories, and analytical structure. Technologies were selected for each part. ETL data design and development included corrections for quality data, loaded into the data warehouse. The final phase involved testing, implementing the solution, and conducting user training (Duarte *et al.*, 2022).

An alternative approach to BI system implementation was proposed in the article "Implementation of Business Intelligence Performance Dashboard for Knowledge Management in Organization."

The process is divided into nine stages, planning, business needs analysis, collecting requirements, creating a data warehouse, collecting data, supplying the data warehouse, process automation, creating reports, checking result accuracy, and training.

The first phase involved project planning, defining data warehouse structure, selecting BI tools, and outlining tasks. The analysis phase identified business needs, followed by creating a data warehouse and defining data cleaning and transformation processes. Cleaned and structured data were loaded into the warehouse. The process continued with automating data updates, creating initial reports for data correctness testing, and concluding with user training (Furmankiewicz *et al.*, 2015).

Bearing in mind the above-mentioned stages of BI system implementation proposed by various authors, it should be noted that the details of the application and implementation plugs will differ depending on the environment of a given organization. Solutions must be selected for a specific case, depending on the current state and needs of the enterprise (Tavera Romero *et al.*, 2021).

2.2 Qualitative Research methods

Qualitative research methods are employed when dealing with constructs that are challenging to measure. Examples of such constructs may include the "identification" or "definition" of a specific research object. This type of research aims to answer questions related to "how" something is happening or understand the underlying processes (Nowosielski, 2016).

According to Kathy Eisenhardt, a methodology involving case studies can serve dual purposes – either generating a completely new theory or expanding upon an existing one. This approach revolves around formulating theories that are assessable, broadly applicable, logically consistent, and empirically sound. It proves particularly valuable in addressing "how" inquiries, accommodating normative or descriptive aspects, and encompassing both procedural and variance-based approaches.

The first step in the research process involves conducting a literature review on a given topic to understand the current knowledge. The second step is to identify the problem and formulate research questions. Once the research objectives are known, the appropriate methodology must be chosen. It is important to specify whether the theory exists or is not well-defined, especially if the process is complicated and dependent on various factors.

The fourth step includes the description of the research project and theoretical sampling. In this stage, the research plan must be finalized, and the chosen research object justified. Kathy proposes different methods such as individual case, polar types, or historical condition control. The fifth step considers data collection (Gehman *et al.*, 2018). Qualitative research should involve various types of sources. Exemplary data sources may include interviews, observations, questionnaires, and document analysis (Kaczmarczyk, 2011).

The sixth step involves building a grounded theory, divided into three themes: the first row (measurements), the second row (constructs), and abstraction at a higher level. The last step is the explanation of a new theory and the creation of propositions. Ann Langley focuses on processes in her qualitative research.

However, she does not believe in any particular methodology for this type of research. Instead, she has formulated a couple of principles that researchers should follow in order to generate convincing and theoretically insightful process studies.

The first one concern study process over time. Process research necessitates the examination of phenomena over time, requiring rich longitudinal data. This involves the use of various qualitative data sources such as interviews, observations, archival data, and real-time methods. The second insist to fit of data with process duration. The data used in process research should align with the time span of the processes under investigation.

The duration of the study can vary, but the data must be sufficient to capture the process in detail. The third one concern adaptation to project needs. The choice of data collection methods, such as interviews, should align with the specific objectives of the research project. For instance, interviews may focus on factual events in the past or real-time interpretations and cognitions. Multiple Analysis Methods: Once data is collected, various analysis methods can be applied, including narrative analysis, quantification, alternate templates, grounded theory, visual mapping, temporal bracketing, and comparative cases (Langley *et al.,* 2013; Gehman *et al.,* 2018).

One of the main analytical activities is data representation, which is typically an elaborated text. This primarily concerns texts derived from notes taken in the course of qualitative research. "Representation is an organized, compressed set of information that allows for drawing conclusions and taking action" (Miles and Huberman, 1994). The better the representation, the more refined the qualitative analysis. Matrices, graphs, charts, maps, and networks are used as part of the representation. These methods are not mutually exclusive and can be combined in different ways. The fourth principle is about mixing and matching methods.

