TRENDS AND FUTURE PERSPECTIVES IN BUSINESS INTELLIGENCE

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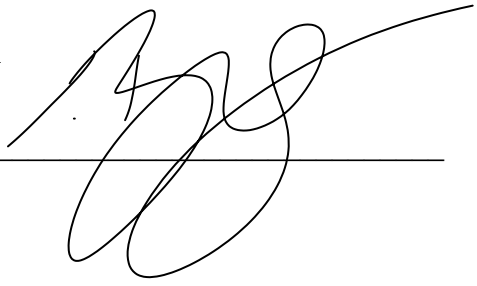

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Dedication

I dedicate the dissertation to the loving memory of my mother, to my supportive father and to my beloved brother.

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First of all, I would like to express my deepest gratitude to Swiss School of Business Management (SSBM) for the given opportunity to make my academic dreams come true.

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ABSTRACT

TRENDS AND FUTURE PERSPECTIVES IN BUSINESS INTELLIGENCE

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Some of the global companies leverage Business Intelligence (BI) trends daily in their strategies and operations, in order to improve their business. With a unique approach to the topic, this research helped to fill the existing literature gap by giving a comprehensive research on BI and its trends. Research succeeded to provide a descriptive analysis of BI trends and identified some of the future perspectives in Business Intelligence. The observation of multiple global-sized companies helped to understand the importance of data for large organizations, and also led to the creation of comparative analysis of BI trends showing exactly how specific companies leverage specific trends for the their benefit. The most prominent trend leveraged by large companies seems to be Big Data due to immense amounts of data available nowadays. Also evidently, with that amount of data, AI is becoming crucial and inevitable part of Business Intelligence. In conclusion, new technologies are developing daily and the advancements in that area have great impact on Business Intelligence and will continue to influence future perspectives of BI

trends. Further research should address new emerging trends and their challenges. In addition, further research on this topic is recommended, but should be adapted to companies of different sizes (small and/or medium).

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LIST OF ABBREVIATIONS

AA - Augmented Analytics

AI - Artificial Intelligence

AIM - Analytics & Information Management

ANE - Apple Neural Engine

AWS - Amazon Web Service

BDA - Big Data Analytics

BI - Business Intelligence

BIA - Business Intelligence and analytics

BIaaS - Business Intelligence-as-a-service

BT - British Telecommunications

CRM - Customer Relationship Management systems

DAQEI - Data Quality Efficiency Index

DQM - Data quality management

DSS - Decision support systems

GBS - Global Business Services

GIS - Geographic Information Systems

GRC - Governance, risk and compliance

HADOOP - High availability distributed Object oriented platform

IaaS - Infrastructure-as-a-service

IE - Information extraction

IoT - Internet of Thing

IT - Information technology

KM - Knowledge Management

KPIs - Key performance indicators

LLM – Large Language Models

MBI - Mobile Business Intelligence

MDSS - Mobile decision support system

MKS - Knowledge Management Systems

ML - Machine learning

MRM - Marketing Resource Management

NLP - Natural Language Processing

NLG - Natural Language Generating

NLU - Natural Language Understanding

OLAP - Online analytical processing

PaaS - Platform-as-a-service

RTBI - Real-time Business Intelligence

SaaS - Software-as-a-service

SMBs - Small and medium sized businesses

SMEs - Small and medium sized enterprises

SSBI - Self-service Business Intelligence

SSA - Self-service analytics

TSPP - Time Series Prediction Platform

UI - User interface

V-NLI - Visualization-oriented Natural Language Interface

WFH – Work from home

CHAPTER I:

INTRODUCTION

1.1 Introduction

Businesses depend heavily on data and how that data is managed, because nowadays data is considered to be company's most valuable resource. Companies utilize that resource to gain or maintain competitive advantage on the market and they do it with the help of Business Intelligence (BI). Studies had shown a direct impact of BI integration on modern organizations (Alnoukari and Hanano, 2017), so organizations realized that leveraging BI significantly affects the efficiency of their operations. It also enables organizations to better comprehend their business (Hurbean et al., 2023). Business Intelligence (BI) collects, stores and analyzes business data in order to support management and decision-making (Edirisinghe, 2022). Precisely this role has established BI as indispensable tool of every organization on their way to success. Recently, Business Intelligence has been defined as a discipline that combines business analytics, data mining, data visualization, data reporting, data tools, infrastructure and best practices to empower organizations to make more data-driven decisions (Gurcan et al., 2023). Some of the previously mentioned components of BI discipline are commonly known as BI trends. BI trends are considered to be tools, processes and applications that influence decision-making and are leveraged to create competitive advantage for businesses. Trends follow technological advancements and provide new solutions for achieving business goals, therefore it can be said that constant evolution of technology considerably impacts Business Intelligence. Many BI trends have emerged over the years, but this research is focused on specific ten trends that are leveraged by large size companies. Chosen ten trends are currently considered to be among top ten BI trends and serve as a great basis for future research. Furthermore, this research bridges the gap identified as lack of comprehensive research in the domain of BI and BI trends. The main goal is to show and explain comparative analysis of specifically chosen business intelligence trends that are observed through case studies and give a descriptive analysis on how these trends

are applied in global-size companies. Focusing on successful global companies and how they leverage specific BI trends, research provides practical examples and valuable knowledge to how trends impact businesses. Descriptive comparative analysis leads to introduction of the term Business Intelligence (BI) Trends Circle, while the overall research contributes to expansion of knowledge on BI trends and the ways they are leveraged. Future perspectives provide insights into the expected evolution of BI trends and open the doors to future research.

1.2 Research Problem

Business intelligence and its trends is broad topic that has been researched, but there are still certain gaps on this matter. For that reason the goal of this paper is to fill the void by providing unified descriptive analysis of BI trends, while at the same time the research goal is to identify future perspectives of BI. This research will give a comprehensive review on subject Business Intelligence and its trends.

After a literature review detected research gap shows a lack of comprehensive research on BI trends, as well as the predictive research on future perspectives in that domain. Both intended to be covered by the topic of proposed research.

1.3 Purpose of Research

This research will give a comprehensive review on Business Intelligence (BI) and its trends. Research goals of this paper are divided into two parts:

1) Provide unified descriptive analysis of Business Intelligence trends
2) Identify future perspectives of Business Intelligence

1.4 Significance of the Study

Even though a good number of BI research exist, this paper will focus on specific trends and make conclusions about future perspectives. It will provide comprehensive research on Business Intelligence and trends. Research of this kind has great potential in theory and in practical use, so for that reason this research will be useful to anyone reading it. Both academic and professional community can benefit from knowledge provided by this research.

Limitations regarding the matter can be identified in terms of advancement of technology that impacts the speed of trends changing, as well as the change of people workwise necessities.

CHAPTER II:

REVIEW OF LITERATURE

2.1 Theoretical Framework

Several definitions of Business Intelligence (BI) exist, but all of them identify it as a part of decision-making process. Edirisinghe (2022) considers it to be a decision-making support system, while Nylund (1999) claimed that term BI addressed all the decision support applications. In early 2000s, many different researches were made on topic of decision support systems, its tools and integration. Negash's (2004) research focused on importance of unstructured data and development of BI tools, while Hurbean's (2006) study approached BI from BI integration standpoint. A year later, Hedgebeth (2007) identified the importance of analytical methods usage in order to get valuable decision-making knowledge. Therefore, study indicated that BI tools, integration and the implementation of BI are key the elements of organizations success. For that matter, Alnoukari and Hanano (2017) study indicated a direct impact of BI integration on modern organizations. As a result, technology advancement led to changes in business world and inevitably and impacted the creation of BI trends. BI utilization created certain trends that follow the use of social networks, mobile devices, cloud and other (Vizgaityte and Skyrius, 2012). Time and access to information mainly dictate the era of these trends. The need for easy and immediate access to data, led to development of Real-time BI, Mobile BI applications and Self-service BI (Kabakchieva et al., 2013). All of the trends have their advantages and face similar or different challenges either during implementation process or in actual usage. For instance BI visualization, according to Bai et al. (2013), meets a great challenge when developing effective visualization due to complexity of business data and it's changing context. For that matter, data by itself needs to be accurate, as well as complete, valid etc. Otherwise, poor quality data can lead to negative impact on overall business operation (Debbarma et al., 2013). Another major concern of Business Intelligence regarding data is its safety. Business use Big Data trend

to collects, analyzes and stores large amounts of data for different purposes. Duggineni (2023) recent study points out a concern for that data safety and suggest implementation of several different security measures as a solution.

2.2 Literature review

Business Intelligence

Business intelligence is considered to be a decision-making support system. It is useful business tool in time of modern technology. The term Business Intelligence (BI) can be generally defined as computer-based techniques used to collect, store and analyze business data to support management and decision-making (Edirisinghe, 2022), although according to Nylund (1999) term Business Intelligence was being used to address all the decision support applications in 1989.

There are several similar definitions of BI. According to review study of BI concepts and approaches, Rouhani et al. (2012), identified BI as an umbrella concept for tools, techniques and solutions that help managers understand business situations. The result of the study showed classified and prioritized concepts and approaches of BI into managerial, technical and system enabled approach.

