Czech University of Life Sciences Prague

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Diploma Thesis

Business Intelligence

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DIPLOMA THESIS ASSIGNMENT

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Systems Engineering and Informatics
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Thesis title

Business Intelligence

Objectives of thesis

The main objective of this thesis is to define the best way to use a Business Intelligence tool to improve the performance of a sales department that works with a traditional sales funnel or sales pipeline, through the understanding of which tool and metrics are seen as the most valuable according to the stakeholders in the sales process and in Supply chain management (SCM).
- to identify set of Key Performance Indicators (KPI's)
- to design analytical dashboard.

Methodology

As for methodology, there will be used quantitative research data methods. Both primary and secondary will be used to produce numerical data. Theory building takes place concurrently with problem solving. In the first phase of the action research cycle, the researcher gathers and analyzes existing theory as foundations upon which to build the theoretical framework that guides the action planning and action taking. Additionally, model building will be included to clarify the objectives. there is the need to review literature for similar efforts to define a theoretical framework in which theory of sales management, performance management and monitoring, and business intelligence can be intertwined, to list all relevant KPI's. The next step is the formal identification of the stakeholders in the process and perform interviews with this stakeholder to quantify impact of the identified KPI's. Thus, we can identify dimensions relevant to the KPI's, on which we can then design and prepare dashboards that include the most important (highly scored) KPI's. The empirical research for this thesis will be done with the GoodData platform as a BI Tool.

The proposed extent of the thesis

60 – 80 pages

Keywords

Sales funnel, business intelligence, organizations, stakeholders, model

Recommended information sources

Ali, M. and Khan, S., 2019. Organizational Capability Readiness Towards Business Intelligence
Implementation. International Journal of Business Intelligence Research, 10(1), pp.42-58.

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TYRYCHTR, J. – VASILENKO, A. Business Intelligence in Agribusiness – Fundamental Concepts and
Research. Brno: KONVOJ, spol. s r. o. , 2015, 100s. ISBN 978-80-7302-170-2.

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Declaration

I declare that I have worked on my diploma thesis titled "Business Intelligence" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the diploma thesis, I declare that the thesis does not break any copyrights.

In Prague on the date of submission 30.11.2022 _____

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I would like to thank **doc. Ing. Jan Tyrychtr, Ph.D.** for his support and guidance while working on this thesis. Additionally, I would like to thank my friends and family for their encouragement, support, and belief in me.

Business Intelligence

ABSTRACT

Real-time data analytics are improved by business intelligence (BI). Self-service BI goes one step further by enabling users to run their own queries and produce their own reports—even if they have no prior experience with statistical data analysis. This thesis describes several underlying presumptions, restrictions, and boundaries. Additionally, the thesis examines some potential effects that the findings might have on the sales sector. By supplying data in easily understandable and assimilable formats and showing it in a more visually appealing way, the business intelligence solutions currently accessible do away with the need for this extra labor. To forecast improvement based on their use, it is crucial to assess how supply chain departments are now operating without BI tools. Modern supply chain management (SCM) processes include BI tools, yet businesses still interact with their suppliers and consumers using conventional sales channels. Particularly the entry-level employees are unaware of the analytical dashboards, which prevents them from employing BI approaches to enhance the initial operations.

Keywords: Business Intelligence, suppliers, consumers, operations, conventional sales

Business Intelligence

ABSTRACT

Business Intelligence (BI) zlepšuje analýzu dat v reálném čase. Samoobslužné BI jde ještě o krok dále tím, že umožňuje uživatelům spouštět vlastní dotazy a vytvářet vlastní sestavy – i když nemají žádné předchozí zkušenosti se statistickou analýzou dat. Tato práce popisuje několik základních předpokladů, omezení a hranic. Kromě toho práce zkoumá některé potenciální dopady, které by zjištění mohla mít na prodejní odvětví. Řešení Business intelligence, která jsou v současné době k dispozici, odstraňují potřebu práce navíc v souvislosti s poskytováním dat ve snadno srozumitelných a přizpůsobitelných formátech a jejich zobrazením vizuálně přitažlivějším způsobem. Aby bylo možné předvídat zlepšení na základě jejich použití, je zásadní posoudit, jak nyní oddělení dodavatelského řetězce fungují bez nástrojů BI. Moderní procesy řízení dodavatelského řetězce (SCM) zahrnují nástroje BI, přesto podniky stále komunikují se svými dodavateli a spotřebiteli pomocí konvenčních prodejních kanálů. Zejména zaměstnanci na základní úrovni neznají analytické dashboardy, což jim brání používat BI ke zlepšení počátečních operací.

Klíčová slova: Business Intelligence, dodavatelé, spotřebitelé, operace, konvenční prodej

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CHAPTER ONE: INTRODUCTION

This chapter will present the research topic, the goal, and the extent of the study that will be conducted for the thesis. It also describes a number of underlying presumptions, restrictions, and boundaries. Additionally, this chapter examines some potential effects that the findings might have on the sector. Finally, some key definitions and concepts have been discussed at the end of this chapter.

1.1 BACKGROUND

Business Intelligence aims to make effective business decisions by using appropriate analytical tools, software applications, technology and data collection, storage, analysis, and access methods them[1]. At the same time, such BI-systems are the main tool not only for large corporations but also for any other business. Additionally, they are essential to the company's strategic planning process [2]. Note that today the leading independent information and analytical agencies engaged in studying the software market, including the type of Business Intelligence are[3]:

- International Data Corporation (IDC);
- Gartner Group;
- Forrester Research Incorporation.
  Business intelligence (BI) refers to computer techniques and technologies used by organizations to transform transactional business data into a readable form appropriate for business analysis and to enable bulk processing of that data. [4], [5]

1.1.1 Supply Chain Management

Supply chain management is the term used to describe how the transportation of goods and services is managed, abbreviated SCM [2]. If a corporation manufactures a product by using parts, components, and materials that were obtained from different suppliers, and then sells those goods to different clients, then that company is said to have a supply chain [6]There are certain supply networks that are straightforward, while others are more involved. The size of the company, as well as the complexity of the produced goods and the quantity of those goods, will all have an effect on how challenging the supply chain is [7], [8]. The management of the movement of

commodities is what's referred to as supply chaisn management (SCM). The industrial engineering, systems engineering, operations management, logistics, and procurement disciplines are all heavily included into the SCM methodology, which seeks to take an integrated approach. Another significant influence is in the field of information technology.[9].

1.1.2 Business Intelligence Applications

From tactical to strategic business solutions, BI enables them all. Product or price positioning is one example of a key operational decision. Priorities, goals, and directions are all included in strategic business decisions in the broadest sense[10]. When internal and external data are merged, it is possible to create highly structured data-analytics that are not possible from using only one of these sources to understand the business[11]. Business intelligence is a word that was first used in 1989 by Howard Dresner, later a Gartner analyst, to describe "concepts and methodologies for improving business decision making utilizing business data-driven systems[12]." The estimated value of the global market for business intelligence services in 2012 was $13.1 billion. Experts estimate that by 2021, this sum will have increased to $ 24.05 billion [13], which represents the applications or advantages. 1.1.
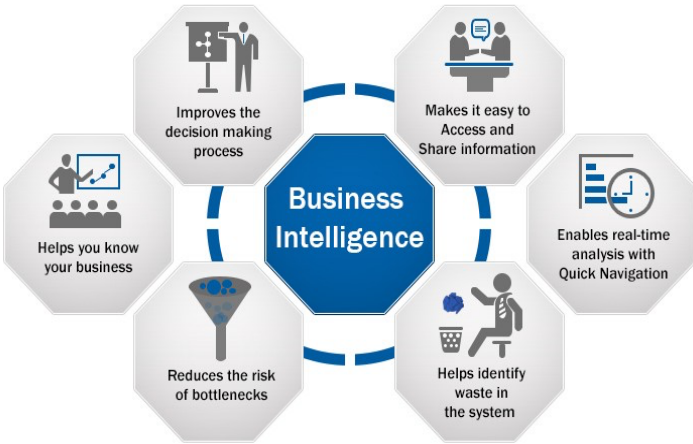
Figure 1.1: Business Intelligence Applications (Chou, 2020)

Three crucial elements were emphasized by Ralph Kimball as necessary for a successful BI project [14], [15]

- level of funding and management support;

- the degree to which the project is in demand for a specific business;
- the volume and quality of available business data.

1.1.3 Company Background

The company chosen for the current analysis is mall.cz. Mall.cz is the operator of an internet commerce platform intended to trade things that are required daily (Crunchbase Company, 2022). The company is based in Prague, Czechia (Crunchbase Company, 2022). It can almost exclusively attribute all its eCommerce net revenue to the Czech Republic (Crunchbase Company, 2022).

Figure 1.2: Mall.cz warehouse in Prague, Czech Republic (Crunchbase Company, 2022)

The company has items that fall under a variety of categories, including "Furniture & Appliances," "Electronics & Media," and "Toys, Hobbies & DIY," amongst others. The year 2000 marked the beginning of operation for the internet shop [16]. The subsidiary that we have been concentrating on has somewhere between 250 and 300 workers, whereas the company has over 4000 people working for it.

Beginning in early November 2021, news broke that the Polish e-commerce company Allegro had agreed to buy the Czech online retailer Mall Group and the logistics firm WE | DO [16]. This transaction includes the Mall Group and We|Do's assets. They can be found in Poland, the Czech Republic, Hungary, Croatia, Slovakia, and Slovenia, among other countries. [16].

1.2 PROBLEM STATEMENT

As was discussed above, the majority of businesses handle their supply chain tasks via a conventional sales pipeline or funnel. The core of business intelligence is the ability to turn data into information, and it is this ability that distinguishes BI from traditional reporting. By supplying data in easily understandable and assimilable formats and showing it in a more visually appealing way, the business intelligence solutions currently accessible do away with the need for this extra labor. Therefore, it is crucial to assess how supply chain departments are operating without BI tools and forecast improvements based on how they are using them.

1.3 RESEARCH QUESTION

How does the use of analytical decision-making tools, such as BI tools, throughout the operations of the distribution network affect the supply chain's capabilities? How can one use these strategies to improve the performance of supply chains at global enterprises to cut costs and increase profitability in today's fast-paced markets?

1.4 RATIONALE

There is a need for proper decision-making to optimize supply chain operations such as predicting; designing; buying; making; manufacturing; and advertising. Many critical success factors may be used to assess the efficiency of a supply chain, including daily sales volume, warehouse size, and inventory levels. It is essential to identify which indications will be useful for decision makers who want to carry out supply chain activities efficiently and effectively. Analyzing and highlighting the relevance of the usage of these specialized analytical implementations is shown by comparing chosen performance metrics for the entire decision-making process, with and without the use of analytic tools. Analytical tool usage was compared to no analytical tool use in the comparison.

1.5 SCOPE OF THE RESEARCH

Supply chain management BI approaches were not restricted but concentrated on specific BI tools in this study.

1.6 SIGNIFICANCE OF THE RESEARCH

There are many different ERP, BI, and SCM software products available, but each one has its own unique features and standards for customers. By contrasting how SAP and Oracle apply the SCOR model as a best-practice model, which fills a research need regarding the supply-chain analytics performance of BI products in the market, an evaluation of these current business intelligence tools has been done. By using theoretical ways to implement real operations in industry, the outcomes of this study might assist these software businesses produce more successful and beneficial BI approaches in future as well as improve real time supply chain procedures.

1.7 ASSUMPTIONS

The following are some of the presumptions that were made while planning this research project:

1. Participants were prepared to do their very best when responding to the questionnaire items or sharing their expertise and experience on the research issue.
2. When responding to the survey about the estimation of performance assessment, Participants avoided potential conflicts of interest and provided honest answers.
3. The responses of one person did not affect those of the other participants.
4. Respondents have a strong command of the English language, as shown by their ability to read, compose, and comprehend the questionnaire.
5. Every single participant was employed by the firm on a full-time basis.

1.8 LIMITATIONS

The following problems hampered the overall effectiveness of this study:

1. The replies of the survey participants and the authorization of the firms were the only factors that determined the outcomes of this research.
2. The research was restricted by the fact that the participants and their supervisors were required to always cooperate and be available.

3. The findings of this research were restricted due to the settings under which the business intelligence approaches were used.

1.9 DELIMITATIONS

The following were the study's delimitations:

1. The study only focused on employees of a Czech company with international supply chain operations systems.

2. The study measured the impact of business intelligence tools on SCM and distribution networks using both qualitative and quantitative data.

3. Study participants without prior BI experience, recent graduates, and new workers were excluded.

1.10   IMPORTANT DEFINITIONS

Business Intelligence – The phrase "business intelligence" or "BI" refers to a broad range of analytical tools and solutions for gathering, aggregating, evaluating, and providing access to information in a way that is anticipated to enable an enterprise's users to make better business decisions.[17].

Data mining (DM) – The process of extracting the implicit, previously hidden, and helpful knowledge and principles for decision-making from a sizable amount of incomplete, confusing, and random practical application data stored in the data warehouse. It is the process of using acronyms to extract crucial information and guidelines for decision-making that was previously unknown. [9].