The mentioned analysis methods can be mixed and matched in different ways. They are not entirely distinct, allowing flexibility in their application. The last principle is connected with visual mapping and temporal bracketing. Visual mapping is useful for illustrating how events are connected over time, emphasizing ordered sequences.

Temporal bracketing helps simplify temporal flows by decomposing processes into phases. These phases, though not necessarily theoretically relevant, serve as units of analysis for longitudinal replication, enabling exploration of the recurrence of process phenomena over time (Gehman *et al.,* 2018).

3. Research Methodology

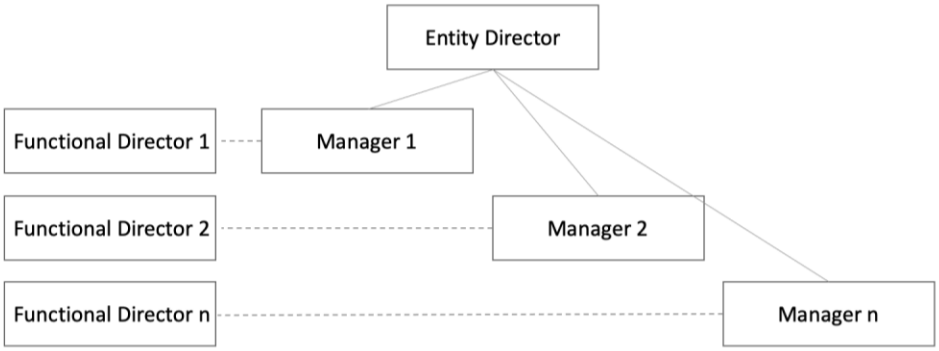
3.1 Description of the Case - International Manufacturing Company

The article is based on the real case experienced in the international manufacturing company producing car parts and hiring more than 100 000 people in 33 countries. The studied unit brings together various competences needed to create a product, from the creation of the product concept to the production. The daily work of the unit is related to the design of new products, computer testing of the created concepts, production of prototypes, product validation and series production.

The considered in the case factory in Poland has been operating for 20 years and currently employs about 400 people. The entity consists of nine departments which represent different competences of automotive industry. All departments, excluding support departments, have the autonomy to operate independently and handle their own sales.

Each department, represented by its manager, reports directly to both the director of the entity and their respective functional superior. The reporting process and presentation of performance indicators vary across departments due to the matrix-functional organizational structure presented in Figure 1.

Figure 1. *Matrix organizational structure of the manufacturing company*



Source: *Own elaboration.*

The strategy for data collection and analysis presentation is influenced by department managers, functional superiors, and the director. This places a significant burden on the director of the unit which initiated the need for changes towards standardization of the reporting process. Initially, challenges arose within the decision-making process, specifically for the director who encountered difficulties in accessing timely information essential for making informed decisions.

These challenges were evident across various decision-making domains, spanning strategic, tactical, and operational levels. Consequently, there emerged a pressing need to standardize the range of information gathered from different departments and establish uniform reporting practices. The additional requirement arising within the reporting domain was linked to the company's objectives of enhancing internal process effectiveness.

Therefore, it became imperative to devise new indicators capable of providing reliable and real-time information regarding the progress of set goals.

3.2 Description of the Applied Research Methods and Tools

This paper will examine the process of implementing a Business Intelligence system in a manufacturing company. The literature review section presents the current state of knowledge regarding BI systems, implementation phases, and associated risks.

The presented study aims to deepen the understanding in this area and clarify its significance in the context of Business Intelligence systems. By conducting the research, the authors attempt to find answers to the questions of what the main

phases and tasks in the BI implementation process are and what associated risks are involved.