Research from the early 2000s points out the importance of decision support system, its tools and the integration. Negash (2004) claimed that BI systems combine operational data with analytical tools to present complex information to planners and decision makers and it is used to understand the capabilities available in the company. His research, guided by matrix of BI data types and data sources, helped conclude the importance of unstructured data and the need to develop BI tools for its acquisition, integration, analysis and delivery. Hurbean (2006) in her research on Business Intelligence: applications, trends and strategies had pointed out the essentials of Business intelligence in connection to ERP system, as well as the evolution of benefits of it’s implementation in the enterprise information system. Drawn conclusion from this research was that business success depends on the success of BI integration. Hedgebeth (2007) explored the

evolution of decision support systems (DSS) and their close relationship with the business intelligence arena. His findings had shown that use of BI applications aids a knowledge enterprise by using analytical methods to provide valuable decision-making knowledge to minimize costs and forecast market trends.

Except for tools and integration, constant improvement plays a critical role. In Bataweel (2015) thesis on Bi: evolution and future trends, it is explained how every organization moves along the evolutionary process and increases business value via information. In conclusion, time and tool improvement will demonstrate improvement of results in BI.

For all business organizations it is considered crucial to implement BI in their operations in order to maintain a competitive edge. Utilizing BI, organizations quickly recognize better decisions being made. Hence, improved decision-making by boosting the key value drivers (productivity, financial, risk and trust value) empowers the organizations (Loshin, 2012). Recognition of competitive edge is important for businesses.

Yu (2021) recently analyzed the basic contents, research tools and characteristics of business intelligence and business data analysis, and compared it to the data analysis. Yu's (2021) results show how BI and business data analysis can effectively analyze " what happened in the past, what will happen in the future and how to handle the next best business strategy"; while BI shows " what happened in the past, what will happen in the future and what the past handling strategy was". According to Yu (2021) the effective combination of the two is a key factor to enhance the competitiveness of enterprises, which provides tools to integrate information technology and implement and automated efficient decision making. Except for competitive edge, it is also crucial to understand relationship between decision makers and BI. Romero et al. (2021) explored business evolution in era after Industry 4.0 where companies require innovative strategies and are in need of rapid response in dynamic markets. They expected for industry 4.0 to primarily address BI in terms of decision-making. Their article contributed with knowledge on positive consequences of industry 4.0 and technology development on BI implementation. Recent study on the impact of BI and analytics (BI&A) on decision-making and work performance, explained the capability of BI&A to enable organizations

better comprehend their business (Hurbean et al., 2023). That helped with better understanding of the relationship mentioned previously. Not only that, Hurbean et al.'s (2023) research also provided a model on relationship between BI&A adoption and manager's decision-making effectiveness, as well as individual work performance.

For successful implementation of BI systems, certain factors need to be taken in consideration. Obeidat et al. (2015) explored several contemporary studies related to the future of BI and surrounding fields. They briefly and broadly explore BI while providing few stimulating and innovating theories and practices. Obeidat et al. (2015) research offered concluding inference about BI and how it is becoming prominent in diverse fields, but also noted that enterprises need to consider several factors when acquiring and implementing BI. Mositsa et al. (2023) presented and analyzed numerous modern BI frameworks and identified key components and properties of each, as well as advantages and disadvantages. They noted that many of the important components of the said BI frameworks overlap. Integration is identified to play a big role. Findings of Alnoukari and Hanano's (2017) study indicate a direct impact of integration of BI and corporate strategic management on modern and flexible organizations. It highlights the role of BI and its integration. It clarifies how it helps decision makers to implement their corporate strategies and gain competitive advantages by BI implementation. Kumar and Yadav (2018) studied the trends of BI systems for accounting in which they state that new system made use of information possible in a way best possible for companies business. Study concluded that by implementing BI companies are able to stay ahead of the competition and help businesses make exponential growth in profit.

Implementation has its own challenges. Azvine et al. (2005) claimed in their paper on real-time BI that analyzing data is essential to be done in real time. Study shows key challenges of implementation of current BI systems such as automated analytics, process automation and semantics-based information. They concluded that data analysis, soft computing and ontologies could contribute to realization of real-time BI. A year later, Azvine et al. (2006) shared issues and problems of current business intelligence systems and outline their vision of future real-time BI (RTBI) for the adaptive enterprise, because

to achieve set goals it is necessary to understand the requirements of RTBI. Their research presented a list of emerging technologies developed within the research program of British Telecommunications plc (BT), which could contribute to the realization of real-time BI. Real-time BI will be available to everyone in the enterprise and that technologies like intelligent data analysis, soft computing and ontologies will play a major role in the development of RTBI (Azvine et al., 2006). Ranjan (2009) defined concepts, components, techniques and benefits of BI. Due to data challenge created by large amounts of data, companies adopted BI tools and systems in order to create effective way of integration enterprise applications in real-time. Besides challenges, BI implementation has positive effects. Popovič et al. (2009) researched the impact of BI system maturity on information quality and shared how implementation of Bi positively affects information quality. Although the effect and explanatory power of BI system maturity is greater on media quality than on the content quality, Popovič et al. (2009) conclusion was that the implementation of BI systems would adequately address the problem in knowledge-intensive activities. Even though BI system implementation carries high costs for companies, Djerdjouri's (2020) paper on Data and BI systems for competitive advantage intended to closer introduce the importance of role BI plays in the survival of the firm in a competitive surrounding on the global map. Distinction was made between the implementation of BI technology in small and medium sized businesses (SMBs) and large organizations. Due to the complexity and high cost gap between the two was identified. However, now crucial role of Bi systems is realized and recognized the necessity of implementation in order of upping the company's performance and competitiveness.

Business Intelligence Trends

With advancement in technology, changes occurred in the businesses world. As a result, ways of utilizing BI with those improvements created certain trends. With the increase of emerging trends and patterns, it is safe to assume that the business intelligence realm is being reshaped. According to Vizgaityte and Skyrius (2012), as changes in technologies are happening, major BI trends follow the general direction: the influence of social networks, cloud, mobile devices, geographical data etc. In Murugesan and Karthikeyan (2006) study on BI market trends and growth in enterprise business, was stated that in digital economy every business run on data and number of business professionals have dealt with slow or untimely access to information which impacted their business decision making at the right time. Essentially, study pointed out that BI improved efficiency on both IT side and business side of the organization.

Up to that point in time, Panian (2012) identified six evolutionary stages in the field of Business Intelligence; the first one in which data mining emerged, the second one whish is characterized by OLAP techniques invention and implementation, third one when Balanced Scorecards methodology was developed, the forth stage in which proliferation of E-Business activities made it possible to implement efficient Web mining and Web analytics methods, the fifth one in which Business Dashboards shaped the face of BI, and finally the sixth stage when mobile technologies promoted Mobile and Location-based Intelligence. According to Vizgaityte and Skyrius (2012) current prevailing trends in business intelligence technologies and systems are MBI, location technologies, software-as-service, Big Data and Predictive Analytics. They believe as the market becomes more mature and merges / acquisitions occur, the human factor should be taken into account; only the high-usability and user-friendly solutions that follow human thinking patterns are meant to survive in the long run. Easy and fast access to information is recognized as key in the coming era of trends. Therefore, Kabakchieva et al. (2013) explored latest trends in BI system development where they recognized the need for easy and immediate access to data, at any place and at any time and how that led to development of Mobile BI applications, Real-time BI and Self-service BI. Kabakchieva et al. (2013) claimed that the

trends that will influence BI system development in the next years will be: Social BI, Cloud BI, Self-service BI, Mobile BI etc.

Edirisinghe (2022) wrote about Business Intelligence Trends and had made a review of Mobile Business Intelligence. It showed how early stages of Decision Support Systems (DDS) had evolved with the technological improvements and availability of massive amount of data. Study intended to present a review of mobile business intelligence (MBI) and it's benefits, challenges and limitations. Study concluded that the expectations of MBI increase with the changes in the business environment. Recent research from Gurcan et al. (2023) used modeling approach on BI strategies, best practices and latest trends to examine emerged significant patterns and trends in field of business intelligence over 20 years. As a result, study had identified 36 topics that reflect the field's research landscape and trends. Their study showed most innovative aspect in content analysis based on topic modeling in the BI field.

Mobile Bi

Homocianu's (2010) research on the mobile business intelligence challenge identified how many enterprises deal with difficulties when trying to consolidate decision-making data from multiple sources. Homocianu's (2010) concluded that it was that the boom in mobile BI may be an advantage when properly transmitted and absorbed by data warehousing and BI solutions which provide at least a report and analyze support.

Another difficulty was recognized by Stipic and Bronzin (2011), since at that time, majority of traditional BI solutions did not have any mobile components. Therefore, extraordinary market opportunity appeared due to significant demand for mobile BI solutions was already present and was increasing. It was expected Mobile BI applications era would expand and would become equal member of the most enterprise BI solutions.