Enterprise Resource Planning – For the most part, ERP systems are focused on transaction processing and have very limited analytic capabilities [18].

Online Analytical Processing (OLAP) – This system provides multidimensional, summarized views of business data and is used for modeling, planning, reporting, and analysis to improve the organization. [17].

Key Performance Indicators (KPIs) – A quantitative evaluation of performance in relation to the passage of time for the fulfillment of a certain objective [19].

CHAPTER TWO: OBJECTIVES AND METHODOLOGY

This study looked at the supply network users who are comfortable with using business intelligence approaches to assist them to make decisions about their supply chain functional operations in various firms.

2.1 OBJECTIVES

As the title suggests, the focus of this thesis is on determining which Business Intelligence software and indicators are most beneficial to the many actors in the marketing funnel to enhance the performance of a marketing department using a standard sales funnel or sales pipeline. This thesis aims:

1. to develop a set of key performance indicators for an efficient supply chains department
2. to create an analytical dashboard and measure the KPIs defined

2.2 THEORETICAL/CONCEPTUAL FRAMEWORK

Using business intelligence and operational assessment tools, this research examined the connections between supply chain business insights and the efficiency of supply chain operations. A previously validated survey was used as a model for creating a new survey that addressed the study questions on the sophistication of the respondents' supply chains. Literature reviews. talks with council members and interviews with business professionals and experts all helped to verify the results of the initial survey. This thesis investigated the following topics. These concerns were investigated primarily via two types of research: a survey and a review of relevant literature.

- The respondents used business intelligence to make choices about supply chain procedures. What was their experience?

- For benchmarking purposes, were these business analytic tools designed in accordance with the recognized reference models?
- Business intelligence solutions should display what kinds of KPIs they want to assist supply chains to operate better.

To develop a framework for supply chain benchmarking at various levels and to conduct a critical analysis of the use of business information tools, it was essential to combine the resources and data obtained. The conceptual framework is provided in figure 3.1. The following were the two main types of research questions:

- The supply chain performance effect of business analytics
- Pre- and post-database architecture model assessment of supply chain activities
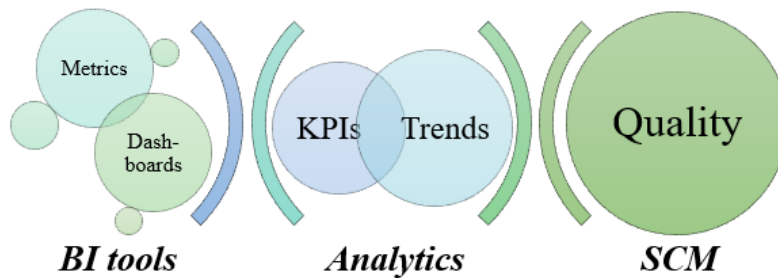
Figure 2.1: Theoretical Framework of the study

2.3 STUDY DESIGN

This study makes use of both the primary and secondary research sources with the aim of combining their merits and providing a strong analysis. The gaps of primary sources will be covered with information gathered from the secondary sources and vice versa.

2.3.1 Primary Research

For primary research, the researcher must be involved in the data collection process. Instead of using data that has previously been collected, researchers in primary research gather their own information to use as the basis for a more thorough inquiry. Businesses and organizations

in fast-paced industries can greatly benefit from this type of research because it gives the researcher total control over the data, which is important.

2.3.2 Secondary Research
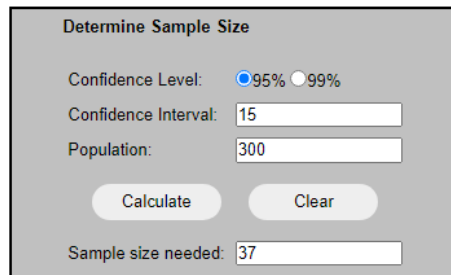
In secondary research, the researcher doesn't gather data for their own research projects; instead, they exclusively rely on previously published study materials. This approach is more time and money efficient than primary research. Archives, libraries, and academic organizations all have access to data that can be utilized for secondary research on the internet. Although accurate data may positively impact study results, researchers must take extra measures to ensure their data is reliable.

2.4 DATA COLLECTION

The methods used to acquire the data used to answer the research question are detailed in this section. In this study, both quantitative and qualitative data were used.

2.4.1 Sample Size Calculation

The survey system, available at https://www.surveysystem.com/sscalc.htm, was used to calculate the sample size (figure 3.2). As we know, the company employs 250-300 people, according to a confidence of 95% and interval of 10, the sample size calculated was 37.

Determine Sample Size

Confidence Level:	●95% ○99%
Confidence Interval:	15
Population:	300
Calculate	Clear
Sample size needed:	37

Figure 2.2: Sample size

2.4.2 Academic Sources

A broad variety of study methodologies and views may be found in published papers, conference proceedings publications, and other sources that were used in this qualitative research. Professionals and researchers that were familiar with the subject matter helped establish the best research approaches for the project. A breakdown of finding relevant literature is provided in figure 3.3.

2.4.3 Survey/Questionnaire

Google Forms was used to conduct the survey, attached in the appendix. Respondents were asked to rate their own performance in areas such as sales and advertising, sourcing, and buying, manufacturing, transportation and production, technology, and quality control as well as the logistical and supply chain aspects. Each participant's task and BI user experience were unique in this research. For the last seven survey items, The frequency of practices was gauged using a seven-point scale (1 - never; 7 - always). On a scale of 1 to 7, participants were asked to rate their own level of self-awareness, whether they agreed or disagreed with a statement made in the survey about applying BI approaches to make decisions relating to supply chain management and operations. The study was conducted between July 01 and July 30, 2022.
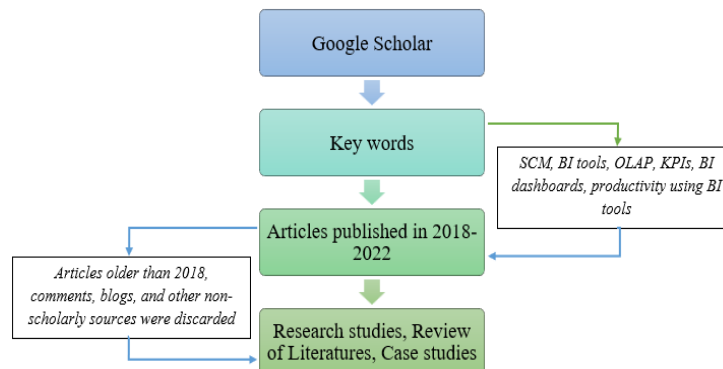
Figure 2.3: Method to retrieve scholarly articles for secondary research

2.5 DATA ANALYSIS

This section of the chapter deals with an introduction to the analytics of the collected data through the GoodData Platform. Preliminarily, MS excel was used for descriptive analysis and KPI identification, which was then followed by dashboard creation and analytics using the GoodData platform.

2.5.1 GoodData Platform

For enterprises and consumers alike, GoodData's predictive analytics platform, available at https://www.gooddata.com/ [20] delivers a single authoritative source. From self-service and interactive analytics to learning algorithms and IoT, they have associated about 140,000 of the most profitable companies achieve their data analytics objectives. It is on a mission to provide every user, regardless of technical competence, the ability to make informed choices.

CHAPTER THREE: LITERATURE REVIEW

This study's chapter provides an overview of supply chain performance and assessment, business intelligence, and its applications in various industries and businesses.

3.1 DEFINITION OF BUSINESS INTELLIGENCE

Gartner initially coined the phrase "Business Intelligence" in the 1980s. Software that functions inside an organization and offers access to and analysis of data kept within a data warehouse, as well as ensuring right and sound management choices was defined by Gartner in 1996, as follows: [1]. Business Intelligence systems (BI systems) are often called Decision Support Systems (DSS) [21].

While BI works with data that has already been cleaned and prepared for analysis, business analytics (in the limited sense) makes use of a variety of statistical and quantitative techniques to analyze the present situation and make projections[14]. An enterprise's BI system is most successful when it incorporates both external and internal data, such as financial and production information (internal data). External and internal data may offer a fuller view of the firm, which cannot be achieved by examining data from just one source [22].

3.1.1 Structure

The BI system does not need the user to have advanced IT skills to utilize it. One may request a summary and have access to analytics with a simple user interface [5]. To make the system easier to use, the data will be organized into meaningful categories and shown on a dashboard. Reports, tables, graphs, and diagrams may all be shown in a variety of ways as shown in figure 2.1.

Figure 3.1: Data representation in a variety of ways [23]

There are three primary areas in which BI systems are growing[22]:

1. *Data archiving*.
2. *Integration of data*.
3. *Data presentation.*

To gather and process a company's data manually is unfeasible. There is still a lot of data that hasn't been analyzed. Inadvertently overlooking consumer demands, failing to learn about production issues in a timely way, and disregarding concerns may all result in a firm losing money. Collecting data from many sources, organizing, and storing it in a single system are the primary functions of BI systems [24].

3.1.2 Scope

Business Intelligence helps companies make data-driven choices. BI-implemented companies have comprehensive, accurate, structured data. Business Intelligence may be used in any sector[22]. BI systems should be implemented if [7].

- One needs to incorporate information from multiple sources
- One must offer quick access to company-wide data
- The number of people who need relevant data or predictive analysis has increased
- Innovations are being introduced
- IT landscape updates are taking place
- It is difficult to track company activities in certain areas
- The organization is growing rapidly

BI systems may help with decision-making and strategy. Advertising, sales, suppliers, and finance may utilize the data. According to [5], a company can

- monitor marketing campaign success
- evaluate cash flow, operational expenditures, and gross profit
- predict income and operations
- obtain information about personnel procedures
- visualize website visits in dynamic
- follow leads via sales channels

BI elevates the company's efforts. Continuous data monitoring enables wiser, faster choices. Historical and present data assist construct company projections. Access to analytics and operational data enhances job quality and decreases labor and time expenditures [11].

Figure 3.2: Modern analytics workflow using BI technology (Tableau, 2022)

BI is a technique used by businesses to govern large amounts of data and make better business choices (Figure 2.2). BI technology shows a company's past and future activities. BI aids firms in decision-making[25]. Decision Support System is another name for BI (DSS). Data Warehouse and Data Mining are crucial components of the BI system, depicted in figure 2.3 since the data utilized in BI are universal (many sources, formats, cauterization, and historical).
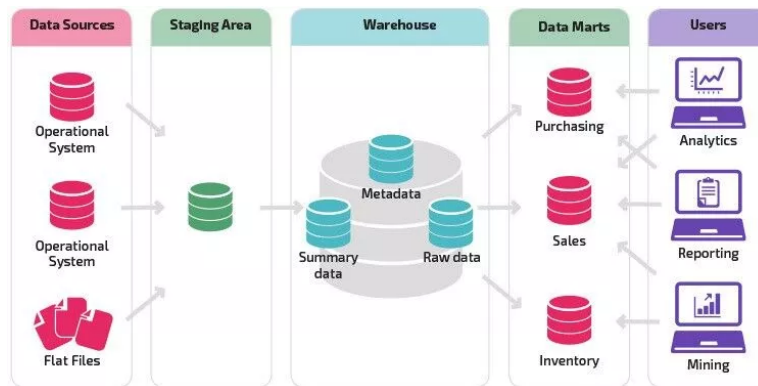
No table of figures entries found.Figure 3.3: Data warehouse and mining as crucial components of the BI systems (Fatima, 2019)

BI data analysis is not a basic analysis (Query, Filtering), but a data mining approach used for classification, clustering, or forecasting (Prediction). BI is linked to Data warehouses and Data mining [26]. Researchers have created business intelligence system implementation phases to ease the process and familiarize the organization with it. This includes optimizing company operations,

introducing new KPIs, extensive data processing, establishing analytical models, and visualizing indications [27].

3.2 BI TECHNOLOGY & APPLICATION TRENDS

The changes taking place now in the field of information technology have also affected BI. The source of influence is the "Internet triumph throughout the organization," innovation in BI itself, and the emerging demand for more than just OLAP query and reporting tools. For a detailed consideration of these trends, not a single article would be required, therefore, within the framework of this work, we will restrict ourselves to only general comments[28]–[30].

- **The Internet**. The fact that the Internet is changing business models is already a common truth. In terms of BI technology, the capabilities of the Internet are presented here in the form of Web browsers used to provide access to the resulting BI data and initiate ad hoc requests.
- **Browser access** has created competition between technologies: BI vendors are adding portal functionality to their products, and portal technology companies are trying to expand their offerings with BI.
- **BI innovation**. The Internet has opened a new source of BI - competitive intelligence. To find the links you are looking for, this technology relies on a search engine known as a crawler.
- **Pattern analysis** is another BI innovation that has been successfully applied in several areas. For example, credit card transactions, phone call processing, and financial trading are areas of e-business where the use of pattern analysis can help detect fraud.