The goal of the research is the identification of risks and the deepening of theory related to BI implementation processes. Hence, the qualitative research method was applied. The analyzed case involved an international manufacturing company where the BI solutions implementation process took place. The entire process lasted around two years, enabling the collection of plenty of data from various perspectives.

The international environment involving stakeholders from seven counties from various operational areas of the considered research object allowed for the consideration of a broader perspective, providing a greater contribution to the research. These factors made the research sample truly relevant.

The participant observation allowed for the collection of primary data. Secondary data were gathered from both official and unofficial project documentation, such as the issue register, project plan, progress reports, and project diary which includes users' feedback from several testing sessions. Data in these sources were input by all project members throughout the entire implementation process.

Analytical part of the research was based on text coming from participant observers notes and project documentations. The parts of text were labeled according to the subject: implementation task, failure, and potential risk. "Implementation task" label cover all actions which were considered as relevant because required longer period of realization time, have significant impact on the project or requires specific decision.

"Failure" and "potential risks" labels were assigned whenever described situation led to or it was a danger to exceed time, budget, or scope of implementation project. Next the representative data were presented in matrixes.

In the matrix related to BI implementation process all main identified tasks are placed in chronological order. The basis for creating the process was the project plan, its updates and progress reports. the supplement included fragments of the analyzed text marked with the "implementation task" label. The chronology of tasks was also maintained, taking into account monthly time frames.

Next, particular phase names were assigned according to theory presented in Decision-making systems (Bojar *et al.,* 2014). It was assumed that according to reviewed theory there should exist at least 6 phases, needs assessment, planning, analysis, design, implementation, operational application. In case a given task did not fit into any characterized phase, the label "not identified" was assigned. These tasks were further analyzed and included in the proposition part of the research (Table 1).

Table 1. *Theoretical description of each BI implementation phase*

Needs assessment	Tasks related to busines case development f.e. needs assessment, goals description, evaluation of the current state, assessment of needed resources, desired effect etc.
Planning	The planning tasks concerning details about system infrastructure. Technical needs such as hardware or software as well as non-technical needs regarding adopted metadata standards or internal procedures or other organizational activities.
Analysis	Activities related to deeper analysis of desired solutions. Task related to detail decryption, construction, organization of data sources and metadata repositories and limitations recognition. Formulation of required functionality of the system and market analysis related to current BI solutions. Preparation of first drafts of the solution.
Design	Tasks related to design of structure of the data source, the definition of cleaning and joining processes, visualization propositions
Implementation	Tasks related to launching the solution: running designed processes, applications and verify visualizations. Activities related to training the users, testing the solution, ensuring delivery of the desirable results and ensuring the correct operation of the system.
Operational application	Activities related to ensuring the operational continuity of the system and ongoing control. Tasks concerning tailoring the solution and father debagging.

Source: *Decision-making systems, Bojar et al. (2014).*

In the matrix related to risk identification, all risks and failures were listed. For each item, a short risk name and impact area were assigned. Additionally, each identified risk in the matrix was assessed by the research team for impact and probability using the qualitative risk assessment matrix outlined below (Table 2).

Table 2. *Criteria description of risk impact assessment*

Score	Criteria
High	Catastrophic-There is a high probability of project failure. If it occurs, the solution will necessitate decisions at the highest levels and may involve the use of significant additional funds not allocated in the budget. This could lead to a significantly delayed implementation date or fundamental changes in the project's scope.
Medium	Critical - high impact on time, budget, or incomplete scope of the project; once it occurs, mitigating the effect may take a longer period or require additional significant budget or other resources.
Low	Marginal impact on time, budget, or scope; once it occurs, it is easy to immediately mitigate the effect, mainly using internal project resources.

Source: *Own elaboration.*

4. Research Results and Discussion

The implementation process commenced with the formation of an implementation

team and the identification of business needs. Workshops were conducted, involving top-level managers, to develop strategic goals resulting in a defined balanced scorecard across financial, internal processes, customer, and development perspectives. Key performance indicators (KPIs) were established for each perspective, facilitating measurable control of business areas. Some relevant KPIs are presented in Table 3. Operational dashboards tailored to department needs were developed to enhance internal processes.