Chan et al. (2013) explain Mobile BI as a mobile workforce that enables to utilization of handheld devices and access to real time analytics reports whenever and wherever the information in needed. In similar opinion, Chelong eand Pratomo (2016) claimed mobile platform for BI allows users to manage their performance from unrestricted locations which is intended to increase efficiency of their work and as such benefit them greatly. There are several definitions of MBI. According to Peters et al. (2014), the definition of Mobile BI refers to a system comprised of both technical and organizational elements that presents historical and/or real time information to it's user's for analysis on mobile devices such as smartphones and tablets. It also enables effective decision-making and management support for the overall purpose of increasing organizational performance (Peters et al., 2014). As every other trend, it has it's own advantages and disadvantages. Brockman et al. (2012) provided overview of user acceptance of Mobile BI services and managed to derive success factors for Mobile BI, which are considered key to a high user acceptance of Mobile BI applications. Peters (2013) believed biggest advantage of Mobile BI compared to BI is anytime and anywhere access to information with mobile devices, while the downside of mobile BI comes from possibility of users loosing their mobile devices, or same being stolen which can than create security issue. Another benefit of Mobile BI can be seen through time. Tona and Carlsson (2013) study on

Mobile BI showed that discourse has evolved from the emergence to the growth period, where the organizing vision is maturing and Mobile BI is found to be the ascendant phase of it's career path. Vision of Mobile BI is shaped by the self-service, power, control and collaboration. They concluded that reduction of decision time generated by Mobile BI would show benefit in better customer service. Mobile BI can improve decision-making of managers by enabling the reduction of cognitive biases, furthermore it also enables managers to quickly acquire factual information when they make decisions (Hou and Gao, 2018).

Self - service Bi

Imhoff and White (2011) discussed the trend of self-service business intelligence (SSBI) with the intention to describe the technological underpinning of four main objectives that organizations focus on while seeking BI implementation, but at the same time two opposing forces at work became apparent; the need for IT to control the creation of BI and the demand of employees for easy access to data without requiring IT help. They concluded that the companies seeking to implement Self-service BI must reach a middle ground in which information workers have free access to data, analytics and BI components while IT has oversight into the SSBI environment to observe its utilization.

In literature, several contributions to classify BI users can be distinguished. Sulaiman et al. (2013) provided two types of users in accordance to informative behavior:

1) Power-users or Information producers; users who generate information that can be used either for their own decision or for business users
2) Business-users or information consumers; main source of their information are provided to them by the power users

Several years later, other roles have been identified. Michalczyk et al. (2020) identified three different SSBI user roles: Casual Users; able to obtain access to information already created, Power Users; able to access and create new information, and finally IT Users; provide necessary infrastructure and are enablers for usage of systems. Traditional BI systems were good, but according to Lennerholt et al. (2018) research on implementation challenges of Self-service BI (SSBI), SSBI promises more benefits but many organizations fail to implement it. For that reason, they have managed to identify ten key challenges related to successful SSBI implementation.

Despite its importance, SSBI had suffered problems with adoption rates at the user level. In recent study, Guan (2021) explained how SSBI has emerged as a popular approach for organizations to empower business users and gain actionable insights from data faster and better. The correlation between trust in data and SSBI has been uncovered and concluded that trust in data influences SSBI adoption by business users (Guan, 2021).

Cloud Bi

Armbrust et al. (2010) predicted growth of cloud computing with the idea of computing, storage and networking being focused on horizontal scalability of virtualized resources rather than on single node performance. Cloud computing is characterized by its ability to consume resources as required in elastic manned and scale the consumption arbitrarily as required (Ouf and Nasr, 2011). Tole (2014) agreed that cloud computing is solution to overcome the problem of processing large amounts of data, as well as it provides company necessary tools to get in front of the competitors due to low cost of needed architecture, but it's downside lies privacy concerns. Cloud BI offers benefits greater than traditional BI. Several advantages have been recognized in those terms and it is believed that BI on the Cloud offers huge possibilities for removing barriers to decision making by integrating high volume and mission critical business processes (Gurjar and Rathore, 2013). According to Ananthi and T.A.Swetha (2015), response-time reduction and offering right resources to the authorized users is priority concept of Business Intelligence coupled with cloud computing.

Looking at Cloud BI from a different perspective, as a service, several can be recognized. Al-Aqrabi et al. (2019) claim cloud computing comprises three ways of provisioning services - Software-as-a-service (SaaS), platform-as-a-service (PaaS) and infrastructure-as-a-service (IaaS). In their research they conclude that Cloud is a big part of future BI and offers advantages in terms of cost efficiency, flexibility and scalability of implementation, reliability, and enhanced data sharing capabilities.

Di Sano (2014) proposed interesting idea. According to Di Sano (2014) Business Intelligence concept refers to the coordination of several different technology components and processes, such as OLAP servers, Data Warehouse and Data mining systems, Customer Relationship Management systems (CRM), Decision Support Systems (DSS), Geographic Information Systems (GIS) and Knowledge Management Systems (MKS), therefore Business-Intelligence-as-a-Service (BIaaS) idea has an aim to put them together and creating a structured middleware which orchestrates the cited services as they were a unique one and so making the data available for the final user. The potential

of BIaaS coincides with the trends in the digital society such as proliferation of Internet connectivity, globalization and big data (Gikandi and Njuguna, 2021). Therefore versatile BI tools can help SMEs with navigation through vast amounts of unstructured and structured data, as well as with adaptable and visualized output. Leveraging Cloud solutions can solves challenges and offers significant benefits to organizations.

AI Business Intelligence

Machine Learning (ML) and Artificial Intelligence (AI) are offering todays enterprises with a great range of trends and opportunities. Advancement in those areas can provide businesses valuable insights and advantages for decision-making. Jankovic and Curovic (2023) research delves into the role of strategic integration of AI concepts for sustainable businesses, claiming AI technologies enhance data management by enabling efficient data collection, analysis and utilization. Consequently, AI-driven data analytics improve decision-making processes. AI helps enhance BI. The use of machine learning and AI in BI allows organizations to process large volumes of data efficiently and also helps uncover hidden patterns and make accurate predictions (Bharadiya, 2023). Except for those, AI in Business Intelligence has shown other advantages. Azmi et al. (2023) described how AI can be able to complement BI by automating data processes, providing advanced analytics capabilities, enabling real-time insights and enhancing data visualization and with that help organizations gain a competitive advantage in the market. Zohuri and Moghaddam (2020) claim that by modeling human behaviors and thought-processes, AI programs can learn and make rational decisions, like for example Chatbots. Azmi et al. (2023) described Chatbot as an AI application that is designed to simulate human conversation through text or voice interaction that can be distinguished either as rule-based or AI-powered chatbots. When talking about AI it is important to consider ethical aspect. Ethical consideration in AI development and deployment are of utmost importance due to possibility of mitigating risks associated with biases, discrimination and unintended consequences by using transparent and interpretable AI models (Bharadiya, 2023).

In conclusion, artificial intelligence (AI) and Data Analytics have a transformative role in the realm of Bi and their synergy with BI. Findings highlight the shift from traditional data processing to AI-driven Predictive Analytics that enhance efficiency and accuracy of BI capabilities. Conclusively, research shows integration of AI and data analytics into BI is therefore fundamental, rather than transient (Farayola et al., 2023).

Big Data Analytics

Business Intelligence and Analytics (BIA) refers to all techniques, technologies, practices, systems, methodologies and applications that analyze critical business data to help enterprise better understand it's business and market and make timely business decisions (Chen et al., 2012). Although similar, Business Intelligence and Big Data analytics are not the same thing. Ukhalkar et al. (2020) research pointed that out. Research explained both terms are used to describe the practice of using big data to make better business decisions. In conclusion, both should be synchronized and need to be used more effectively for better decision-making. Certain studies show effects of Big Data analytics on effective decision-making. Wang et al. (2022) provided core concepts and descriptions of main applications, as well as addressed challenges on big data analytics. As a result, evolution of BI&A was traced to data-driven discovery. Also, study identified usage of advance analytical techniques with massive data sources for creative decision-making process.

Hiba et al. (2015) offered another definition of Big Data. According to them, Big Data analytics explores large amount of data to reveal hidden patterns and secret correlations. It is an important technological trend that needs to be implemented accurately. Research explained 5V's of Big Data characteristics. Research concludes that this trend has potential to enhance and transform organizations business models.

In their recent paper on Big Data Mehboob et al. (2022) talked about multifaceted characteristics (5V) of Big Data explaining how issues and challenges occur in data retrieving and manipulation due to those characteristics and versatility. They concluded that existing tools and algorithms are not capable of resolving these issues. Unlike them, Wani and Jabin (2018) summarize most relevant big data issues into three sections: management issues, storage issues and processing issues. Except for that, they addressed some of the most pertinent challenges that are believed to need immediate attention such as lack of big data professionals, interactivity, data loading and synchronization and visualization.

BI Visualization

Properly adopted Visualization improves the reception of necessary information, which consequently gives enterprises and their decision-makers solutions to easily find, understand and use needed information (Dudycz, 2010). To better understand it's application, Data Visualization needs to be defined. According to Simoff et al. (2008) data Visualization is a process of representing knowledge in an understandable way in order to enable more efficient decision-making. Information Visualization is a very close field to Data Visualization, so much in fact term is often used as a synonym to Data Visualization if data is used in more general sense (Zheng, 2017). According to him, Standalone visuals are more like applications than visualization. One segment of Standalone visuals is Dashboard. Few (2004) described the term "dashboard" as a visual display of the most important information needed to achieve one or more objectives; consolidated and arranged on a single screen so the information can be monitored at a glance. According to Zheng (2017) dashboard is a major standalone visual. He concluded Dashboards are sum of Data plus Visualization and user interface (UI). Dashboard is not the only tool. Visualization tools, such as stack charts, pie charts or word cloud, help with better understanding of BI system that can be used for querying, financial planning, forecasting and other (Desai et al. 2021).

Great example was provided from Wani and Jabin (2018). Their research express there is no doubt about it that online marketplaces (e.g.ebay) are using Big Data Visualization tools for transforming their large, complex data sets into picture formats to make all the data clearly understandable.