Companies are realizing not only the need to integrate Web data with business data but also that no single BI technology can provide all the tools required to succeed. Thus, another principle is that strategic BI should rely on several different BI technologies that work well together (see Figure 2.4). The only way to achieve this goal is by using an integrated platform that will provide a single source of metadata needed to manage compatible and appropriate applications composed of various BI tools [31].
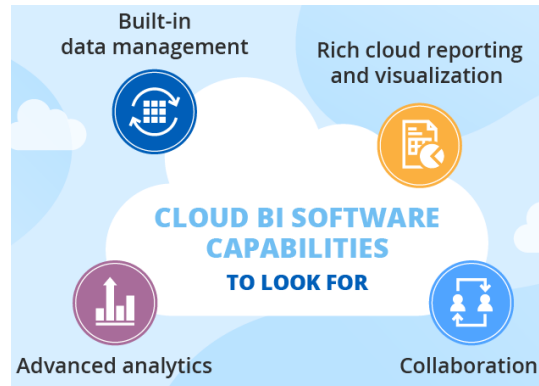
Figure 3.4: Several different BI technologies that work well together [32]

3.3 BUSINESS INTELLIGENCE TOOLS

Large volumes of past, present, and future data are collected, processed, analyzed, and visualized using business intelligence (BI) technologies, which also enable the creation of interactive reports and the streamlining of decision-making processes. [33]. There are many Business Intelligence solutions on the market, which, as a rule, solve one problem - to build corporate reporting, or, in other words, reporting (figure 2.5). By the way, Excel can also be attributed to BI tools, so those who worked with data in Excel, built graphs, etc., are partly BI developers[34]. And if you still need to collect the requirements for building a report, connect to databases and use Pivot in Excel, then you can definitely consider yourself a BI developer. Data analysis can be divided into several types[31], [35], [36]:

1. **Operational analytical data processing** (OLAP)

2. **Advanced visualization**

3. **Modeling, forecasting, and research of data**

4. **Indicator maps**
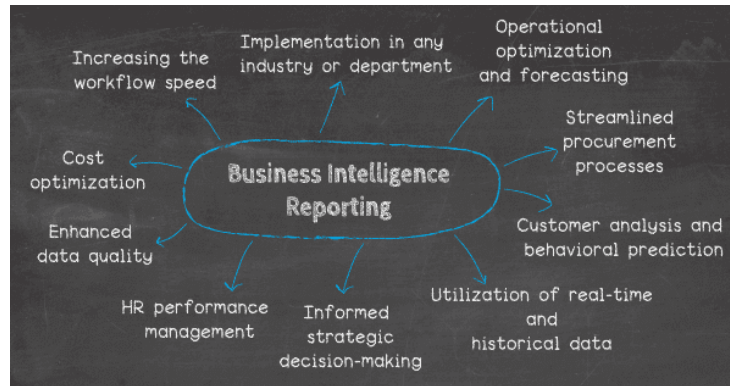
Figure 3.5: Business Intelligence Reporting (Calzon, 2020)

Due to the huge number of units, often the full calculation is only for some measurements, for others, it is performed "on demand". Along with the basic concept, MOLAP is best suited for small data sets, it quickly calculates aggregates and returns answers, but it generates huge amounts of data. ROLAP is valued as a more scalable solution that also uses the smallest possible space. The processing speed is significantly reduced. HOLAP is in the middle of these two approaches, it is quite scalable and fast to process [35], [36].

3.4 ADVANTAGES AND DISADVANTAGES OF BI SYSTEMS

Today, business intelligence (BI) is crucial to the survival of practically every company. BI solutions organize large amounts of data and help companies stay competitive. Dashboards make a major contribution to this process by visualizing complex information and making it understandable. By combining indicators from many sources into one clear letter, they calculate the level of productivity of the entire company[37]. Visualization can also help control inventory in small, medium, and large enterprises. Advantages of using BI systems [37]–[39] are illustrated in figure 2.7.

Figure 3.6: Advantages of BI tools (Kalluri, 2020)

3.4.1 Availability of Information

Mobile platforms have already adopted modern business intelligence. Want BI in the cloud? No question. So you can always get the necessary information regardless of the time of day or location. [40]

3.4.2 Practical Application of Data

Previously, business analytics was to compile a bunch of reports and spreadsheets. It took days, nights, and tons of caffeine to get results. Thanks to huge technological leaps, modern BI programs are more interactive and efficient than ever [16].

3.4.3 Realtime Data Array Management

Sometimes you have to make a decision in minutes, but in seconds. This means that the most "fresh" information should be at hand. BI-systems can process data and output the result in real time. Now it has become much easier to improve strategy and tactics [9].

3.4.4 Choice & Easy Scalability

The BI systems market boasts several good players. Variability will allow you to "adjust" the program to the required scale and objectives [17].

Figure 3.7: Example of data visualization using BI platforms [23]

3.4.5 Tracking of KPIs

With the aid of business intelligence, you can monitor important performance indicators more effectively (KPIs). If the indicator drops below the necessary level, the system can issue a warning. As a result, businesses maintain a pulse on the market, ensuring the effectiveness of work in the SMB sector.

3.4.6 Visualization of Data

Modern analytical data programs can instantly interpret big data in clear grap. Availability of comparison and comparison of numbers in massive spreadsheets - "normal" graphical reports and a clear understanding of the overall map [18].

3.4.7 The Growing Community of Business Analysts

The number of forums to which business analysts respond is constantly growing. System vendors and integrators help in the choice of programs and build analytical scripts. Applications are constantly updated, adding new templates or ready-made settings to simplify work. Without help in work or work with a number of "innovative" systems that will not remain. If there is an analyst in the staff, he will be grateful for a tool that will speed up his work in the case[17].

3.4.8 Modification

You can customize information dashboards depending on the user and expectations. They can be adapted for managers of any department to display the most relevant information. This allows everyone to see enough details to do their job effectively and achieve their goals[41]. There are many such solutions that can be configured. Strategic, analytical, operational, tactical dashboards - everyone has a specific purpose. You can also choose the environment where they will be created, i.e., in the cloud or local software.

3.4.9 Cost and Time Efficiency

Earlier it was necessary to enter several systems to collect the necessary indicators and to make a worthy report. But by the time it is ready, the report often becomes irrelevant. Worse, the company loses money without having time to adequately respond to changing conditions [42]. Now, thanks to BI dashboards, organizations can adapt to market fluctuations, and sometimes even predict them. However, even with full transparency, the cost of software itself companies may face data management costs.

3.4.10 Diverse Conclusions

The analytics provided by BI applications are just analytics and do not say what to do with this data. Although, in fact, this is not a disadvantage of the system itself. However, the implementation needs to understand that different people will examine the same data and come to two different conclusions and applications. So, there is no escape from meetings. Or introduce a dictatorship ([41]

3.4.11 Data Privacy & Protection

BI is a program. Like any other system, it must be secure. Developers, for their part, provide the maximum possible protection. However, if the system is connected to the Internet, then the proactive data protection is an issue that clearly requires consideration. Plus, no one has canceled the human factor yet. Business analysts can insist on having employees use their own devices to obtain this data. Data that might be gathered in accordance with such regulations might be regarded as confidential [9].

3.4.12 Broad Horizons of Business Applications

Standards for working with data around the world are being set right now. For example, the General Data Protection Regulation (GDPR). Legal and regulatory sanctions are constantly changing, and technologies are being adjusted to them. And vice versa. A vicious circle, and you need to have time to follow the news [6]. Most businesses today have access to business intelligence, but not all sectors are prepared to offer the data needed for it to be effective. Some of them are just beginning to understand what exactly BI can offer them. There are many options for business intelligence systems. Some of them can cover a specific segment of work [38], [43]. To get the most out of your information, you may need to invest in an entire software suite to provide the most efficient BI solution.

3.5 DATA SOURCES

Organizing your data might seem like a tricky business. However, the experience of mergers and regional reorganizations shows that too often, when creating data marts, the organizational structure of the company is used as a principle for organizing data. This approach may meet current operational challenges, but it negates the ease with which you can develop an enterprise BI tool - the fact is that the same data is dispersed across multiple data marts [38].

The implementation of this approach is obvious: design a single mart or data warehouse that contains all the required corporate and local (by department, region, etc.) data items. This method not only allows you to take advantage of the data mart for local purposes, but also supports data analysis at the enterprise level[44]. While the organizational structure of companies will inevitably change, tracking these changes will be simplified and the number of data marts will remain the same. Typically, such modifications to the corporate structure involve adding values (or their refinement) to data or measured facts located in the Data Warehouse [9].

3.5.1 External

Enterprises can utilize business intelligence to assist a variety of business choices, from tactical to strategic. Product positioning and price are examples of important operational decisions. At the most general level, strategic business decisions comprise priorities, goals, and directions. [43]. In all situations, BI is most effective when it integrates data from the firm's internal sources,

such as financial and operational data, with data from the market in which the organization works (internal data). In reality, combining external and internal data can provide "intelligence" that can't be found in any one dataset[45]. It can give a complete picture. Business intelligence technologies help firms, among other things, understand developing markets, evaluate the demand for and acceptability of goods and services for various market segments, and evaluate the results of marketing initiatives. Market data, such as that from clients and rivals, is external. It includes information like statistics from polls, questionnaires, studies, and consumer reviews. External information aids in your understanding of the customer base and the competitive landscape[46].

You can think of external data in two different ways. According to database theory, this means that it is any data that is saved or stored outside of a certain database. Scientists also claim that external sources are centralized data warehouses or distributed databases[47]. Although most scientists do recognize that external data is data that crosses organizational boundaries ([48], [49]; [50]; [51]; [52]. Companies can have two paths. The first is where external organization systems allow you to collect and manage information related to external entities. For example, it can be customers, suppliers or competitors. The second - IT solutions have the ability to integrate information from the outside facial, as well as internal systems [53].
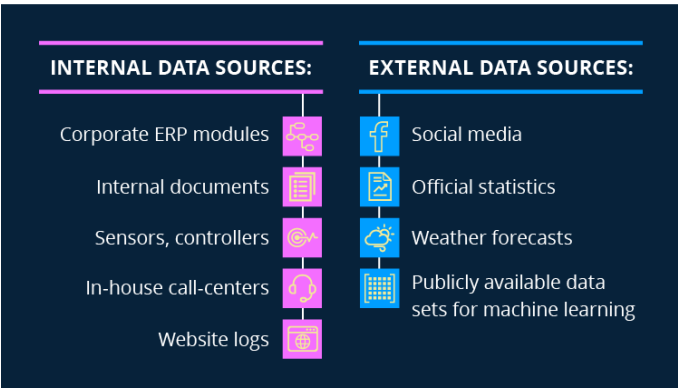
Figure 3.8: Types of internal and external data sources [54], [55]

External data is a necessity for the normal functioning of the business. It is very important for companies to include the environment in their model. Business owners can see how the world functions through external data and make decisions in line with that understanding. among the outside information is customer feedback. This is the strongest form. The company can determine if it is getting the product right and how it can be improved [55]. Company reviews should never

be missed, regardless of the industry. Utilizing external data also relieves the company of the burden of obtaining the pertinent data independently. Today there are many different databases with a lot of different information. The company can also create its own external databases. But if you don't have a data analysis company, it is a time-consuming and challenging process that is just not worth your time. [38].

With the public's assistance, external databases are also continuously expanding and can be a very dependable source of data. Despite the fact that sometimes it can be challenging to discover pertinent data. The evaluation of any data set's reliability can take a lot of time. And the process is not inexpensive. For quality data, appropriate company data must be allocated. The business must also keep an eye out for inaccurate data. Governments in every nation will make an effort to play up their accomplishments or downplay their flaws. It is essential to comprehend what data is and where it comes from.[56]; [45].

3.5.2 Internal

Information on operations, maintenance, people, and finances is referred to as internal data because it originates from within the company. Business analysts, according to research, value internally generated data more highly. [10] Because 65% of respondents believe that internal data is more significant than data gathered from outside the firm. You may manage and improve your operations using internal data. In this sense, internal data refers to information that an organization already possesses, controls, and owns, such as specifics from its own computer systems and cloud settings. [46].

Although internal data has numerous benefits, it also has many drawbacks. If the business is only now beginning to expand, it's possible that you have a small number of departments and relatively little data. Results from data analysis from a tiny data set will be erroneous, particularly for long-term initiatives. Additionally, internal data could be wrong. In other words, the data are utilized to refer to data about false information[57]. The analysis's findings won't be reliable if you use such data. Another factor for the lack of complete information is internal data. There are occasions when using data from sources outside of your business is all that is necessary to avoid having decision-making gaps.[58]. Additionally, it might be expensive for a corporation to analyze a lot of data. Analyzing fresh client data can occasionally cost more than it is worth. You must pay

to manage, organize, and utilize the data. Consider if you even need to collect big volumes of data before you start. For developing firms, having too much data is a serious issue. [45].

Companies can search for data extraction opportunities in a number of internal locations. [59]; [57], [60]; [57]:

1. **Transaction data and POS information**. One of the biggest internal data sources for the company is housed in its financial and transactional systems. This information can relate to past and present purchases you have made for the company. You can also mention details regarding their clients' trading patterns. The business can learn crucial information from this data, including how to cut costs and save money as well as critical models about consumer behavior and preferences.