Table 3. *Example of key performance indicators defined as part of creating a balance scorecard*

Financial perspective	Internal processes perspective
Sales value in relation to the forecast	Employee efficiency (based on the system - number of hours worked on projects in relation to available hours)
Average hourly rate in relation to the budgeted one	Percentage of projects completed on time
Sales profitability	Number of quality alerts
Customer perspective	Development perspective
Number of complaints for all orders	Number of employees in relation to forecasted demand
The value of the complaint in relation to the value of all orders	Number of completed recruitments in relation to the current plan
Percentage of customer satisfaction (based on a system survey)	Average absence duration per employee

Source: *Own elaboration.*

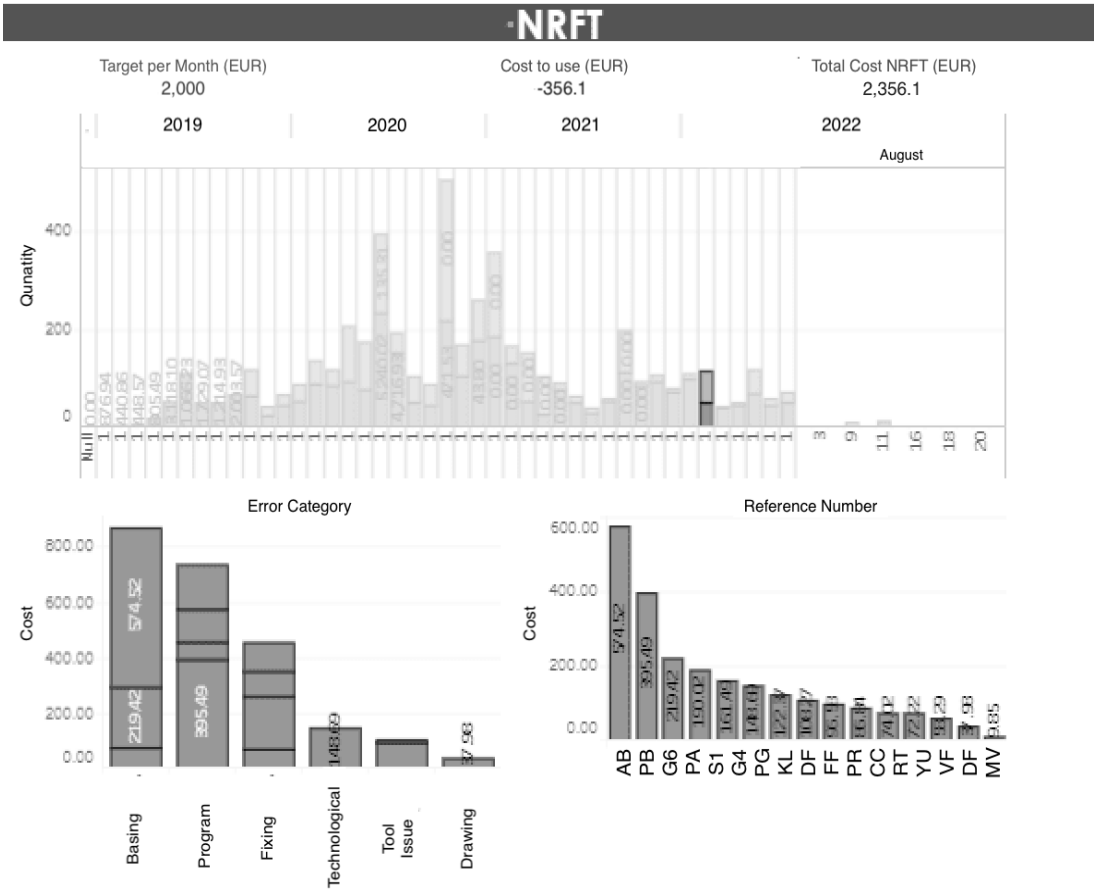
The team's initial task was to identify necessary data sources, resulting in the identification of four databases: HR system, SAP, Warehouse Management system and Access databases. Subsequently, project milestones for BI system layers were established. The planning process defined functionality assumptions and data collection methods.