As every other BI trend, it has its advantages and challenges. Bai et al. (2013) point out that BI Visualization meets a great challenge when developing effective Visualization due to the difficulties while dealing with complex business data and evaluating and maintaining Visualization fit under changing contexts. Their proposed solution was to make Visualization context adaptive, as well as modifying BI systems in such way to enable decision makers to modify, enhance, integrate and transform visualization solutions.

Other difficulties that Visualization encounters due to vast volume and high magnitude of Big Data such as visual noise, information loss, high performance requirements (Ali et al., 2016). They concluded there is no single tool that can be the solution to these challenges, instead organization should choose them accordingly to their requirements.

Data Quality Management (DQM)

Data governance describes an evolutionary process for a company, altering the company's way of thinking and setting up the processes to handle information, so that it may give power and intelligence to the entire organization (Sarsfield, 2009). The basic definition of data quality encompasses some quality attributes which can act as key measures to decide whether data is complete, understandable, relevant, consistent, valid and accurate (Debbarma et al., 2013). Enterprises need Data Quality Management (DQM) that combines business-driven and technical perspectives to respond to strategic and operational challenges that demand high-quality corporate data (Wende, 2007). Quality of data greatly affects the quality of the decisions made by the organizations. According to Debbarma et al. (2013), poor quality data can have negative impact on overall business operation and costs. Sarsfield (2009) claims data governance guarantees that data can be trusted. It is a cornerstone that insures data accuracy necessary for making informed decisions. Making decisions on poor quality data can dramatically affect the strategy of the organization (Vasile and Mirela, 2008). Therefore, in order to increase the quality of data they proposed series of steps that should be followed, insisting on data validation as most important step. In order to better understand how good data quality impacts the usage of BI application, Hartl and Jacob (2016) divided DQM into eight separate data quality items. Conclusion drawn was that major challenges of data quality come from three items: non-traceable master data, lack of data consistency and non-transparent BI architecture. Barker (2016) agreed that data quality is the key to improve data challenges. He claims in order to achieve goals around data quality, companies need to have basic tools and give them to capable staff to overcome those challenges. Different approach was made by Bouchana and Idrissi (2015), as they approached the Data Quality Management from aspect of quality assessment of BI system, therefore it was concluded end-user satisfaction and data quality are effectively the most important factors in BI systems since they represent its particularity. Research showed interesting result scheme in which it was obvious how the two factors overlap in importance of timeliness and accuracy.

Predictive Analytics

Predictive Analytics is a component of business intelligence (Halladay, 2013). According to him, members of the finance industry consider the use of Predictive Analytics to be a competitive advantage due to the benefits it provides such as: cost reduction, efficiency, better risk identification etc. As organizations grow, there is an overwhelming need to analyze historical business data in order to predict future trend and business forecasting (Obeidat et al., 2015). Predictive Analytics help analyze change and foresee potential market change early on. Organizations use Predictive Analytics from predictive marketing and data mining to applying machine learning (ML) and artificial intelligence (AI) algorithms to optimize business processes and uncover new patterns, simply explained, Predictive Analytics is practical result of Big Data and BI (Ongsulee et al., 2018). It can be said that predictions are considered forward-looking. According to Aziz (2014) predictive analysis is going to help business to make decisions based on facts rather than judgments and interpretations as business seeks forward-looking rather than backward looking. But backward looking is also necessary and useful. Bharadiya (2023) claims machine learning algorithms utilize historical data and identify patterns and trends, therefore enable businesses to make accurate predictions about the future in order to optimize operations and mitigate risks.

Kumar and Garg (2018) devised and explained a model showing six-steps process of Predictive Analytics through which a data analyst can predict the future based on current and historical data:

1) Requirement collection
2) Data collection
3) Data analysis and massaging
4) Statistics, machine learning
5) Predictive modeling
6) Predictions & monitoring

Chen et al. (2022) recent study on Big Data and Predictive Analytics for BI had explored current studies, historic developing trends and future directions. Their findings showed that big data and AI-based methods for BI are one of the most popular research topics. Big data and AI approaches should be paid more attention because without a high level of interpretability, transparency and accuracy AI prediction algorithms may cause huge economic loss (Chen et al., 2022).

Data Security

Individual issues, governance, risk management and compliance (GRC) have always been fundamental concerns of business and its leaders (Racz et al. 2010). To govern data securely, three key areas are important; data privacy, governance, risk and compliance (GRC) and access controls (Barker, 2016). In the era of Big Data, security and privacy issues grow daily. Zhang (2018) analyzed the security problems of big data and proposed several potential solutions for successful data security and privacy protection through fully supervised data information in social networks, improvement of privacy protection legal mechanism and establishing privacy protection agency. Internet of Thing (IoT) is broadly used in Business Intelligence. Security issues of IoT are a biggest concern in managing and maintaining business data because organizational data can be in danger due to potential threats, loss of data and data manipulation, as well as IoT being dependent on the internet, therefore chances of data attacks are high (Kagita, 2019). It can be discussed how much attention has been given to big data collection versus security of that same data. Gahi et al. (2016) claim too much focus is put on advantages of Big Data, but too little on its security and privacy protection because it is believed that Big Data analytics treat all data with the same priority without assigning special attention to sensitive data. In order to deny any malicious party from getting access, they suggest data encryption, authentication and anonymization as solutions. In order to reach high level of data security certain security measures should be taken. Recent research shows ensuring data security and privacy is critical concern when accessing data from various sources, therefore robust authentication and authorization mechanisms are necessary (Duggineni, 2023).

Natural Language Processing (NLP)

The beginning of Natural Language Processing (NLP) can be traced back to early 2000s, because Maynard et al. (2007) believe information extraction (IE) is a key NLP technology that automatically extracts specific types of information from text to create records in a database. Bahja (2020) explained NLP history and evolution through the years dividing it into 6 stages: from beginning of NLP in 1950s with the Turing test for creation of intelligence, all up to today. In essence, Computational Linguistics, also known as Natural Language Processing (NLP), combines computer's ability to process volumes of text at high speed and human's ability to understand natural language, spellings and contextual meanings (Gupta and Narang, 2012). Nowadays, NLP is considered part of AI. AI techniques such as NLP and computer vision are used to extract information from unstructured data sources such as text documents, images and videos (Bharadiya, 2023). Researches show great benefits of NLP. Bahja (2020) recent study concluded that complex processes in commerce, analyzing large volume of data in E-governance, simplification of customer interaction are some of the benefits that NLP techniques can engender. Mah et al. (2022) explained another benefit describing how companies with the help of NLP and AI with support from IoTs, can target their customers before initiating the product test phase in order to predetermine their product's needs and better understand how customers think. Aziz (2014) research confirmed that by explaining how social media analytics use advanced NLP to read, analyze and normalize data by extracting customer's perception from terabytes of social media data in real-time and conclude deeper insights about customer opinions and emotions. As NLP applications grow daily, so do the challenges. In their recent study Khurana et al. (2023) identified misspelling words, informal phrases, irony and sarcasm to be some of the really big challenges for NLP encounters.

2.3 Summary

Business Intelligence (BI) is focused on data collection and serves as a tool in a decision-making process. When looked at as a process, BI collects data and information from open sources which later become knowledge. It is also regarded as a Decision Support System (DSS). Business Intelligence is directed at information upon which organizations can anticipate future development, that way it shows its supportive role in the process. In order to achieve successful results, BI tools, integration and implementation are considered to be equally important. Apart from tools, integration and implementation, key element for better results in Business Intelligence in constant improvement. It helps businesses gain competitive edge. To be able to gain that competitive edge, it is important to understand relationship between the decision makers and BI. Research indicates direct impact of BI integration on modern organizations due to its effect on strategic management. Implementation of BI system is crucial, but it is also challenging for several reasons. One of them is high cost. Even so, the necessity of implementation is recognized in order to get better organization performance and results. Advancement in technology brought changes into the business world. Development of Business Intelligence trends follows the development of social media, mobile devices, cloud etc. Today's combination of modern technology and access to information influenced the creation of many Business Intelligence trends, as time and easy access are the two main pillars in this era of trends. Although organizations face different challenges when implementing BI trends, the advantages and benefits from them show great positive impact on performance. For instance, Mobile Business Intelligence trend's biggest advantage over traditional BI is anytime and anywhere access to information using mobile devices but possibility of losing mobile device or same being stolen can create security issue. Mobility is enabled via Cloud. Cloud computing processes large amount of data with out the need for high cost infrastructure. It provides quick information to only authorized users. Self-service BI, besides time and access to information, also provides user-friendly analytical tools that allows practically everyone within the organization to reach, use and explain / report collected data. This trend has emerged as a popular approach for organizations to

empower users and gain insights faster, but main influence on SSBI adoption by users is trust in data. Data governance is cornerstone that insures data accuracy, which is necessary to make informed decisions. Otherwise it can create security vulnerabilities, lead to misinformed decisions that consequently result in poor organizational management. Therefore, Data Quality Management (DQM) is necessary for organizations that combine technical and business-driven perspectives as an answer to challenges that demand high-quality corporate data. Although similar, Big Data analytics and Business Intelligence are not the same thing. Big Data analytics influences effective decision-making process, but its implementation is challenging for organizations because of potential issues such as management, storage, processing and visualization of data. Value of Business Intelligence trend Data Visualization lies in translating large and complex sets of data into easily understandable information using tools such as dashboards, charts or word clouds. Organizations use BI in such a way to predict the future of their business based on well-informed decisions. Predictive Analytics is a part of risk management, helps by analyzing changes and foreseeing potential market changes early on by analyzing consumer behavior. To get deeper insight about the customers, Natural Language Processing (NLP) combines processing high volume of text at high speed and human ability to understand natural language. Challenges of this BI trend arise with computers ability to completely understand all parts of natural language such as irony or sarcasm. NLP is considered to be a part of Artificial Intelligence (AI). Machine learning (ML) and AI are present in great range of trends. AI helps enhance traditional BI by automating data processes, uncovering hidden patterns, providing advanced analytics and by enhancing visualization. AI as a Business Intelligence trend is peculiar because of its ethical aspect. In this era of Big Data, privacy issues grow every day, so for organizations and users, data security is at utmost importance. Therefore, Data Security trend suggests high levels of authentications and authorization mechanisms, data encryption and other measures to govern data securely.