2. **Archives.** Companies should not use only the latest information as inside. Historical data can also be very revealing, so Additionally, Kapow Software advises viewing the organization's archived records and data streams.

3. **Other business programs.** One of the most dependable internal sources of big data for a firm is CRM. Therefore, it is impossible to extract any internal programs. Project management, marketing, productivity, corporate resource management, human resources, cost management, and automation programs are just a few other platforms that are quite helpful (mostly used by employees). It is in the company's best interests to extract these sources and let the nature of their big data project dictate which sources to use.

3.6 SUPPLY CHAIN MANAGEMENT

Businesses encounter several issues owing to increasing rivalry between enterprises and supply chains. Supply chain performance must be improved to gain market share and competitive advantages. Today, supply chain performance is a company-wide issue. Suppliers, manufacturers, and distributors may all have key issues that influence supply chain effectiveness [61]. [62] and [55] wrote in according to their research, supply chain management entails coordinated decisions and activities to achieve customer expectations by integrating end-to-end operations at the lowest possible cost. Coordination and IT are needed to monitor and optimize supply chain performance.

Identifying measure criteria and objectives, planning, setting communication mechanisms, reporting, and feedback are incorporated in SAP and Oracle [43].

By focusing on various assessment criteria, performance measurement methodologies can help executives and decision-makers increase the efficacy and efficiency of the supply chain. Performance must be measured in supply chains. Understanding supply chain processes, identifying bottlenecks and opportunities for improvement, and making data-based decisions can all be aided by performance assessment. It can also help uncover consumer wants and improve product or service fulfillment. Supply chain management efficacy is impacted by quality assurance, although both performance assessment and quality assurance are challenging. Supply chain networks have become increasingly complex and dynamic as a result of globalization. [18] illustrated how, despite IT advances, wholesale inventory forecasting is still inaccurate.

In some circumstances, cutting-edge identifying technology like RFID may help forecast inventory and avoid bullwhip effects. For ensuring the quality of the supply chain, researchers looked at operational methods, tactical employment, and strategic planning.

Collaboration, technology, risk management, and dependability assurance are required for continuous supply chain quality management. [36]. To uncover solutions to improve supply chain performance management, [63] evaluated the literature on supply chain performance measurement.

They recommended businesses to concentrate on agile and adaptive performance assessment methodologies due to internal and external connectivity, particularly via the integration of supply chain management and the Internet. Internet-based intelligent systems encourage information interchange and supply chain optimization with autonomy, interaction, and proactivity. [41]

[64] found that information system techniques improve supply chain performance. [42] published a survey-based quantitative research article on a hypothetical To examine the impact of information sharing on performance, a supply chain performance model in a new market is used.

The findings showed that cost and innovation orientations boost supply chain performance [42]. Researchers say supply chain integration on information sharing may improve performance.

3.6.1 Key Performance Indicators

KPIs facilitate the development and evaluation of organizational goals, which are essential to the success and longevity of any ongoing organization. KPIs assist businesses in creating a performance management framework based on quantifiable organizational functions. Most usually used is a balanced scorecard. Six Sigma, Lean, and others utilize KPIs extensively [10]. KPIs assist businesses avoid common errors and risks, but they're sometimes too many, complicated, and haphazardly formed, making the measuring process ineffective or counterproductive. KPIs may modify behaviors to enhance company results and operational performance. KPIs assist applies performance measurements and improving organization management [10].

According to [65], There are three primary advantages to identifying an organization's critical success elements and accompanying performance measures: (1) Increasing purposefulness by connecting daily staff actions to the organization's key success criteria, (2) enhancing performance through the use of fewer, more significant metrics, and (3) fostering greater ownership, empowerment, and fulfillment at all organizational levels. Significant Performance Indicators (KPI), which drive social systems, economies, and organizations, may have normative implications on organizational behavior and key choices. Performance management systems incorporate stakeholders' KPIs (such as suppliers') to define long-term goals, policies, and behaviors to accomplish anticipated outcomes [65].

To ensure that KPIs meet company objectives, a dynamic performance measurement system combines process expertise, IT, people, and scientific methodologies. Performance measurement is a method by which a business examines its everyday operations and evaluates its objectives[66]. A group of indicators that reflect firm performance must be used for performance measurement. Indicators that can be measured or not are employed. Customer satisfaction is not a quantitative (or financial) criterion, whereas lead time is. KPIs are numerical measures of an organization's effectiveness [8]. Each KPI should be quantifiable and chosen depending on the circumstances of the organization. KPIs serve to clarify primary responsibilities and define departmental performance measures.

Quantitative performance assessment is possible. Effective performance management requires clear, attainable KPIs. According to the literature, KPIs should reflect organizational

objectives [64]. KPIs assist discover and evaluating corporate performance indicators and give guidance, data, and real-world assessment circumstances. NIX Software Engineering (2020) conducted literature research to discover variable manufacturing KPIs. Evaluation criteria for KPIs are utilized. This study presents Key Performance Indicators (KPIs) for evaluating the application of KPIs that are appropriate for different industrial sectors and creating the KPIs assessment model of manufacturing setups to obtain the best performance organization or production.

Industries should be able to perform better thanks to the provided KPIs and assessment methodology. The number and types of performance indicators are influenced by the information's complexity. Different metrics are produced by factors such as data, expense, waste, satisfaction, online applications, supply chain optimization, etc. [64]. Different research objectives and focuses lead to various performance measures. The study's published literature demonstrates that studies focus on KPIs to enhance customer satisfaction, quality performance, education, product, SCM, operational processes, maintenance, a reduction in environmental cases, identification of financial blind spots, financial audit, power targets, better capability, safety criteria, and even a wireframe for best organizational effectiveness.

3.7 SALES STRATEGIES MANAGEMENT

From managing raw materials to controlling end-users, traditional buying and supply management changed significantly [67]. It is critical to examine supply chain data to determine financial conditions, share information, and make decisions in the future. At the beginning of this century, western nations developed BI. To assist companies in better managing their supply chains and business operations, such as resource selection, product definition, manufacturing, inventory, sales, supply-demand management, customer relationships, business intelligence analyses data to make informed decisions. Analytical tools and solutions are used to acquire and analyze real-time data to assist users to make better business choices both internally and externally as depicted in figure 2.10.

Figure 3.9: Sales strategy components (ConWISE, n.d.)

Business intelligence analysis includes data extraction, transformation, database management, data mining, recovery, reporting, visualization, and multidimensional analysis. [67]; [68]. For business intelligence, OLAP is a must. Query and reporting tools, according to[68], are critical parts of business intelligence. A company's reporting, analysis, modeling, and planning may be improved by using OLAP. For the purposes of business intelligence, OLAP technology may be used alongside data warehouses and data marts. Finding patterns and root causes is made easier by these system process studies. To keep management updated, reporting software creates presentations of aggregated data. [69]. Data mining and data warehouses, forecasting and decision support systems, document management and storage, knowledge management, information visualization and dashboards, and mapping are all other methods for storing and analyzing data, respectively[40].

In real-time, business intelligence systems may estimate material quantities, delivery costs, product costs, and inventory turnover rates. Businesses may save money and increase profits by improving the management of customer and supplier relationships, increasing supply chain flexibility, and so on. A well-balanced supply chain, according to [67] may help firms maintain a stable cash flow by ensuring that products are produced and distributed consistently. Supply chain integration and real-time data analysis are used by BI to forecast client demands, as well as the performance assessment of supply chain players, such as suppliers [67]. Suppliers, manufacturers, distributors, and logistics service providers would all benefit from a more tightly connected supply chain. It's possible that this will work as businesses and their environs evolve. An analysis of the supply chain's operations is needed to determine how well the supply chain is doing [68]. A supply

chain analytics goal is to gather real-time supply chain data and offer actionable insight for decision-makers [61].

[55] recommend that companies employ business intelligence to improve supply chain analytics' efficacy and efficiency. Using this method would help the company's suppliers and save money, giving it an edge in the marketplace. There are other benefits for the supply chain that may be gained via analytics [55]. Business intelligence solutions are on the budgets of many companies. ERP, SCM, and CRM projects sometimes fail because of a lack of data and incorrect predictions [40].

3.7.1 Customer Relations

Business information is frequently delivered to corporations as basic statistical summaries in dull, dated papers. However, beneath BI's drab exterior, there are brilliant ideas, especially for those prepared to re-evaluate their BI approach in order to successfully tackle the issues that forward-thinking firms are already resolving with contemporary BI [69]. This article offers some encouraging insights into how businesses are utilizing BI to enhance customer service, staff efficiency, revenue growth, and much more, whether you're wanting to install a new BI solution or get more value out of your current BI setup. [70].

Building relationships with customers, managing marketing and sales, monitoring and maintaining a customer and supplier base, tracking and analyzing staff performance are impossible without the use of a modern, flexible, and easy-to-use BI system in the company [71]. Implementation of the BI system enables specialists working with clients to minimize the time spent on entering information into the client base, and the presence of clear scenarios when working with different levels of clients allows to reduce the level of errors in communications with clients and suppliers. Managers can easily monitor and evaluate the performance of salespeople, analyze the tools used to increase the number and level of sales, both to new and existing customers[72]. If necessary, connect specialists from other departments to communications, which increases the productivity and efficiency of sales managers and the company as a whole, increases customer and supplier loyalty to the company, increases the number of direct and cross sales, and contributes to an increase in the number of closing deals[48].

Understanding your company's position and function in the unfolding of events allows you to develop an integrated plan of action for gaining long-term competitive advantages.[69]. To solve this problem it is necessary to have a synthesis of knowledge, resources, capabilities, intentions. For strategic management it is necessary to have specific components [72]; [48]; [70]:

- Strategic thinking. Creativity, entrepreneurial "enlightenment" in the understanding of the company, industry and environment.
- Formalized strategic planning. Systematic and clear process of strategy formation.
- Situational strategic decisions. Effective response to unexpected threats and opportunities.

OLAP servers and client analytics tools are examples of multidimensional analysis software that offers a data management environment for business problem modeling and business data analysis.[73]. The main vendors of this category are SAP, IBM, Oracle, Microsoft, SAS. Customers want the most up-to-date information, especially for those systems and processes that they consider critical. Therefore, you need to add some real-time BI to the company's services. For example, Rackspace (a web hosting company) did it. BI is now used by more than just internal corporate users. In fact, the value proposition is gradually becoming more and more dependent on BI data regarding systems[74]. This Rackspace development offers one strategy if your IT staff was looking for a means to increase business value. The answer is to integrate BI into reports and client products. Working with unstructured data has long considered a hopeless endeavor. Simply put, there was no useful way to view this information. Nevertheless, using structured customer and financial data was quite practical. For instance, the insurance company Aflac has introduced a new program to make working with unstructured data simpler. [22].

In today's online world, a disgruntled customer has the opportunity to instantly express their negative opinion about a product or service. Reposts on social media have the potential to make this problem worse. Business intelligence can help identify consumer unhappiness early so that it can be fixed before it becomes a major issue [75]. Be careful to contact the finance department for a cost-benefit analysis when dealing with service-related concerns like warranty claims. You might receive a lot more orders in the future if you agree to accept temporary losses in order to please the consumer. IT professionals can add value to these discussions by evaluating data quality and developing end-user BI tools that are simple to use, particularly those that include monitoring social media sentiment regarding your brand.[69].

Business intelligence systems are widely used by restaurant companies like Hardee's, Wendy's, Ruby Tuesday, and T.G.I. Friday's. For them to make strategic decisions, BI is really helpful. What dishes should remove from the menu, what foods to include, what ineffective areas should be closed, etc. [76]. Additionally, they employ BI for tactical concerns like renegotiating contracts with product suppliers and finding strategies to enhance ineffective procedures. Restaurant chains are among the top industries that truly benefit from these solutions since they are extremely focused on their internal business processes and because BI is essential to regulating these processes and managing enterprises.[77].

One of the essential elements of BI is business intelligence. In any industry, a company's success depends on this element. Wal-Mart heavily relies on data analysis and cluster analysis in the retail industry to maintain its leadership position[78]. Rather than continuing to operate a massive casino, Harrah's has altered the basics of its competitive gaming policy by putting an emphasis on customer loyalty and service level analysis. In addition to being major web projects, Amazon and Yahoo also heavily rely on business intelligence and a well-known "test and understand" strategy to streamline their internal operations. Every year, Capital One runs over 30,000 experiments to determine its target markets and assess its credit card options. [70].

[78] What can salespeople and their managers do to increase earnings predictability? IT professionals can learn advice from this book and create BI tools to assist them in making sales decisions, such as deciding which customers will be advantageous to the business. What-if analysis is also supported by the calculator. If a potential client has reached a higher level in social networks, he may become a higher priority for the company. Farias says the app is in the "alpha stage," so it's too early to determine its impact [78].

Marketing managers around the world compete based on customer experience, and it becomes important to know the behavior, needs, and requirements of customers. Business analytics for digital marketing provides businesses with an understanding of consumers to segment customers and attract the right type of leads to meet the company's targets [22]. BI tools help clear bottlenecks, automate tasks, improve processes, prioritize workflows, and increase productivity. Thus, business intelligence for marketing brings significant improvements in sales, consumer experience, day-to-day efficiency and effectiveness [79].