The analysis phase focused on understanding data structures, developing data connection diagrams, and defining technical needs. Software selection involved purchasing Alteryx for data integration and Tableau for analysis and visualization.

Designing the BI system involved creating an architecture diagram, leading to the decision not to launch a data warehouse due to high maintenance costs. A simplified diagram of the solution is shown in Figure 2. Cleaned, integrated, and aggregated data were stored in tool-generated repositories.

After design approval, Tableau and Alteryx were purchased, and reports and dashboards were conceptualized. Applications were installed and configured, followed by data extraction, integration, and cleaning. Testing involved checking data quality, correctness of calculations, data model accuracy, and the update schedule.

Figure 2. *An example of designed visualizations – operational dashboards: NRFT (Not Right First Time) dashboard presenting analysis of rework parts*



Source: *Companies' materials.*

Figure 3 depicts a dashboard analyzing products requiring rework and identifying additional resources for repairs. The upper section displays rework costs, with the leftmost value representing the assumed maximum monthly repair costs. Below this threshold, the process is considered correct. The subsequent value shows remaining costs for the current period, and a negative value indicates exceeded costs.

The last value represents currently incurred costs. The chart below illustrates daily reworked product quantities. The lower part features two charts: one showing Error Category costs and the other, "Reference Number," presenting a Pareto analysis of the most costly rework.

Training sessions for BI users preceded the operationalization of the system. Weekly meetings with department managers ensured effective implementation and analysis testing. The team addressed discovered errors, and a comprehensive document on

system operation and reporting processes was created at the project's end. The implementation team become part of the controlling department, remains dedicated to BI system maintenance, control, and ongoing development. In Table 4 the identified implementation phases with assign tasks are presented.

Table 4. *Idented BI implementation phases in the researched manufacturing company*

No	Phase	Duration	Tasks
1	Needs recognition	1 month	Form a BI implementation team.
			Define the scope and objectives of BI implementation project.
			Conduct a workshop with top management to assess the needs and identify business requirements.
			Describe critical KPIs basing on workshop output using Balanced Scorecard approach.
			Define required data and identify currently available sources.
			Define the technical needs.
			Develop budget, time, and scope assumptions.
2	Planning	1 month	Develop a project plan with timelines and milestones.
			Allocate budget.
			Create general plan of BI infrastructure.
			Define list of purchasing needs with cost assumption.
3	Analysis	4 months	Evaluate current state of data management and data structure in existing systems.
			Define the hierarchy of indicators into strategic, tactical and operational - cascading goals.
			Assess data quality and integrity.
			Meet with first line stakeholders to understand user requirements.
			Selection of the scope of information for each system user.
			Definition of the assumptions of the required software.
			Research of tools available on the market for data integration and analysis.
			Define minimum technical requirements for desired BI tool and applications
4	Design	4 months	Design the data architecture and transformation model.
			Choose a BI software vendor and complete purchase.
			Develop prototypes for dashboards and reports.

			Create a data governance plan.
5	Implementation	6 months	Set up the BI infrastructure and environment.
			Launch the processes: extract, transform and load data into the BI System.
			Develop custom reports and dashboards.
			Train users and administrators on BI system usage.
			Define testing procedures.
6	Testing	3 months	Perform system testing for functionality.
			Conduct user acceptance testing.
			Identify and resolve issues or bugs.
			Validate data accuracy and consistency.
7	Operational application	5 months	Execute the BI system processes.
			Monitor system performance during initial implementation.
			Provide ongoing support for users.
			Collect feedback for continuous improvement.
			Establish regular system maintenance procedures.
			Monitor data quality and refresh processes.
			Conduct periodic training for new features.