CHAPTER III:

METHODOLOGY

3.1 Overview of the Research Problem

Business Intelligence and its trends is broad topic that has been researched, but there are still certain gaps on this matter. For that reason, goal of this paper is to fill the void by providing unified descriptive analysis of BI trends, while at the same time, research goal is to identify future prospects of BI. This research will give a comprehensive review on subject Business Intelligence and its trends.

After a literature review, detected research gap shows a lack of comprehensive research on BI trends, as well as predictive research on future perspectives in that domain. Both are intended to be covered by the topic of proposed research.

3.2 Research Purpose

This research will give a comprehensive review on subject Business Intelligence (BI) and its trends. Research goals of this paper has been divided into two:

1) Provide unified descriptive analysis of Business Intelligence trends
2) Identify future perspectives of Business Intelligence

3.3 Research Design and sample

a) Comparative qualitative analysis of following case studies according to unified criteria (description, application, advantages):

- Mobile BI
- Self-service BI
- Cloud
- Artificial intelligence (AI)

- Big Data analytics
- Bi Visualization
- Data Quality Management (DQM)
- Predictive Analytics
- Data Security
- Natural Language Processing

b) Future perspectives were based on literature review and acquired knowledge on the topic.

3.4 Case study Selection

a) Trends:

Ten Business Intelligence trends observed in this research have been chosen because they are considered to be top ten BI trends. Another reason is that these specific ten trends have good possibility of influencing future perspectives of BI trends by evolving on their own or merging with others trends.

b) Companies:

The following companies have been chosen because they are some of the world's most successful companies and they operate globally:

- Deloitte – created in 1845 year and employing around 457.000 people, is one of the Big Four companies that own the market on audit, tax and advisory services.
- EY – created in 1989 year and employing around 395.442 people, is another one of the Big Four companies that own the market on audit, tax and advisory services.

- KPMG – created in 1987 year and employing around 273.424 people, is third of the four Big Four companies that own the market on audit, tax and advisory services.
- PwC – created in 1998 year and employing around 364.000 people, is last of the Big Four companies that own the market on audit, tax and advisory services.
- Microsoft – created in 1975 year and employing around 221.000 people, is a multinational technology company.
- Amazon – created in 1994 year and employing around 1,525.000 people, is also multinational technology company.
- Nvidia – created in 1993 year and employing around 29.126 people, is another one of multinational technology companies.
- Saudi Aramco – created in 1933 year and employing around +73.000 people, is world's largest oil and natural gas company.
- Eli Lilly – created in 1876 year and employing around 43.000 people, is a pharmaceutical company.
- Visa – created in 1958 year and employing around 28.800 people, is a multinational payment card services company.
- Apple – created in 1839 year and employing around 161.000 people, is also a multinational technology company.
- Berkshire Hathaway – created in 1976 year and employing around 396.500 people, is a multinational holding company.
- TSMC – created in 1987 year and employing around 74.478 people, is a semiconductor manufacturing and design company.

Previously provided unified description of selected companies is based on following perimeters:

- Year the company was founded
- Size of the company shown in number of employees in 2023 year
- Sector the company operates in

For purpose of quality comparative analysis, the companies have been grouped according to the sector they operate in.

3.6 Data collection procedures

Data collection includes open-source data collected from review articles, original scientific articles, policies, official company websites and newspaper articles (based on professional sources).

3.8 Data Analysis

Case studies will be processed with the help of qualitative analysis giving each of them

a) Description
b) Application
c) Advantages

3.9 Research Design Limitations

Research included data collected only from the open sources, therefore one of the limitations of this research lies in the number of scientific papers that were unavailable due to source. Another limitation was unfamiliar languages some articles were written in and because of that they could not be included in this research. Also, research was limited to large size companies only and limited the research to 13 companies and only 10 trends.

3.10 Conclusion

Business Intelligence (BI) is an important part of every sucessful company's business strategy. There are many BI trends and they used to be implemented and leveraged separatly depending on company's needs and capabilities, but nowadays trends are put together as solutions in different applications (platforms). Some companies develop platforms on their own, while others outsource solutions, but all leverage BI trends in order to facilitate work, cut costs, improve efficiency and maintain company's competitive advantage.

CHAPTER IV:

RESULTS AND DISCUSSION

4.1 Case study: Mobile BI

Mobile Business intelligence is a system that is comprised of both technical and organizational elements that present historical and/or real-time information to its users for analysis on mobile devices such as smartphones and tablets (Peters et al., 2014). Mobile BI system is an application of business intelligence on mobile devices that offers similar functionality as traditional BI, but claim it is not just a replica of desktop interface on mobile devices (Dubravac and Bevanda, 2015). Mobile Business Intelligence is also referred to as type of enterprise-wide Mobile Decision Support System (MDSS) (Hou and Gao, 2018), although Haralayya (2021) describes Mobile BI trend as one of the biggest disruptive threats to legacy businesses such as big financial institutions and card companies.

Mobile BI facilitates effective decision-making and enables management support with the goal of increased company performance. It provides organizations business agility and might generate competitive advantage to a business, as well as create obvious difference between two seemingly equal competitors (Homocianu, 2010). Its capabilities enable the mobile workforce to gain business insights through information analysis using applications optimized for mobile devices (Verkooij and Spruit, 2013). The Mobile BI system provides users with necessary information and content, regardless of their location and time, in order to gain business insights through information analysis using applications optimized for mobile devices (Dubravac and Bevanda, 2015). Often Mobile BI features are similar to the capabilities offered by traditional BI, but are displayed on mobile devices. Application programing interface (API) is a cornerstone of software ecosystem (Andreo and Bosh, 2019) and very important for Mobile Business Intelligence because it drives innovation and helps app developers build application with different features that meet the users needs.

According to Chelong and Pratomo (2016) Mobile BI platform allows users to manage performance from unrestricted locations, therefore increase efficiency of work. Homocianu (2010) gave an example of how it is used in order to track Key Performance Indicators (KPIs), than push reports about it to the executives who are therefore able to respond to critical issues faster. It is interesting that according to Watson (2015), some companies implemented Mobile BI early as in year 2008 and their executives and regional sales directors used it for sales reporting with purpose of operational efficiency and effectiveness improvement and customer service enhancement.

Several other advantages of leveraging Mobile BI have been recognized. It shortens reaction time of executives (Homocianu, 2010) and improves access capabilities, lowers costs, increases accuracy and productivity (Verkooij and Spruit, 2013). Matoza Jr et al. (2021) shared the expectations of mobile BI implementation to be getting insights such as transactional data, Visualizations, product inventory and reports. Observing the overall impact of Mobile BI on business, its greatest capability is the ability to enable users insights at any time and in any place.

In the following part of the text, a practical example of Mobile BI trend is described more comprehensively.

Ex. 1: Deloitte

Deloitte (2024a) uses a Mobile BI tool called Roambi, which provides high-level historical view of performance of business using dashboards.

Ex. 2: KPMG

KPMG (2024a) created a BI platform called LINK Go that supports organizations by combining a broad range of mobility needs in one tool, thus giving organizations precious time to focus on strategic objectives. This tool helps efficiently coordinate global mobility program for businesses, allowing organizations to coordinate, track and monitor processes, as well as generate and store documents, while at the same time assess risk (KMPG, 2024a). Potential benefits from leveraging LINK GO are digitization and automation of processes, increase in speed and quality while decrease in cost, scalability and data security (KMPG, 2024a).

Another KPMG (2024b) Mobile BI platform called Clara. Platform is used for auditing and it enables users real-time access to audit information and reports, while it also allows collaboration and is globally consistent.

Ex. 3: PwC

In regards to managing a supply chain, PwC (2024a) has created a BI tool called SCOOP that helps organizations get and manage critical information in real time and is also used to predict the potential impact of future design supply chain.

In year 2019, PwC helped large company SSGIL implement a comprehensive BI solution in form of Orcale E-Business Suite in order to build an enterprise-wide BI system that would unify and invigorate that company. While supporting SSGIL in their quest for unified, digitalized and centralized company business information, PwC's (2019) integration of data from several systems served as backbone of a comprehensive MIS solution. After the support of PwC (2019) with the implementation of new BI solution, SSGIL's executives were able to have a clear enterprise-wide view of operations and their KPI's.

Ex. 4: EY

EY Strategy Edge is business intelligence platform that generates actionable insights from broad data sources to give answers on most strategic questions (EY, 2024a).

EY Strategy Edge helps make better decisions regarding capital strategies by identifying opportunities and risks with help of advanced analytics applied to different data sources (EY, 2024a).