3.7.2 Why Business Intelligence

Business intelligence (BI) uses technology to analyze data and present useful information to help company leaders, managers, and other end users make better business decisions[80]. For obtaining data from internal and external systems, preparing it for analysis, running queries against the data, and producing reports, dashboards, and other data visualizations, business intelligence (BI) includes a wide range of tools, applications, and methodologies for both corporate decision-makers and operational staff to see the results of the analysis [81]. Simple definitions: to get data-driven insight into company performance; to monitor existing business performance; to boost profits; and, finally, to discover new business possibilities [42].

The foundation of every business intelligence activity is based on facts and dimensions. The data in these tables is essential for doing in-depth studies and determining the true worth of a firm. For the sake of business intelligence, facts and dimensions have been developed and used[81]. Resumes, covering letters, proposals, and interviews all benefit from this set of business intelligence skills: Depending on the position you're applying for and the sort of expertise you're looking for, you'll need to check out our list of skills[80].

3.8 BUSINESS INTELLIGENCE FRAMEWORK OF SALES

BI system is a system for building reports for various departments of an enterprise. The reporting system is included in the NERPA ERP solution package and is used by all program modules for business intelligence purposes. Employees can track performance, examine trends, and spot potential issues early on thanks to access to current data and robust analysis and reporting tools, as shown in figure 2.11[82].

Reporting management is necessary for almost all employees of the enterprise using NERPA modules for planning various resources. BI system is used by [15]; [79]; [83]:

1. Local performers and program operators - to automatically create reports on the work done using the BI module (business intelligence system).

2. Managers of departments and structures of the enterprise - to build reports on the activities of the entrusted unit, individual activity of employees, etc.

3. The management personnel of the enterprise - for the analysis of reporting, business intelligence tasks, improving work efficiency and eliminating shortcomings using a BI system.

4. Managers, accountants, lawyers, employees of the sales department - for the formation of regulatory reporting documentation, budgeting, forecasting, etc. tasks.

Figure 3.10: Example of company reporting [84]

3.9 BUSINESS INTELLIGENCE IN SUPPLY CHAIN

Techopedia defines business intelligence as "the use of computer tools to identify, find, and analyze business data" Standard reporting and BI differ in that BI can convert data into information[44], [56]. The ability of supply chain BI solutions to make sense of the seemingly infinite variety of data made available by logistics technologies like TMS, WMS, and SCEMS attracts businesses. It is crucial to find, comprehend, and use data in order to make strategic decisions that improve supply chain performance. By their ability to transform data into information, standard reporting and BI are distinguished from one another[85]. In the past, moving data out of a system and into a spreadsheet or database, where a company would try to slice and dice it into useful information, was known as data extraction. Data is provided by today's BI systems in clear, understandable formats. Reporting, real-time dashboards, and benchmarking are BI tools for supply chain users.[86].

Data analysis is made simpler by delivering BI data through real-time dashboards and reports. Depending on the type of data and data pieces, graphs provide trending visibility and radial dials show performance within ranges. Assessment of processes and strategies is supported by data depth and frequency[57]. Management was informed of a decline in delivery performance in one lane by BI data. The corporation changed carriers after seeing this red signal. One may then analyze

performance to ensure it improved and if any expenditures were spent. BI data has also saved the organization from overreacting to little faults in the supply chain. Exceptions are rare. Any variety of reasons might cause a store's late delivery[62]. With BI, one can assess whether a late delivery indicates a bigger problem. It provides actionable performance and cost data to optimize outcomes. Without the BI platform, it had to sift through much data. Logistics & Management, Order Fulfillment, Procurement & Supplier Relationships, and Opportunity & Risk Assessment comprise Supply Chain Management business intelligence [62].

CHAPTER FOUR: RESULTS & ANALYSIS

BI tools' literature analysis and online questionnaire data are presented in this chapter. The relevant data of all the respondents in this research are outlined in this section. The correlations of responses define the key performance indicators for use in GoodData platform. It demonstrates how supply chain performance is impacted by business intelligence strategies, as well as how various people have used business intelligence. There were four SCOR areas that were examined in the research and BI systems were compared to see how the company performed in each of them, leading to the development of their strongest and weakest links.

4.1 SURVEY RESPONSES

A total of 65 responses were collected and according to the sample size calculation, 37 responses were finalized for evaluation. The criteria for the screening of responses were as follows:

1. Incomplete responses were left out in primary screening.
2. The first 37 responses after primary screening were kept for analysis, remaining were discarded.

4.1.1 Descriptive Data

Out of the 17 questions of the survey, the first 10 and the last question were descriptive and allowed us to analyze the existence, usage, and effectiveness of different BI platforms in the company and each of its departments. The individual responses are attached as appendix 2 here, however, an external excel file is also attached. The descriptive, as well as correlation analysis performed by MS excel tool, is provided in the sub-section below.

4.1.2 Quantitative Data

The remaining seven questions were based on a Likert-scale and were used to quantify the effectiveness of BI tools in four SCOR areas and create an analytical dashboard in the GoodData platform. It allowed us to not only creatively visualize the numeric data but served as an example of how the platform can be used for much more than customer-centric analyses. The individual responses to the Likert-scale questions and their association with the descriptive questions is provided in appendix 3, as well as a separate excel file.

4.2 STATISTICAL DESCRIPTION OF RESPONSES

This section individualizes the questions and provides statistical analyses to each question for ease of correlation and further quantitative analysis.

4.2.1 Question 1

Discussion: Out of a total of 37 respondents, 25 were males and 12 were females as shown in table 4.1.

Table 4.1: *Gender distribution in the respondent company*

Row Labels	Gender
Male	25
Female	12
Grand Total	**37**

4.2.2 Question 2

Discussion: Employees from all departments of the company were requested to fill in the interview and the selected respondents' positions in the company are provided in Table 4.2.

Table 4.2: *Positions of respondents in the company*

Position	Count
Junior	
Analyst	13
Associate	8

| Senior	
Analyst	8
Manager	8
Grand Total	**37**

4.2.3 Question 3

Discussion: Employees from all departments of the company were requested to fill in the interview and the selected respondents' department in the company are provided in Table 4.3.

Table 4.3: *Departments of respondents*

| Department	Count
Information Technology	8
Logistics and Supply Chain	5
Sales	5
Engineering	5
Marketing	4
Quality	4
Purchasing and Sourcing	4
Manufacturing and Production	2
Grand Total	**37**

4.2.4 Question 4

Discussion: Out of the respondents, majority were the ones that had spent more than a year at the company, only 5 employees were older than four years. 8 employees belonged to the category of less than one and more than eight categories, as shown in figure 4.1.
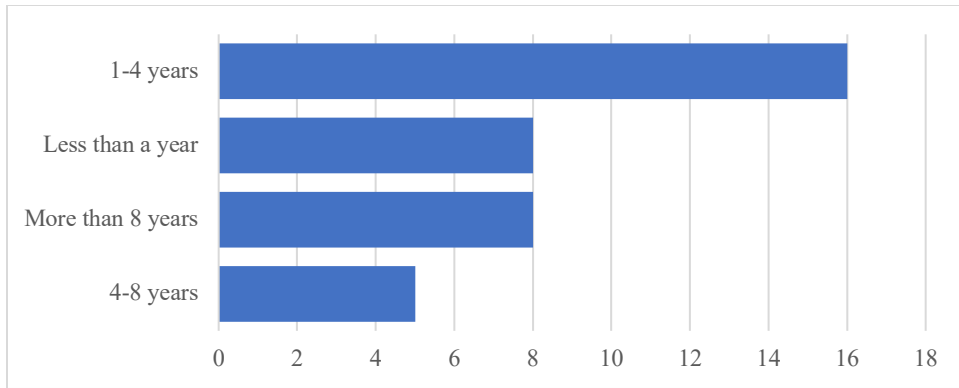
Figure 4.1: Experience of the respondents in mall.cz

4.2.5 Question 5
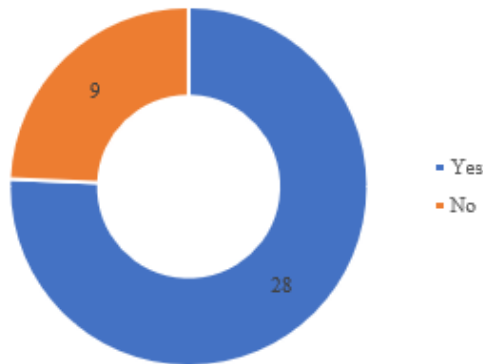
Figure 4.2: The breakdown of people connected directly to the databases

Discussion: When asked whether the respondents were directly connected to the company's database and information systems, majority responded positively. The breakdown is depicted in figure 4.2.

4.2.6 Question 6

Discussion: 29 out of 37 people said yes, they have worked with BI tools, while the remaining 9 said they have not worked with any BI tool.

4.2.7 Question 7

Discussion: This was a general question aimed to learn about the basic understanding of respondents about the utilization of BI tools. 30 out of 37 assessed it right, while 7 said that they don't think that BI comprises the given definition.

4.2.8 Question 8

Discussion: According to the responses, 16 out of 37 said that they are familiar with the techniques at an expert level, while 5 said they are not familiar with the techniques. The responses are summarized in figure 4.3.
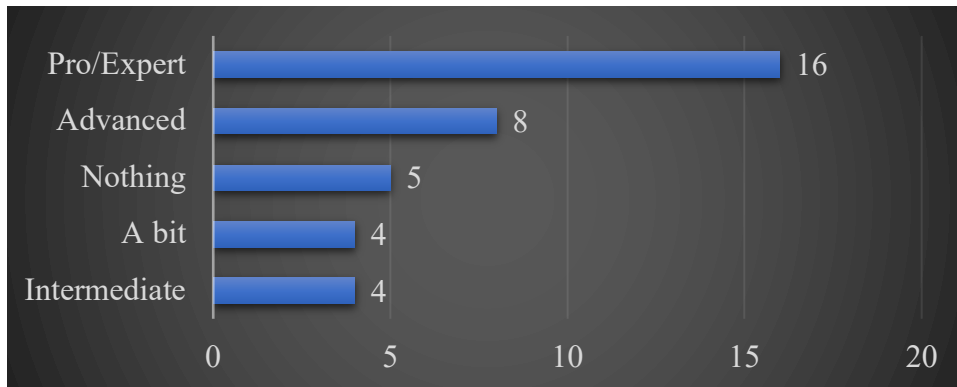
Figure 4.3: Familiarity with the BI techniques

4.2.9 Question 9

Discussion: Table 4.4 summarizes the responses to this question.

Table 4.4: *Categorization of BI tools for company success as per respondents*

| Categorization	Count
It is a critical success factor	17
It supports our strategies	8
It culminates in minor improvements	5
It stabilizes our platforms	3
It has no role	3
It decreases productivity	1
Grand Total	**37**

4.2.10 Question 10

Discussion: Out of commonly used BI tools like Microsoft Excel, SAP business objects, predictive analysis, and dashboard analytics, the employees' choices are summarized in table 4.5.