Source: *Own elaboration.*

However in methodology description there only 6 phases defined the presented process include one additional called "testing". During the implementation, many tasks related to checking and improving the solutions were identified. These tasks also took a significant amount of time, over 3 months, which resulted in the decision to present this important separate phase of the process.

Based on the analysis of documents, many situations were identified that had or could have had a negative impact on the implementation. Table 5 presents the most important ones, i.e. those that affect the time, budget or scope of the project.

Table 5. *Matrix presenting identified risks with impact assessment*

Name	Possible Budget Impact?	Possible Time Impact?	Possible Scope Impact?	Label	Description and exemplary quotes	Impact	Effect in the Case

Lack of necessary data sources	yes	yes	yes	failure	**Participant observer explanation (observations)** Lack of data necessary to build defined strategic reports related to workload management. **Quotes from issue register** "Data unavailable – it is not possible to deliver requested reports basing on existing sources"	high	Budget and time extended for purchasing additional system to collect missing data.
Poor quality of data	no	yes	no	risk	**Quotes from register** "Data in the SAP system are incomplete – not possible to prepare billability report" "Results presented in warehouse value reports does not match reality- some unit prices are missing"	low	Internal reporting process improved. Use of one of the BI application "Alteryx" to clean and integrate data. Finally no impact on budget, time or scope.
Reluctance to change	no	yes	no	failure	**Observations** Reluctance to change among top management and people involved in the reporting process. **Quotes from project diary** Feedback from trained sessions: "I prefare to use my excel" "I have been using my calculations for many years and everything works, I don't need any inventions"	medium	Organizing training sessions and regular meetings for top management to discuss the implemented indicators, which aimed to highlight the significance of the new system and facilitate their gradual adaptation to the new solution. Impact on time – testing session prolonged.
Lack of trust in new technologies	no	yes	no	risk	**Quotes from project diary** Feedback from testing sessions: "it doesn't work, I won't use it"; "I am not sure if the system consider all the variables. Probably not" "I saw the graphs made by the system but I have to make my own calculation anyway to be sure"	low	Conducting a series of tests and scheduling regular meetings to discuss indicators and gather feedback on the accuracy of the data. Finally no impact on budget, time or scope.

Lack of common goals in top management	no	yes	yes	risk	**Observations** At the initial stage of the project set of indicators were proposed by the team a cording to BSC methodology. The feedback coming from different managers were extremely different. **Quotes from project diary** Feedback sessions with management: "I do not need this view", "I need to see details" "I need just top view from all relevant areas" "those indicators are ok but I would add some more…"	medium	Organizing workshops with top management to establish standardized set of indicators- conducted by company director. Finally, no impact on budget, time nor scope.
Lack of clear, official definition of KPI calculation	no	yes	no	risk	**Observations** Managers and functional directors was reporting errors in reports meanwhile the differences between results presented by the BI solution and their own ones was mainly coming from different KPI definition or different billing period. **Quotes from register** "Check calculations – we received feedback about errors in calculations" "double check reporting periods- errors reported by managers" Quotes from Project plan – tasks "update reporting process with detailed KPI definition including data sources, formulas and billing period"	low	Internal reporting process improved. Official document with updated process shared with top management. Internal reporting process improved.
Lack of data standardization	no	yes	no	risk	**Observations** Data stored in different systems were not standardized- different nomenclature, format, level of aggregation what makes the joining process difficult. **Quotes from issue register** "Not possible to match data from SAP and warhouse database – different aggregartion levels" Not possible to match data from SAP and HR system-	medium	Development of comprehensive database "dictionary" that collects different terminologies and assigns new official names. Use the Alteryx application to clean and integrate data. Finally, no impact on budget, time nor scope.