Ex. 5: Microsoft

Power BI Mobile is the mobile version of Microsoft's Business intelligence platform that allows users to connect to their data and monitor business from phone or tablet by Power BI Mobile apps (Microsoft, 2024). It is used to securely access, view, share and interact with the data anywhere and anytime (Microsoft's, 2024)

According to DataScientest (2024) Power BI Mobile apps enable users to connect to data, extract actionable information, collaborate remotely and receive notifications of changes. DataScientest (2024) further explained how Power BI Mobile apps allow quick view and navigation between different Power BI reports and dashboards using tabs, as well as interaction with reports using different visuals or filtering data.

Platform offers many useful features for consuming and sharing data easily, such as: annotations, alerts on dashboards, interaction with reports and notifications (DataScientest, 2024).

Ex. 6: Amazon

One of the key components of Amazon Web Service (AWS) mobile analytics is Amazon Pinpoint (CloudDefense.AI, 2024). Amazon Pinpoint offers rich analytics related to the performance of business engagement efforts using metrics that allow quick understanding of historical trends and identify areas of improvement (AMAZON, 2024b).

This service can be viewed as a business tool that helps businesses understand user behavior, app performance and track metrics necessary to measure Key Performance Indicators (KPIs). It's powerful application analytics, cost-effectiveness, reliability and its global reach creates business benefits (AMAZON, 2024a).

Ex. 7: Nvidia

NVIDIA NeMo™ is an end-to-end platform for building and customizing enterprise-grade generative AI models that can be deployed anywhere. Platform leverages cloud and data centers to allow enterprises connect to their data in real-time (NVIDIA, 2024a).

Part of this platform is also NeMo Retriever, a collection of micro services enabling semantic search of enterprise data to deliver highly accurate responses using retrieval augmentation (NVIDIA, 2024b). NeMo Retriever lets organizations make better use of their data and generates insights in real-time by including world-class information retrieval with lowest latency, highest throughput and maximum data privacy (NVIDIA, 2024a). It also enables organizations to seamlessly connect to diverse business data, as well as it generates business insights in real-time and delivers highly accurate responses (NVIDIA, 2024a).

Ex. 8: Saudi Aramco

According to Hatlani (2021), the Aramco's Mobility Center is an example of successful dovetailing of the best people with the best technology. The Aramco Mobility Center, as a digital technology that the company uses, gives company an opportunity to manage and control all assets more efficiently, giving the decision makers real-time information across various operations at the right time (Houston, 2021).

This largest energy company in the world with over 70,000 employees across the globe, thought about employee experience (EX) with the goal of unifying all its digital and digitalized content into one central platform, therefore Aramco launched Aramco LIFE mobile app and web experience in 2021 (Lara, 2024). According to Lara (2024), the company knew it wanted to create a solution to help keep its employees informed and that the solution had to be first and foremost mobile, easy to use, flexible and accommodating for wide variety of content. Managers at Aramco use Aramco LIFE as a form of mobile business intelligence. Aramco integrates data on various forms of transportation companywide through AI and cutting-edge technology and the state-of-the-art facility delivers all available information to the decision makers at the right time (Houston, 2021). So in summary, Aramco LIFE and specifically capabilities like the Mobility Center, serve as a powerful mobile business intelligence tool for Aramco's managers to optimize operations by leveraging real-time data from across the enterprise.

Ex. 9: Eli Lilly

Eli Lilly's platform, MagnolAI, was developed in order to deal with large amounts of digital biomarker data being collected, as well as to perform real-time monitoring and result analysis (Singh, 2023). According to Carter (2023), MagnolAI is engineered to turn data into intelligence and allows view of data at scales and also delivers digital data at full spectrum to analysis environment anywhere and anytime. Platform's real-time data monitoring tool has enabled Eli Lilly to promptly track big data quality and compliance of their clinical trials (Singh, 2023). When mentioning clinical trials, Proof Pilot is a great example of MagnolAI's utilization. The leading provider of innovative clinical trial automation had collaborated with Eli Lilly's MagnolAi and as a result enabled any researcher to get access to a comprehensive and actionable analysis and evidence-based decision-making (PRNewswire, 2023). Carter (2023)

stated that as the platform will be utilized in more clinical trials, MagnolAI will help the company get better insights for quicker medicine development.

Ex. 10: VISA

Visa (2024) makes an increasing portion of their capabilities available as API's via their Visa Developer platform that gives direct access to a growing number of APIs tools. Part of that platform is Visa (2024b) Developer solution. This solution is integrated with standalone application, as well as with API, therefore allowing it to be available on mobile phones quickly and safely.

Ex. 11: Apple

Apple engineers and researchers collaborated in order to create software and hardware integrated across its devices, therefore improved user experiences while protecting their data (V Noushad, 2023). Software is called iOS, while their hardware is iphone, ipad, iwatch etc. Apple inc. created and developed the iOS, multiplatform operating system (OS) for its iPhone that also formerly supported the company's iPad and iPod (Volle, 2024). These technological inventions from Apple have narrowed the gap between two ends of the market in such manner that results became equally beneficial for customers and businesses (V Noushad, 2023).

Ex. 12: Berkshire Hathaway

Berkshire Hathaway is an American holding company that owns dozens of companies across various sectors whose managers are allowed considerable autonomy of their subsidiaries (Montevirgen, 2024). In order to gain better control over their data, one Berkshire Hathaway subsidiary company, integrated Casepoint's platform called eDiscovery. This centralized technology solution allowed data to be collected,

processed, reviewed, analyzed and enable them to cut costs so efficiently that they ultimately won an award for managing costs and generation high return on investment (Magness, 2024).

Ex. 13: TSMC

TSMC's (2024) sophisticated, agile and intelligent operating system drives the company's manufacturing excellence and the end result is real-time information analysis, improved forecast capability, maximum cost effectiveness and accelerated innovation.

4.2 Case study: Self-service BI

Self-service analytics is an easy-to-use BI tool that enables handling business data and generation of reports without help. Although there are some correlation between Self-service Business Intelligence (SSBI) and automated data storytelling, Kaur (2024) made a clear distinction between them. He explained how both differ in level of automation and the degree of human involvement required and is used for independent data discovery, but automated data storytelling will augment Self-service analytics.

The concept of Self-service Business Intelligence was created in order to solve the problem of high financial cost of BI implementation, while allowing casual users to access BI resources through software without having to involve IT departments and BI specialists (Silva, 2020). Bhat's (2020) research confirmed the reason for companies moving towards adoption of Self-service analytic BI tools was due to increased cost factors. According to her, SS BI is a development in "Big Data technology" that allows present business opportunities, without requiring them to have background in statistics, analytic or technology.

Expanding the definition, it can be said that Self-service Analytics (SSA) is an element in the Business Intelligence (BI) sector that aids workers in generating reports and acquiring information on their own and guarantees the workers a chance to access the enterprise-related data remotely to enhance the quality of the decisions regarding the projects (Dash and Ansari, 2022).

Except for different theories on what SSBI is, research also showed different titles for SSBI users. What Silva (2020) referred to as IT department and BI specialists, Michalczyk et al. (2020) addressed them as causal and power users, while Lennerholt et al. (2021) called them technical or non-technical users.

Lennerholt et al. (2021) described SSBI as a tool that allows non-technical users to use Business Intelligence in a self-reliant manner without the support of technical users. Michalczyk et al., (2020) viewed it as an upcoming approach and a trend that enables casual business users to prepare and analyze data with easy-to-use Business Intelligence

and Analytics (BIA) systems without being reliant on expert support or power users to perform their (complex) analytical tasks easier and faster than before.
But in the end no matter the difference in the their titles, Self-service analytics is used to empower business users and gain actionable insight from data faster and better, therefore Self-service Business intelligence (SSBI) has emerged as a popular approach for organizations (Guan, 2021).

In the following part of the text, a practical example of Self-service BI trend is described more comprehensively.

Ex. 1: Deloitte

The company Deloitte has an intuitive and easy to use Business Intelligence tool called Roambi. This BI tool allows users quick access to important business information. Users are able not only to view, but also interact with their data with easy setup, therefore it can be a compelling way for users to create and present reports (Deloitte, 2024a). According to the company, Roambi helps speed up the retrieval of important information.

Ex. 2: KPMG

KPMG (2024b) believes that the ability to access necessary data 24/7 enhances productivity. The company has a business platform called Link Go. This platform is designed to provide flexible user experience for easy-to-use intuitive operations worldwide with data stored centrally so can be reached any time. Another significant KPMG's (2024d) platform is GBS (Global Business Services) platform, which enables and encourages the use of self-service to work on complex cross-functional workflows.

Ex. 3: PwC

PwC's (2024f) Employee Service Platform is an example of how the company applies Self-service analytics by enabling their workforce to find and access any information they need. Utilizing this platform, PwC (2024f) employees have access to different self-service tools such as Chatbots, Knowledge Base and Case Submission enabling them a cohesive analytics. The company benefits from Employee Service Platform by enhancing productivity and efficiency doe to ability of employees to solve issues without any assistance.

Ex. 4: EY

Two platforms are especially important to mention in regards to this case study and they are: Strategy Edge Platform and Intelligent Data Platform. EY's (2024f) Intelligent Data Platform, powered by Microsoft technologies, is an example of easy, self-service analytic solution with capabilities that allow organization to leverage the power of intelligent data. Benefits of this platform can be recognized in flexible and Self-service analytics layer offering customizable data governance and reports (EY, 2024f). According to Qui et al. (2022), EY's Strategy Edge Platform increases project efficiency with self-service analytics.