Table 4.5: *BI tool in use by the employees*

BI tool in use	Count
Microsoft Excel/Access	12
SAP business objects	8
Predictive Analysis	8
Dashboard analytics	7
Other	2
Grand Total	**37**

4.2.11 Question 11

Discussion: Six questions were asked in relation to sourcing of raw materials and products from the respondents. Based on figure 4.4, we can say that the BI tools are used in almost all the sourcing processes, however, the processes themselves are quite limited. For instance, the documentation of supplier inter-relationships is one thing the company focuses on. However, planning and scheduling are areas of improvement. Supplier performance feedback is another important area for improvement.
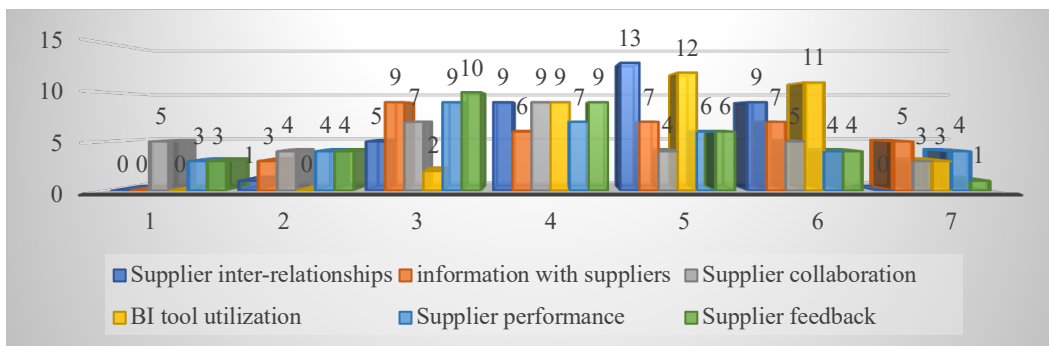

Figure 4.4: BI tools usage in sourcing processes

4.2.12 Question 12
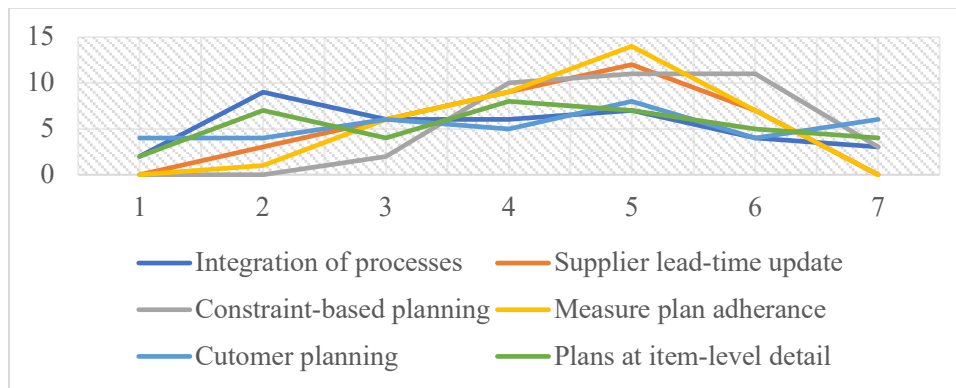
Discussion: According to the responses, forecast accuracy, customer profitability, use of customer information in demand, and the use of BI tools for demand forecast are the most credited

areas in the planning processes. However, review of existing plans and supply chain measures are the balanced areas, which means neither less nor extra attention of the BI tools is given to these areas. Lastly, product forecast and demand variability are the areas that are given the least attention to. The responses are summarized in figure 4.5.
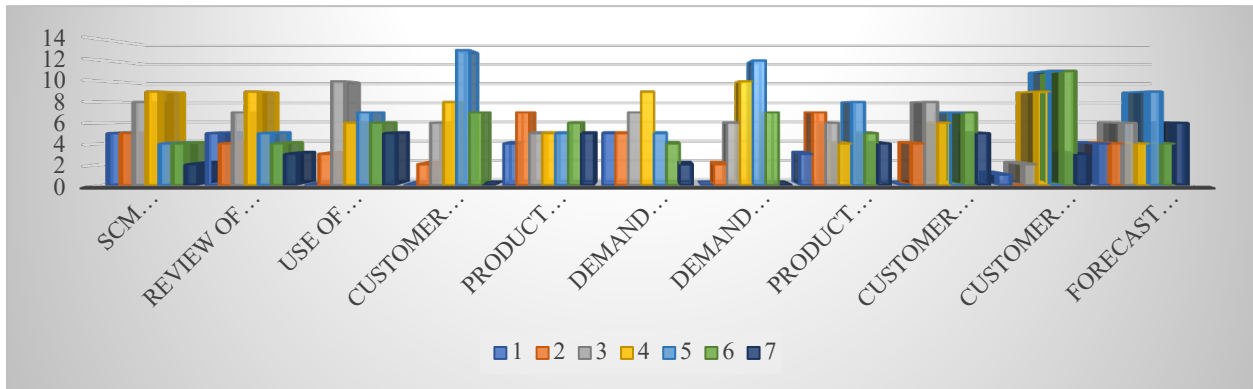
*Figure 4.5: Planning processes and the use of BI tools*

4.2.13 Question 13

Figure 4.6: The use of BI tools in production areas

Discussion: According to the trends of responses in figure 4.6, customer planning, integration of processes, and planning at item-level details are the most balanced areas utilizing BI services. Conversely, plan adherence is the area, where the most attention is required.

4.2.14 Question 14

Discussion: According to the responses, the use of BI tools process and situation measurement is the major contribution in the delivery department, whereas documentation and planning are the areas, where the employees suggest further improvement.
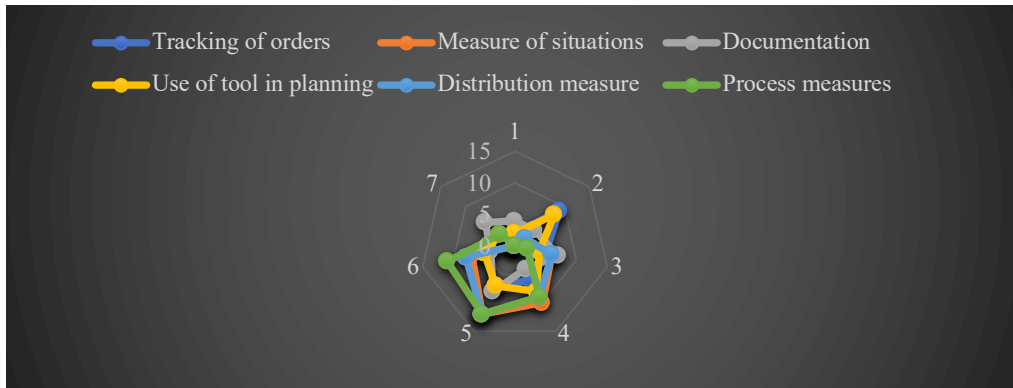
Figure 4.7: BI tools and delivery processes of SCM

4.2.15 Question 15

Discussion: Commitment and demand are the two areas where BI tools have been used utilized by the company to the maximum level. Inter-department sharing, supply chain management, and support processes are the balanced areas, however, the BI tools have not been used to speed up decision processes in the company. Also, it has little contribution in the production processes, as shown in figure 4.8.
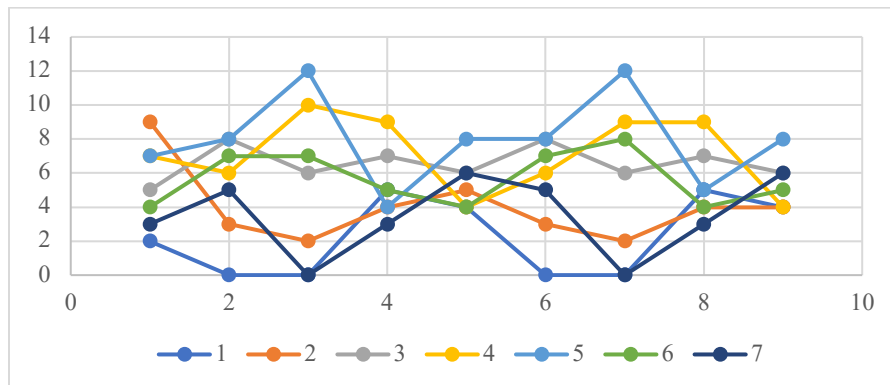
Figure 4.8: BI tools and information support systems
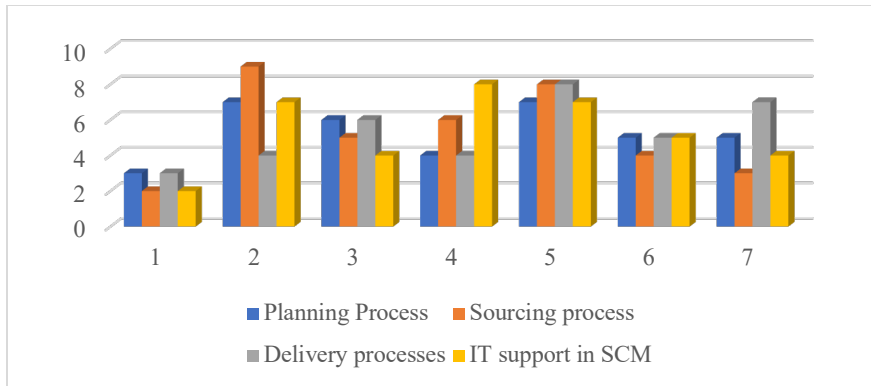
Figure 4.9: BI tools and overall SC performance

4.2.16 Question 16

Discussion: The responses demonstrate that the BI tools have been used steadily by the company to improve the productivity of all SCOR areas, however, the delivery sector is the one with most involvement of the BI techniques, as depicted in figure 4.9.

4.2.17 Question 17

Discussion: The responses are summarized in figure 4.10.
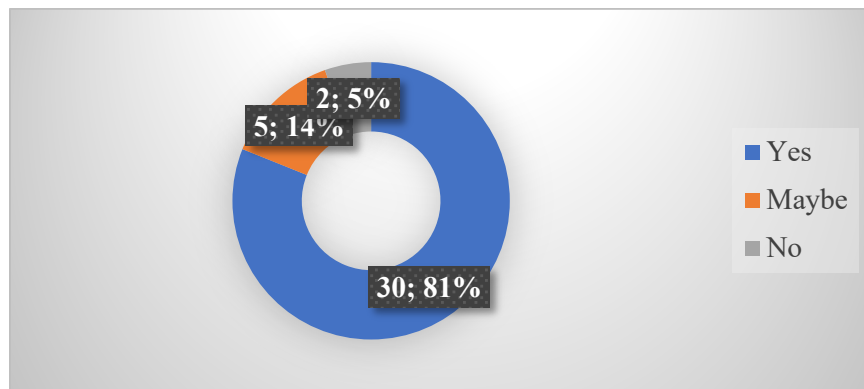
Figure 4.10: Overall performance improvement using BI tools

4.3 CORRELATIONAL ANALYSIS

This section deals with the correlational analysis of the descriptive questions we have discussed above. Here we will cover the most important relationships and their culminations.

4.3.1 Position and Familiarity with BI techniques

The questions 2 and 8 are correlated here. According to figure 4.11, we can see that the senior analysts and managers of different departments are mostly familiar with the BI techniques. Whereas the junior analyst and associates are not as familiar given their low ranks. This suggests that the BI techniques are not introduced and practiced equally in all organizational ranks.

Figure 4.11: Relationship between position in the firm and familiarity with BI techniques

4.3.2 Department and Connection the Company Database

Figure 4.12 shows that the employees from engineering department are the ones that are not connected to the company database directly. Employees from sales, manufacture, and quality, are somehow connected to the database and have access to some or all the analytics.

4.3.3 Department and Working with BI Tools

Similarly, the employees from engineering department are the least familiar with the BI tools as shown in figure 4.13.
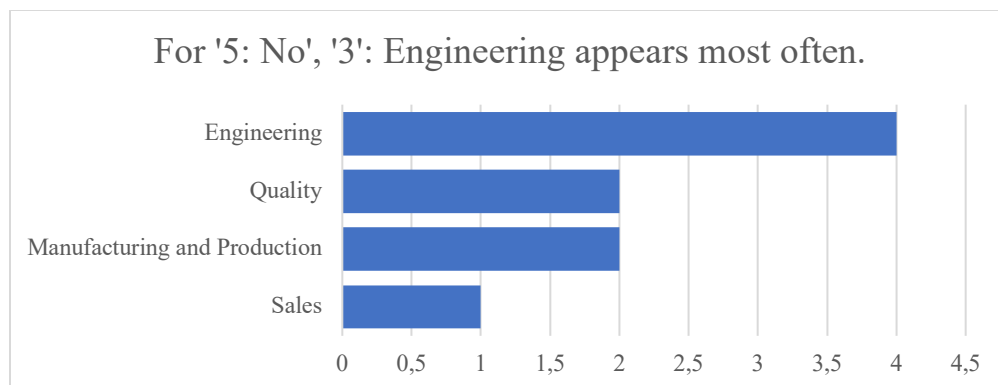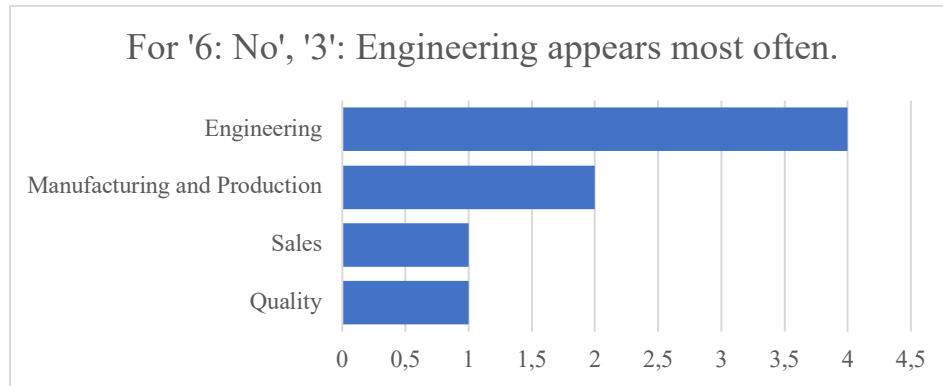

Figure 4.13: Relationship between department of the employees and their work with BI