					different nomenclature"		
Limited data accessibility / Internal IT policies	no	yes	yes	failure	**Observations** Limited access to system databases due to internal IT security procedures or system limitations. **Quotes from issue register** Decision sends by IT representative "it is not allowed to connect directly to SAP system by external software"	high	The SAP system has a functionality that enables automatic data extraction to Excel files, and this feature was utilized. The generated Excel files were then systematically stored on a network drive, serving as an alternative data source. Each year excel files must be archive manually. The scope was not fulfilled as the reporting flow was not fully automated.
Not experienced team	yes	yes	no	risk	The implementation team was created from internal employees with limited experience in the field. Some initial training and consultations with experts were budgeted. **Quotes from issue register** "Problems with data connection in financial report- arrange meeting with Tableau consultants" "Problems with data connection in financial report- arrange meeting with Tableau consultants"	medium	Use if external experts and consultants. Necessary services were within budget.
Lack of management involvement	no	yes	yes	risk	**Observations** The leading director were not available for longer period of time due to work travels. At this time responses and feedback from department managers. **Quotes from issue register** "Test postponed due to lack of feedback", "the correctness of the new report has not been confirmed - the manager will be available at the end of next week"	medium	In the examined case, the director was involved in the project, so in this case it did not pose a risk for the project, however, due to the observed changes in the managers' approach during the director's absence, it was decided to include this point in the identified risks

Inadequate BI tools	yes	yes	yes	risk	**Observations** Initially, it was decided to purchase only the Teableu application, hoping that its basic data integration and cleaning functions would be sufficient to create the required visualizations. However, after some time it was found that with such diverse data sources and lack of standardization, a professional tool dedicated to cleaning and organizing data is needed. **Quotes from issue register** "data joining operation not possible for investment report- different aggregation levels"	medium	It was decided to purchase the Aleteryx program. However, this did not affect the entire project because the budget included the purchase of additional software.

Source: *Own elaboration.*

Two situations categorized as "high impact" proved to be particularly problematic. The first involved restrictions on data access due to the limited functionality of the existing system and internal IT regulations. Consequently, an imperfect solution had to be adopted, necessitating manual archiving of data annually, leading to an incomplete project implementation. The second situation related to the absence of data sources for crucial strategic indicators. This oversight, not identified at the project's outset, led to unbudgeted costs for an additional data collection system, resulting in the project exceeding its budget.

5. Conclusions and Recommendations

The implementation process is intricate and time-consuming, demanding careful planning that considers potential risks. In the initial preparation stage, involving a diverse group of stakeholders to collaboratively establish goals and define needs is advisable. Management's active involvement is crucial for success, as their leadership sets an example and motivates employees during the change process.

The human factor remains pivotal throughout the entire process, necessitating a competent implementation team comprising employees familiar with the organization's processes. The selection of suitable tools for efficient data collection, cleansing, integration, analysis, and visualization is essential and depends on data quality, structurization, budget, and time constraints.

User-friendly tools that facilitate quick adaptation to new needs are preferable. In some cases, building data warehouses may not yield expected results due to high maintenance costs. In the examined case study, Alteryx and Tableau programs met

the expected requirements. Implementing BI systems offers numerous benefits and can serve as a strategic tool for organizations. The analysis of the implementation process identified risks, and based on observers' experience and document analysis, proposed actions to minimize risks in similar projects are outlined in Table 6.