Ex. 5: Microsoft

Hashemi-Pour et al. (2024) described Microsoft's Power BI as a self-service tool that brings data analytics to employees. According to them this platform is used by technical and non-technical business users who are provided with tools to aggregate, analyze, visualize and share data. Hashemi-Pour et al. (2024) identified advantages of Microsoft's Power BI platform to be affordability, usability, as well as customization and interactivity.

On the other hand, Microsoft (2024b) described their platform as wide range of services provided both to power users and experts with equally efficient depending on the needs, whether is to create business reports or to monitor operational progress (Microsoft, 2024b).

Ex. 6: Amazon

The company Amazon designed a platform called QuickSight. It allows users to create data visualization reports irrespective of their location (Patel, 2023). Part of this platform is also known as "Q". Amazon (2024d). Q makes it straightforward for everyone to confidently understand data better due to the fact users can self-service meaningful insights with ease. In other words, Amazon's Q is used to facilitate self-service business analytics (Amazon, 2024f).

Ex. 7: Nvidia

Nvidia's (2024c) AI Enterprise standards-based and containerized micro-services are certified to run on the cloud, enabling work from anywhere.

Ex. 8: Saudi Aramco

Aramco's digital solution, such as Citizen Developer project, ensures that every digital solution both dives value and fulfills a significant business need (Gray, 2022). Differentiation of company employees and their data access provides Aramco with a way of gathering data insights on type of content that resonates with the employees and external audience (Lara, 2024). Aramco's platform LIFE differentiates company employees from external or public and distinguishes users by their email logins. According to Lara (2024), user type determines the functionality and what the user can see, with employees having more access to certain areas and restricting certain

access to external users. In Lara's (2024) interview, Samad, the Head of Aramco's Web Group explained how that is a critical feature for improving the awareness of the brand and its overall reputation.

Ex. 9: Eli Lilly

Salesforce platform is considered to be the cornerstone of Eli Lilly's company's Knowledge Management (KM). The company was customizing that platform to fit their needs for KM with the vision in mind to always keep the person / user at the center of it (Haydar, 2017). Furthermore, the company incorporated different types of users during the customizations of the process and decided to divide them to formal and informal users. According to Haydar (2017), this decision directly impacted system improvements.

Eli Lilly is a global company and therefore during the period of global pandemic, the company realized a need for certain change. So, at the time of the pandemic the company switched to WFH model and through training they encouraged employees to have heightened sense of security while working online (Harper, 2020). In order to ensure continuous smooth business operations, for instance in India, company had to sent devices to enable WFH model of work (Harper, 2020).

Except for Salesforce platform, the company found other way to empower their users. Eli Lilly's MagnolAi platform proved to have certain advantages when it comes to SSBI. According to Singh (2023), this platform empowers users by helping them master some unique analysis-driven abilities.

Ex. 10: Visa

The company leverages Analytics Platform, self-service analytics solution used to get key insights on payments intelligence. This type of solution is beneficial for all company users, from data analysts to managers and executives.

Because the platform provides easy-to-understand KPI dashboards accessible to all users, even for non-analytics experts and helps make data-driven decisions more quickly (Visa, 2024c).

Ex. 11: Apple

Not enough verified and reliable data available.

Ex. 12: Berkshire Hathaway

One of Berkshire Hathaway's project goals was to centralize data repository to achieve wished level of self-management. Berkshire Hathaway's subsidiary company, Dairy Queen is a great example of how data centralization has helped with Self-service Business Intelligence. In order to manage the technical environment in their own way, company leveraged Casepoint platform as a solution for self-management issue (Magness, 2024). Its centralized system to consolidate information accessible by employees and managers to enabled quick and accurate reporting for strategic decision-making and improved operational efficiencies of both employees and managers (Mullenbach, 2024).

Ex. 13: TSMC

Not enough verified and reliable data available.

4.3 Case study: Cloud

Cloud computing has become one of the revolutionary technologies over the recent years and is conceptualized in three forms – software-as-a-service (SaaS), platform-as-a-service (PaaS) and infrastructure-as-a-service (IaaS) (Al-Aqrabi et al., 2019). Cloud computing means using various services like software developments platforms, storage, software and servers over the internet, rather than a local server with technologies that provide users an agile way to access business intelligence applications (Aslan et al., 2021). It is an efficient way of providing computing resources and it is a form of outsourcing, such as data storage and processing (Bailon et al., 2021). According to Alnoukari's (2022) definition, Cloud computing is the result of evolutions of distributed computing technologies that are enabled by advances in fast and low-cost network, commoditized faster hardware, practical high performance virtualization technologies and maturing interactive web technologies.

The technology of Cloud computing allows multiple clouds to be used from different vendors without platform complexity.

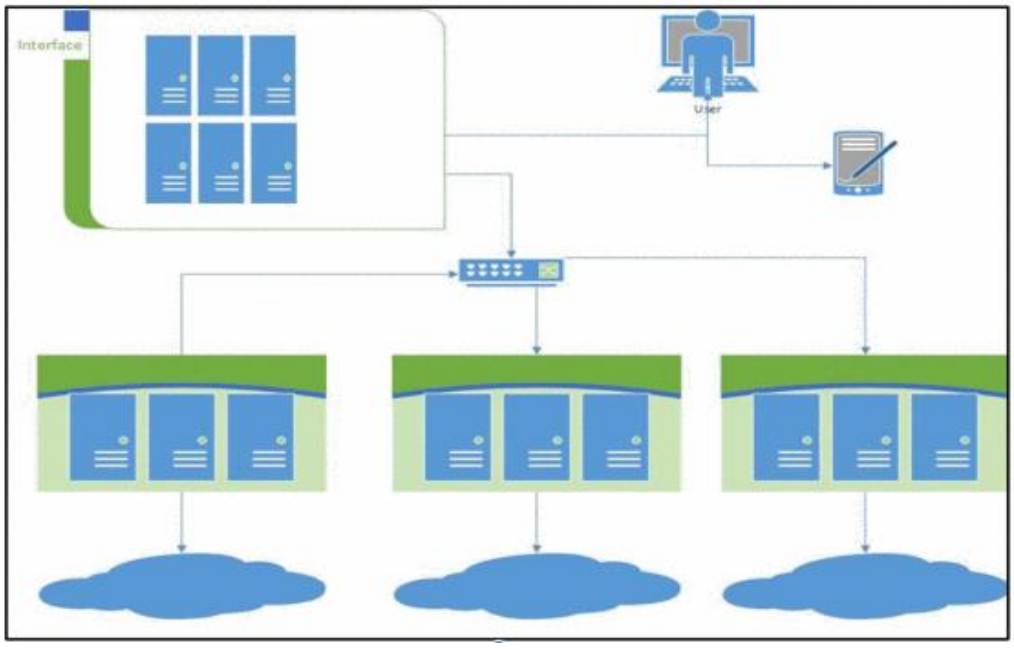

Figure 1: Multi-cloud technology abstract view (Imran et al., 2020)

Imran et al. (2020) defined Multi-cloud computing as the usage of autonomous cloud platforms with one interface, which may clue to different administrative and implementation domains. Similar interpretation was offered by Iqbal et al. (2022), saying that Multi-cloud is a combination of two or more distinct cloud computing services from various cloud vendors that can be all-private, all-public or mixture of both which enterprises use to spread assets in computation, reduce risk of data interruption and destruction, as well as for the improvement of computing storage and processing. Dornala (2023) explained how the Multi-cloud load balancing strategy aims to optimize resource utilization and performance by distributing data processing tasks across multiple cloud service providers, allowing dynamic workload allocation. According to him, load balancing is an essential aspect of Cloud computing that helps to optimize resource utilization, improve performance and ensure the high availability of apps and services. Cloud computing offers the elasticity to satisfy the demands of performing analytics on big data to gain timely insight and drive decisions, but relying on single public cloud provider has its drawback, therefore adopting a Multi-cloud strategy is imperative for robust Big Data analytics (Abdel-Rahman and Younis, 2022). Except for the cloud, edge computing is important for company performance. Edge and Cloud Computing combination is precious in various industries and applications, for example, edge computing can handle real-time sensor data processing in autonomous vehicles while the cloud can perform high-level analytics and provide over-the-air updates (Dornala,2023). Cloud computing and associated solutions provide access through the web to computing resources and product including servers, storage, databases, networking, software, analytics and business intelligence (Oracle, 2024). Furthermore, Cloud Computing provides the speed, scalability and flexibility that enable businesses to develop, innovate and support business IT solutions (Oracle, 2024).

In conclusion, modern cloud solutions help companies meet the challenges of the digital age so that the organizations could have the ability to respond quickly to a fast-paced and complex business landscape, therefore the cloud delivers business value and reduces cost, helping enterprises achieve their full business potential (Oracle, 2024)

In the following part of the text, a practical example of Cloud trend is described more comprehensively.

Ex. 1: Deloitte

Deloitte (2024b) uses cloud to transform the way of work into fast and more efficient way. To Deloitte (2024b), the cloud is not just a simple technology solution for apps and storage, but it is considered to be a driver of business transformation because it puts advanced technologies at a hart of business. Cloud as a BI tool, helps their company with fast market adaptation, gives company great asset agility, enhances employee engagements and collaboration while converting data into true business assets (Deloitte, 2024b).