4.3.4 Department and Familiarity with Techniques

Out of all the given departments, employees working in the IT department are expertly familiar with the BI techniques. Following it are the sales, logistics, and SCM departments, which is understandable and coherent with our main idea that SCM is hugely dependent on BI analytics, after of course the IT department who provide such analytics, as illustrated in figure 4.14.
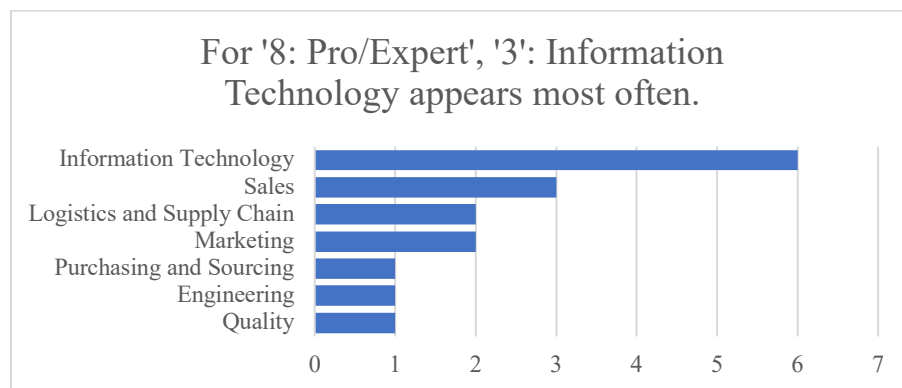
Figure 4.14: Relationship between department and familiarity with BI techniques
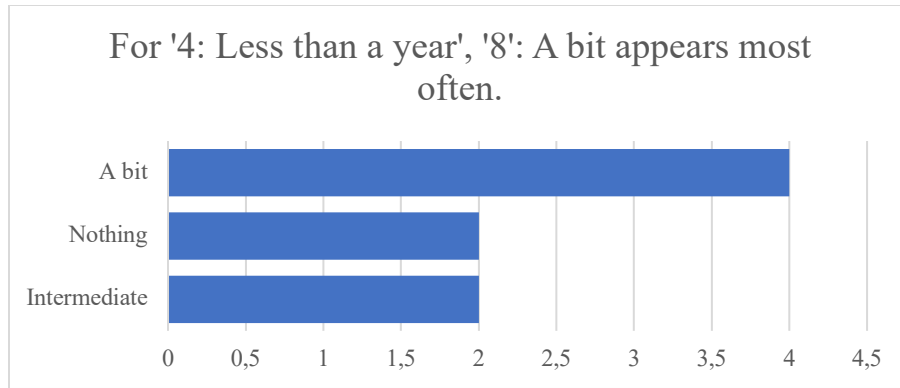
Figure 4.15: Relationship between experience and familiarity with BI techniques

4.3.5 Experience and Familiarity with BI Techniques

These trends are interesting as they tell us, according to figures 4.15 and 4.16, employees who have been with the company for less than a year are a bit acknowledged and familiar with the BI techniques, which suggests that employees are informed about intelligent analytics and advised to practice them very early in their career. Most employees who have been with the company for around 4-8 years have an advanced knowledge of the BI techniques and tools. Furthermore, the highest level of expertise has been shown by employees that have been with the company for more than 8 years. It suggests that employees are taught to improve their expertise with BI tools as their time increases with the company.
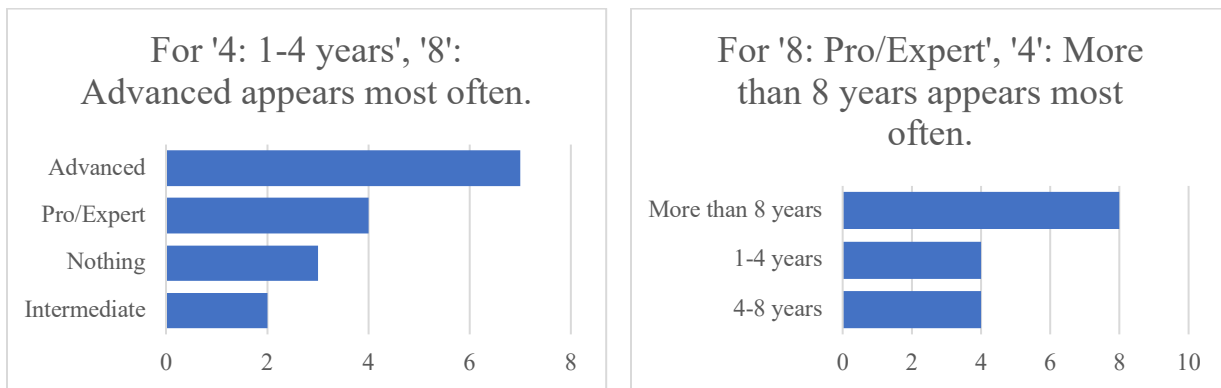
Figure 4.16: Relationship between employee experience and familiarity with BI techniques

4.3.6 Experience and the Impact of BI Tool

According to figure 4.17, the employees with more experience, especially those having more than 8-year experience think that the BI tools are a critical success factor for the company. A small minority has also suggested that the BI tools improve their future strategies as we have thoroughly discussed in the individual assessments of questions 11-16 in the previous section, while some with little to no experience and minor positions don't think BI has an important role to play.
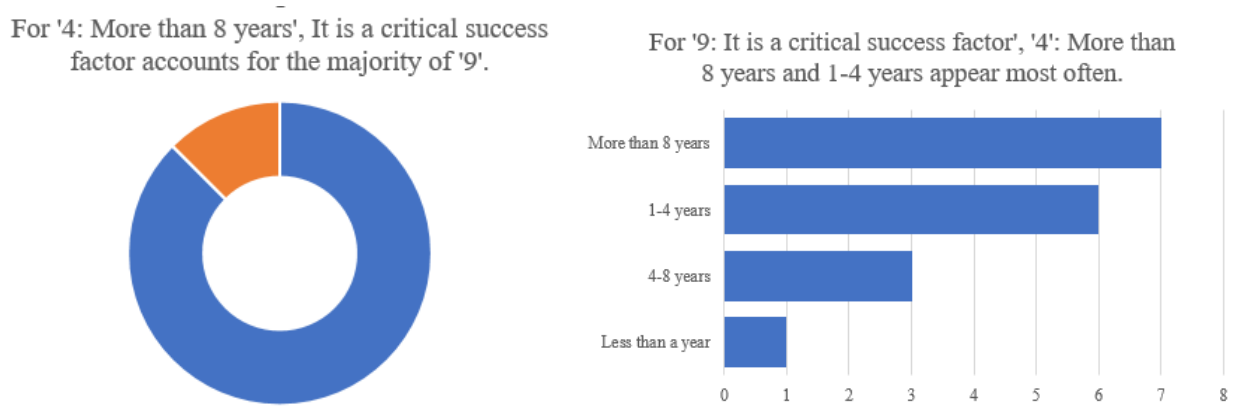
Figure 4.17: Relationship between employee experience and impact of BI tools on company performance

4.3.7 Connection to the Database and Working with BI tools

We have noticed that employees who are not connected to the database have not worked with BI tools either. Similarly, these employees do not understand the basic concepts of BI as well, as shown in figure 4.18. This further suggests that the company does not focus on the employee awareness regarding Business Intelligence, especially if they know that their employees have nothing to do with using BI techniques.

4.3.8 Working with BI Tools and Understanding its Role

According to figure 4.19, the employees who answered 'no' to working with BI tools think that it has either no or minor roles in a company's productivity. This assessment can be understood since they have never worked with the tools and, as per the previous section, are not familiar with how it works and helps the company.
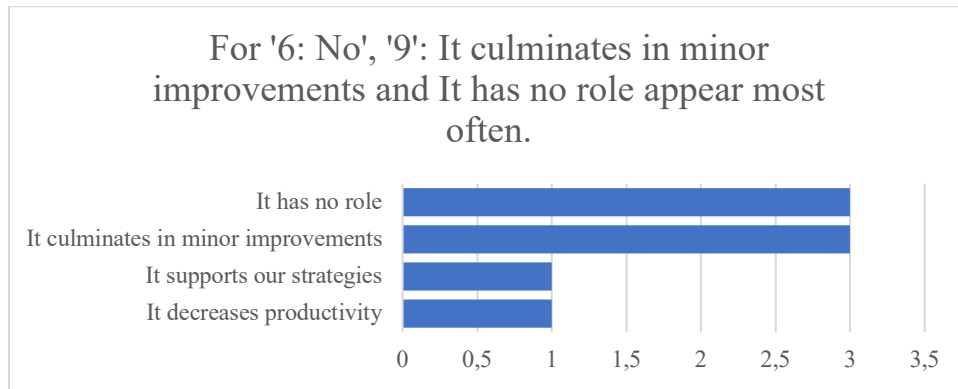
Figure 4.19: Relationship between working with the BI tools and understanding its role

4.3.9 Familiarity with BI Tools and Understanding its Impact

As discussed in the previous section, those with little to no understanding of the BI tools do not assume it to have a significant role in the company's productivity. Consistent with these facts, we have analyzed the relationships of questions 8 and 9 as well. It is illustrated in figure 4.20 that the employees with expertise in the BI tools suggest that it is a critical success factor for any company. It is also demonstrated that as the level of expertise with the BI tools' decreases, their understanding also decreases.

For '9: It is a critical success factor', Pro/Expert accounts for the majority of '8'.
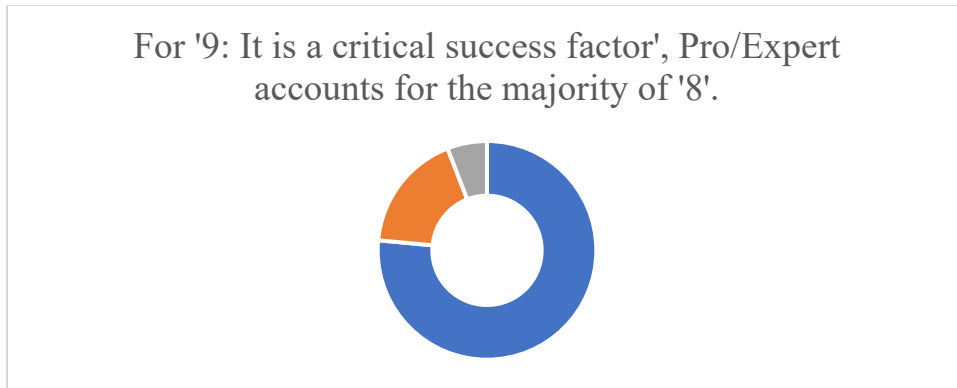
Figure 4.20: Relationship between familiarity with BI tools and understanding its impact

For '8: Pro/Expert', '11': SAP business objects and Dashboard analytics appear most often.
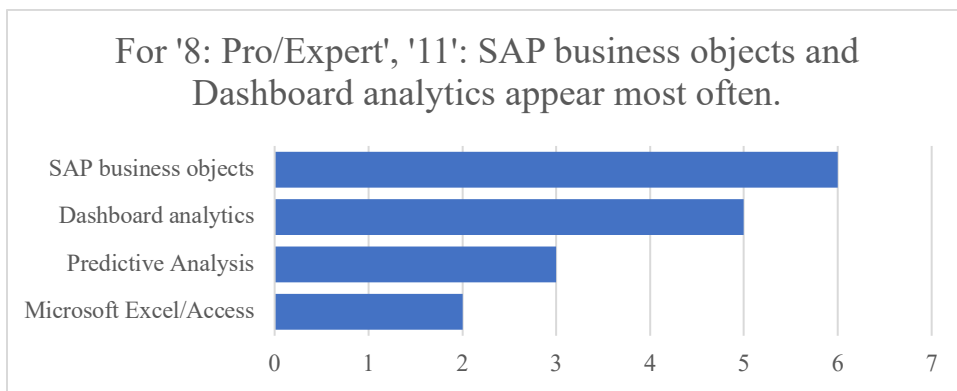
Figure 4.21: Relationship between expertise with BI tools and their choice

4.3.10 Expertise and Choice of BI Tools

As seen in figure 4.21, the pro/expert level employees prefer SAP business objects and dashboard analytics over other tools evidencing their promise in the analytics world.

4.4 KEY PERFORMANCE INDICATORS

The key performance indicators are the ones that measure the effectiveness or success of a given process or tool. In our case, the means to identify KPIs of BI techniques for SCM productivity was the Likert-based questions of our questionnaire. Based on the analysis above, the following KPIs have been identified and will be used to achieve the other objectives of this research study using the GoodData platform.

1. *Supplier inter-relationships measurement*
2. *Supplier feedback measurement*

3. *Demand forecast measurement*

4. *Demand variability measurement*

5. *Constraint-based planning*

6. *Plan adherence measurement*

7. *Situation measurement*

8. *Delivery process documentation*

9. *Demand management support measurement*

10. *Measurement of support processes*

4.5 DATA WAREHOUSE ARCHITECTURE

The sample file (in .csv format) loaded on Good Data utilized the final question of the survey as an ***attribute*** and the ten highest-scoring KPIs (listed above) as facts to design an analytical dashboard. The KPIs listed above provide the strongest and weakest areas of BI utilization in the company, allowing us to measure the effectiveness of BI tools in detail. After uploading the data, all the facts were measured against the sole attribute.

4.5.1 Model Design

Figures 4.22 and 4.23 illustrate the published models that are further used by the BI tool of the GoodData platform to create analytical dashboards.