Table 6. *Proposition of preventive action for identified risks*

Risk	Impact	Preventive actions proposals
Lack of necessary data sources	high	Clear definition of needs and the design of data structure should precede project initiation. Crucial KPIs, required data, and its current sources must be clearly identified. If the data source is not identified, the budget for additional systems or applications should be taken into account.
Poor quality of data	low	Due to the low impact, no significant actions are required. It is advisable to review the data required for significant Key Performance Indicators to provide initial comments and recommendations for quality improvement.
Reluctance to change	medium	Implementation of new IT systems always poses challenges for end users, as it takes time to familiarize themselves with the new tools and adjust to changes in their work routines. Therefore, change management should be applied. In this case, it is crucial to prepare people for the change, clearly explain the goals and expected benefits, involve them in the entire change process, consider their opinions, and consistently communicate the objectives. Additionally, it is essential to lead by example, especially through management authority.
Lack of trust in new technologies	low	Due to low impact, no significant actions are required before project initiation. Building trust in new technologies takes time and multiple tests to confirm correct operation. It is recommended to allocate time in the project plan for user training, comprehensive testing involving end users, and individual consultations and feedback sessions.
Lack of common goals in top management	medium	The benefits resulting from the implementation of the BI system should be experienced by the entire management. Given that BI systems deliver valuable information in the form of key indicators presented through visual interactive reports (dashboards), it is crucial to establish a common reporting strategy. It is recommended to conduct joint workshops for top management, where the vision, mission, and strategic goals of the enterprise are precisely formulated or revisited. Subsequently, key indicators are formulated to monitor the achievement of these goals. Following the balanced scorecard methodology, these indicators should be defined in four perspectives: customer, internal processes, finances, and learning and development. Only then can goals be cascaded by specifying tactical and operational indicators that influence the achievement of strategic goals.

Lack of clear, official definition of KPI calculation	low	Due to the low impact, no significant actions are required before project initialization. It is advisable to establish or update the reporting process, incorporating detailed descriptions of indicators, data sources, and calculation formulas as a mandatory element of the project product. This information should be disseminated among system users.
Lack of data standardization	medium	Data from different systems may exhibit variations in levels of aggregation, formats, or nomenclature. While basic data processing tools can address some of these issues, advanced tools may be necessary for comprehensive data compilation, calculations, and real-time visualizations. Therefore, it is recommended to define the needs and design of the data structure before project initiation. This allows for a better understanding of system elements and more accurate budgeting.
Limited data accessibility / Internal IT policies	high	Internal IT regulations and the functionalities of current systems may impose significant limitations when implementing BI solutions, particularly in international enterprises with highly regulated IT security processes. Therefore, it is recommended to thoroughly understand all regulations in this area and precisely determine the limitations arising from them before initiating the project.
Not experienced team	medium	Currently, there are numerous BI solutions available on the market, facilitating the easy and quick development of automated dashboards. These include ready-made applications, systems, implementation companies, consultants, and various instructions and training courses available on the internet. Consequently, the implementation team may not always need to be highly qualified in BI systems. If the company aims to develop such competences internally, it is possible, but it should be considered in the project plan regarding time and additional budget. The risk increases with a very inexperienced team that may struggle to estimate the required resources or complete planned tasks. In such cases, consulting the plan and approach with an external specialist is advisable.
Lack of management involvement	medium	The lack of support from an authority can lead to significant issues in the implementation process, especially if subordinates resist change. Therefore, it is crucial, before initiating the project, to ensure that the business case is well-argued, understandable to the authority, and that they commit to providing full support by setting an example and leading the change.
Inadequate BI tools	medium	Choosing the wrong software can have a significant impact on the project. The selected solution might prove too complex and not aligned with the competencies of users or the implementation team. It could also lack the necessary functionalities for the intended solutions. Hence, it is

		advisable to clearly define the needs and functionality scope before making a selection and thoroughly research the market for available solutions. In cases of uncertainty, consulting the choice with an expert or the software provider is recommended.

Source: *Own elaboration.*

While the case study presented in this article offers valuable insights into the implementation of a business intelligence system in an manufacturing company, it is important to acknowledge certain limitations that may have impacted the findings and generalizability of the study. Firstly, the case study focused on a single manufacturing company, which limits the ability to generalize the results to other industries or contexts.

Future research could include a broader range entity across different sectors to enhance the external validity of the findings. Furthermore, the case study primarily focused on the implementation process itself, and identification of risks. Future work could assess the effectiveness of the implemented BI system by measuring its impact on decision-making processes, operational efficiency, and overall performance.

Additionally, the findings from this article's case study can serve as a foundation for proposing an implementation model for business intelligence systems. By analyzing the challenges, key phases, and risks identified in the case study, future research can develop a structured framework or model that outlines the necessary steps, considerations, and best practices for implementing BI systems specifically tailored to manufacturing industries.

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