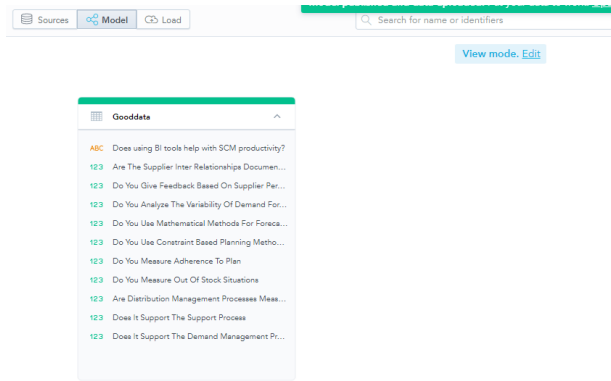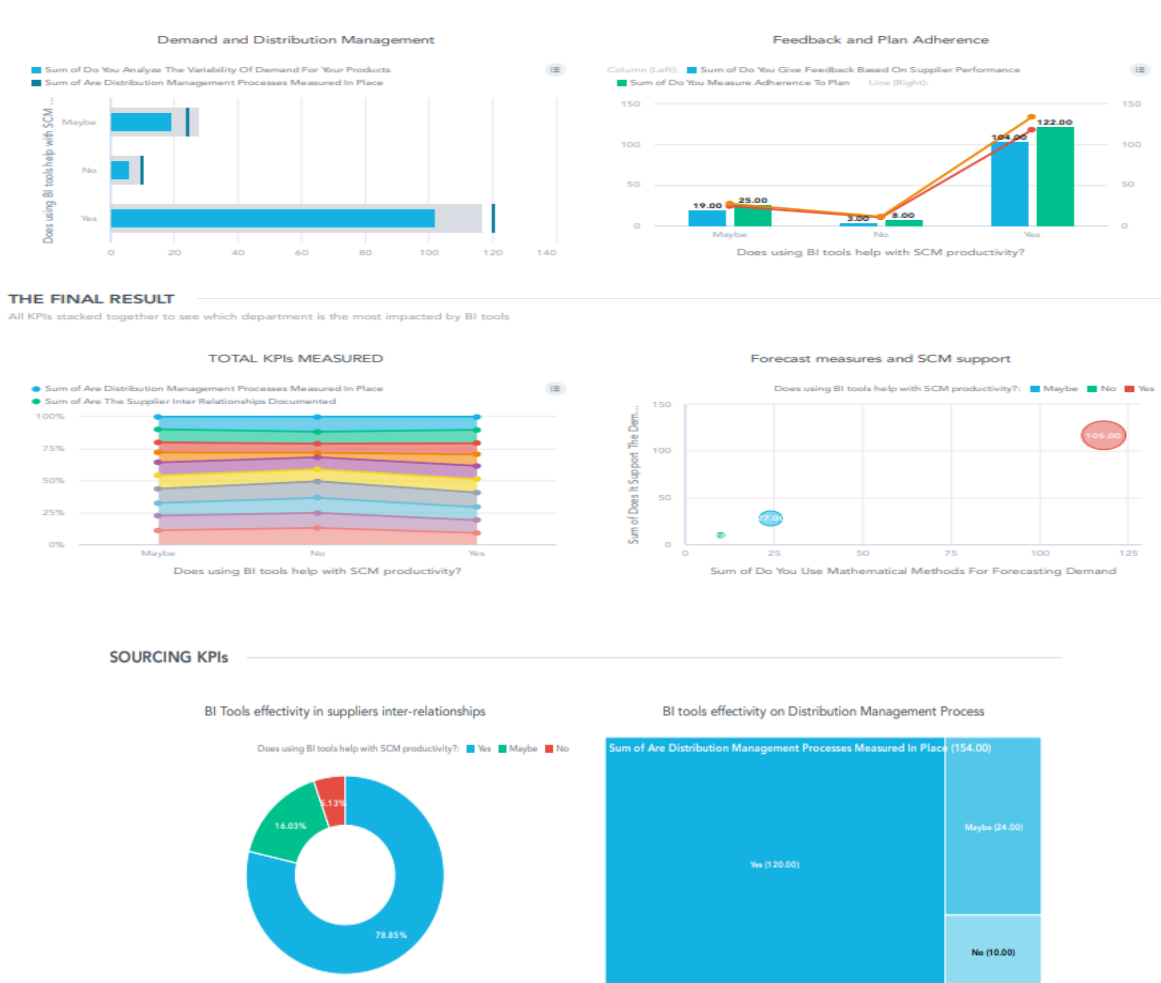***Figure 4.22: Importing data to create the data model***

Figure 4.23: Published model of the provided data

4.6 DESIGN OF ANALYTICAL DASHBOARD

The designed analytical dashboard is illustrated in figure 4.24.

Figure 4.24: The designed analytical dashboard using GoodData

It provides easy and quick visualization of the measurement of the high-scoring KPIs identified in our research. It allows the users to prioritize processes and strategies based on the provided measurements, and the BI tools can be further used for quantification and maximizing profit on the prioritized processes.

4.7 SECONDARY RESEARCH ANALYSIS

After doing an analysis of surveys and conducting a study of academic sources, it is not difficult to discover that business intelligence is popular and that the market offers many alternatives, solutions, and features to choose from. Some of them are sophisticated, and they provide a business solution that is quite comprehensive for a wide range of sectors and types of organizations [37], [87]. Because the goal of business intelligence is to enhance information quality and make better choices, BI technologies may be helpful for all SCOR categories and may operate in a variety of situations as discussed by [45]. For instance, the business intelligence (BI) platform that Good Data offers is adaptable to a wide variety of organizations and fields. The vast majority of the company's offerings can be modified, and the cost is reasonable enough for small to mid-sized businesses.

On the other hand, several difficulties that existing BI tools face might be summarized as follows: First, if there is a new worker hired on board, that person must always be provided with training on how to make use of the information system as well as the business intelligence methods consistent with the findings of [55]. Especially for businesses that have a variety of BI tools but don't provide training, new users may not have a good knowledge of places to mine data, where the data is stored, which data they can access, and where to find other data from other departments or hidden places. This is especially true for businesses that have a variety of BI tools but don't provide training.

Second, if the BI system is designed to serve several industries, it runs the risk of omitting certain functionalities that are beneficial to specific companies or industries. This is because each sector and firm may have its set of business procedures and processes. If an information system has many features and can be customized to fit the needs of most businesses, it may become overly complex and difficult to use for smaller businesses [63]. This may be the case because some of the

procedures may be overly detailed, and other procedures may not be applicable to the needs of the smaller businesses at all. Additionally, the increased complexity may result in ambiguity and increased difficulties for novice users who are seeking to master the system. It has the potential to be a significant obstacle, as well as an opening, for the growth of business intelligence in the future.

The fourth issue is that communication is always a challenge when using any kind of technology as seen in studies of [27], [30], and [42]. According to the findings of this research, it is apparent that the information system can enhance the flow and exchange of information at some point; nevertheless, it is still difficult to transfer data from one department to another, from one process to another, or from one party to another.

CHAPTER FIVE: DISCUSSION

This chapter provides an overview of the findings from the research as well as additional commentary pertaining to the subject of the study.

5.1 PREDICTED IMPROVEMENTS USING THE MODEL

In today's global marketplace, supply chain management is critical. According to the Harvard Business Review, the United States supply chain employed 44 million people in 2018, accounting for 37 percent of all occupations in the country [17]. To succeed in the supply chain management industry, analysts must identify their organization's possible shortcomings and devise strategies to overcome them [17]. As a result of the use of business intelligence (BI), it is possible to detect potential threats to a company and take prompt remedial measures. The organization's data banks need to be organized and visualized for employees to get insight into their patterns [19]. Overall, BI tools allow the following improvements in a company's SCM chain.

1. Decision-makers who use BI can monitor internal bottlenecks and act based on metric-driven information.
2. It is possible to get an in-depth look into a company's performance using business intelligence (BI) tools such as performance metrics and dashboards. Monitoring the company's growth via metrics like quarterly targets and forecasting future outcomes based on past performance is made easier with these tools.

3. There is a lack of context and a great deal of data dispersed across several divisions in supply chain management. An industry's data is brought together in one place via Business Intelligence (BI).

4. Every step of the manufacturing process may be tracked and optimized using precise data collected at each stage, from the transportation of raw materials to the delivery of finished goods to clients.

Operations management, logistics, procurement, and IT are all part of the supply chain. It's like a vehicle's wheels. There is no moving vehicle if any of them fails. BI helps companies to operate in a more profitable way by coordinating all aspects of it. The predicted improvements can be subdivided into the following categories as per our analysis.

5.1.1 Demand and Supply

Inventory management is critical to keep up with ever-changing client preferences and market shifts. Low profitability and high supply chain expenses are the result of poor sales forecasts and inventory management. As a result of BI, many companies can keep up with market needs while still meeting their profit targets. It is possible to make the supply chain more competitive, improve customer service, and improve inventory tracking and trade processes by using BI.

5.1.2 Distribution

When it comes to distribution, it's not simply about transferring goods from one location to another. There's also the issue of adequate storage, inventory management, and distribution. Real-time communication with workers on the flow of items is a time-consuming task. However, the lifespan of an organization is determined by its ability to effectively distribute and communicate its message. Real-time notifications on order progress may boost customer satisfaction with the use of Business Intelligence (BI). For example, BI may help organizations keep tabs on your fuel costs, detect supplier issues, and unearth new possibilities that might help your business develop.

5.1.3 Integration of Systems

Companies may manage a more efficient and lucrative supply chain by integrating all systems into one. Visualizing all your data in one location is made possible via BI. With BI, you can bring new goods to market more rapidly, identify areas for improvement, reduce waste, and increase productivity.

5.1.4 Forecasting

BI helps firms make sense of their data to anticipate future trends and patterns. Overstocking is no longer an issue thanks to a better understanding of consumer demand. Customer service is enhanced since it allows supply chain managers to monitor shipments in real-time and precisely estimate when they will be delivered to their recipients.

However, as discussed in the results section, there are a few issues with using BI tools in a company. First, if there is a new worker hired on board, that person must always be provided with training on how to make use of the information system as well as the business intelligence methods. Second, if the BI system is designed to serve several industries, it runs the risk of omitting beneficial functionalities. We have provided a SWOT analysis to summarize the strengths and weaknesses of the organizations with the integration of BI techniques.

5.1.5 SWOT Analysis

Table 5.1 summarizes the SWOT analysis of companies in their effort to utilize BI tools in their supply chain processes.

Table 5.1: *SWOT analysis summarizing the implications of BI techniques usage in companies*

	STRENGTHS	WEAKNESSES
OPPORTUNITIES	Monitoring internal bottlenecks Process tracking Authentic forecasting	Employee lack of familiarity Identification of the under-scoring KPIs
THREATS	Accessing all company assets Limiting certain areas while prioritizing others Losing SCM balance	Increasing ambiguity and complexity Proper communication within divisions

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

This chapter provides an ending to the research study with a summary, ethical considerations, and recommendations for the effective utilization of BI tools as well as for future studies.

6.1 RESEARCH SUMMARY

This research concluded that even though BI techniques are a part of modern SCM processes, companies still deal with their suppliers and customers through traditional sales funnels. Especially, the grass-root level employees are not aware of the analytical dashboards and, hence, do not get the opportunity to improve the preliminary processes using BI techniques. Furthermore, we analyzed that the experts in BI analytics prefer dashboards analytics like the GoodData platform to visualize their data architecture easily and correlate whatever is prioritized. Lastly, the research, by designing an analytical dashboard and comparing the survey's results with previous literature allowed us to shed light on the fact that BI tools can help us more than just design customer-directed models, they can also provide worthy company analytics for the internal users. However,

the gaps identified in the utilization of these tools are what sets this research apart, as it highlights the complexity of the integration of these tools with traditional sales funnels.

6.2 ETHICAL CONSIDERATIONS

None of the employees were surveyed without their consent. Any data that may be personal to the clients were not included in the survey. No identification was taken to maintain the anonymity of the clients and the Likert-scale-based questions were explicitly explained to the employees for their thorough understanding.

6.3 RECOMMENDATIONS

Based on the final SWOT analysis, the following recommendations should be considered when utilizing BI tools for supply chain management and improvement.

1. The analysts should monitor the under-scoring KPIs and prioritize them along with the high-scoring KPIs as we have done in our research. It allows them to keep the majority of the activities and processes in check.

2. The companies should maximize process tracking and provide rewards and other positive reinforcements for employee commitment and encouragement.

3. The ability to forecast future sales or key areas to focus on allows the companies to strategize accordingly, which should be included in their weekly analytical dashboard.

4. The company should provide employee codes to all the employees having access to the dashboards through the cloud to track the management of data and prevent it from being leaked.

5. The organization must provide employee training and incentives to familiarize themselves with BI techniques and provide input on SCM productivity.

Lastly, future researchers might analyze the influence of the TOE model on alternative models of BI adoption, or they could investigate the impact of agile distribution networks that are acceptable for multinational companies, or both. Further research should focus on the impact of corporate structure on the design and implementation of business intelligence systems (BIS) that are tailored to the needs of specific organizations.

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