Interesting example of Deloitte's cloud application is their Marketing Resource Management (MRM) cloud solution. It allows quick and rapid development and deployment of MRM solutions in the cloud in order to create a simple way of performing bottom up budgeting and estimating (Deloitte, 2024c). This MRM solution enables the company to centralize access to digital assets while tracking and managing activities. Furthermore, Deloitte's MRM Cloud solution helps optimizes the company's resources while speeding up the development process (Deloitte, 2024c).

Ex. 2: KPMG

KPMG uses platform based on cloud technology called LINK Go that enables the enhanced audit methodology through a data-enabled workflow in order to provide higher quality results. According to KPMG (2024b), this platform is fully integrated, scalable, cloud-based platform, which provides broad range of mobility needs in one tool.

Another example of KPMG's cloud-based platform is KMPG Clara, which enables the enhanced audit methodology through a data-enabled workflow. Platform provides the possibility of globally consistent execution of work tasks.

Ex. 3: PwC

PWC (2024a) believes if properly applied, data analytics through the cloud, AI and process automation can free up time and deliver value across the whole organization. Their cloud services deliver the ultimate mix of human skills and leading technology, therefore building advantage into every area of business (PwC, 2024c).

According to GoogleCloud (2024), PwC will apply Google Cloud service to help their business operates with gen AI and to build new solutions in order to enhance global organizations function and optimize infrastructure. From that collaboration, PwC expects to accelerate time-to-value function and improve complex and time-consuming processes (GoogleCloud, 2024).

Ex. 4: EY

EY (2024a) Strategy Edge is cloud-based platform that helps answer company's most strategic questions. The company uses cloud services to help organization turn technology disruption into value and to create long-term value (EY, 2024g). Furthermore, EY (2024g) recognized the benefit of the Cloud by seeing decrease in operation costs.

Ex. 5: Microsoft

Microsoft Azure is Microsoft's public Cloud Computing platform that provides a broad range of cloud services, including compute, analytics, storage and networking (Bigelow, 2022). According to Bigelow (2022), the platform can be used for cloud computing in four different forms: IaaS, PaaS, SaaS and serverless function and is commonly used as a platform for hosting databases in the cloud.

Ex. 6: Amazon

According to Patel (2023) Amazon's AWS is one of the prominent names in Cloud Computing industry and offers numerous cloud services that help businesses ensure efficient operations. Amazon has services that enable processing large datasets without infrastructure constraints and optimize resource utilization such as QuickSight, Redshift, EMR and Glue, therefore leverages cloud-based analytics to avoid expensive investments in hardware and software while only paying for resources actually consumed (Nair, 2023).

Ex. 7: Nvidia

According to Gcore (2024) cloud computing is changing rapidly and the NVIDIA H100 GPU is a significant development in this field because it offers exceptional processing power. Nvidia (2024e) leverages Cloud computing to accelerate diverse workloads. Nvidia (2024c) AI Enterprise platform is an example of company's cloud-native software platform that accelerates data science. Company's Cloud Native Technologies provide the ability to run deep learning, ML and other workloads that can be seamlessly deployed on enterprise cloud native management frameworks.

Ex. 8: Saudi Aramco

Aramco leverages technologies enabled by cloud to enhance security, drive innovation and increase the speed and agility of business processes. With the collaboration of Google Cloud, Aramco was able to provide high-performance cloud services so the company can be able to meet with the rising demand of cloud services (Mohammed, 2022). Mohammed (2022) described how the company Aramco claimed that the cloud helps companies of all sizes with an optimized, scalable and agile platform that accelerates digital transformation while at the same time reduces infrastructure costs. Furthermore, explained how the company using cloud services, can reduce operating costs and company's expenditure capital drastically.

Ex. 9: Eli Lilly

According to PRNewswire (2023), Eli Lilly company and ProofPilot, leading provider of innovative clinical trial automation, collaborated on technology solution called Magnol.AI^{tm}, enabling sophisticated management of high-frequency sensor data with security and ease. According to Chief Executive Officer Chris Venezia (2023), Eli Lilly's Magnol.AI^{TM} platform and its industry-leading cloud services were used it in order to provide customers with the most advanced solution and to enable flawless execution of clinical research.

The pharmaceutical giant Eli Lilly leverages cloud solutions of MagnolAI to transform collected digital data into meaningful medical insights.

Ex. 10: VISA

Visa's (2024c) Analytics Platform, is web-based analytics solution that helps the company gain competitive edge with the analytics of payments data. Because it is cloud-based setup, it enables faster data acquirement with less effort with the aim to gain actionable insights. Visa Cloud Connect is another cloud-based platform that the

company leverages in order to maintain high-performance delivery across all applications and end points, while at the same time its solutions eliminate data center overheads and associated costs (Visa, 2024d).

Ex. 11: Apple

Not enough verified and reliable data available.

Ex. 12: Berkshire Hathaway

This company has been using cloud-based solutions as a part of their technology approach for more than ten years. Due to the potential threats, cloud-based solutions have been implemented on a limited basis with primary focus on data security. That said, Ball (2023) explained how Berkshire Hathaway Energy chooses to embrace and implement cloud solutions only when the cost, capabilities and security controls provide the best options to drive the company's performances and when it impacts the service to their customers. According to him, even though the company continues to take a conservative approach to applying cloud solutions in their control networks, company believes the solutions are becoming increasingly beneficial enablers that help the company perform complex data analytics and optimize management of assets.

Ex. 13: TSMC

The company teamed up with top cloud service partners to provide the largest Cloud compute capacity worldwide (TSMC, 2024b). Some of their Cloud Alliance Members are AWS, Google Cloud, Siemens and Microsoft Azure.

TSMC (2024b) created the next generation Cloud-optimized design methodologies in order to accelerate turnaround time of critical design tasks.

According to head of the Design Infrastructure Management Division at TSMC, Dan Kochpatcharin (2023), company is leveraging the cloud to boost productivity and to differentiate from competitors with higher speed and quality of products.

4.4 Case study: AI

Artificial Intelligence (AI) is the ability of a computer program or a machine, to think and learn similar to the that what human does naturally (Zohuri and Moghaddam, 2020). Mikalef and Gupta (2021) gave another definition of AI. They believe AI is the ability of a system to identify, interpret, make inference and learn from data to achieve predetermined organizational and societal goals. In simple terms, AI supports decision-making process and increases performances of business processes (Buntak et al., 2021).

From a business perspective, Artificial intelligence refers to the broad concept of creating intelligent systems that can simulate human-like intelligence and enhance the capabilities of business intelligence by enabling organizations to extract valuable insights from complex patters and trends that may not be apparent to human analyst (Bharadiya, 2023). AI in business context is often synonymous with technologies such as Machine Learning, Predictive Analytics and intelligent automation, which allow businesses to process vast amounts of data with unprecedented speed and accuracy (Farayola et al., 2023).

Such a valuable tool can be helpful to an organization. AI empowers BI by enhancing data analysis, automating data integration, enabling predictive analytics, providing natural language interfaces, detecting anomalies and delivering advanced data visualization (Azmi et al., 2023). AI enabled technologies enhance data management by enabling data collection, analysis and utilization, and improve decision-making processes, resource optimization and overall operational efficiency of an organization (Jankovic and Curovic, 2023).

Internet of Things (IoT) is a system of connected interrelated “things” with sensors and unique identifiers that can transfer data over the internet, without requiring human-to-human or human-to-computer interaction (McGilvray, 2021). AI is important for IoT because it enhances IoT’s capabilities by enabling data analysis, automation, predictive insights and intelligent decision-making.

When defining AI and its parts and roles in Business Intelligence, it is important to also understand what are Augmented Analytics (AA) and Machine Learning (ML).

Augmented Analytics (AA) combines the capabilities of traditional BI with AI and machine learning, allowing more nuanced and sophisticated analysis and enabling businesses to derive actionable insights from their data more quickly and accurately. (Farayola et al., 2023).

Machine Learning (ML) is a method of data analysis originated in the field of computational science in which systems learn from data to identify patterns with minimal human intervention (Halper, 2017). According to McGilvray (2021) Machine Learning (ML) is a discipline within AI that uses sophisticated algorithms to help computer software get better at making decisions. Metaphorically speaking, ML and AA are just some of many pieces of big AI puzzle.

Other popular "piece" frequently used by businesses are Chatbots. Chatbot is an AI application that is designed to simulate human conversation through text or voice interaction that can be distinguished either as rule-based or AI-powered chatbots (Azmi et al., 2023). Bharadiya (2023) explained how AI-powered chatbots and virtual assistants are used in automated routine customer interactions such as answering frequently asked questions for which they leverage NLP techniques in order to understand and respond to customer queries. According to her, Chatbots and virtual assistants automated routine customer interactions reduces the workload on human customer service agents and allows them to focus on more complex or specialized tasks, therefore enhances customer service efficiency.

Therefore, it is noticeable how AI affects businesses. Using AI, organizations can extract more added value from their data, improve decision-making processes and gain competitive advantage on the market (Azmi et al., 2023). Also, AI-driven analytics provide organizations with real-time actionable insights that enable agile decision-making (Bharadiya, 2023). Simply said, artificial intelligence accelerates data analysis process and reduces manual effort.

In the following part of the text, a practical example of AI trend is described more comprehensively.

Ex. 1: Deloitte

Deloitte uses AI solutions in order to take advantage of the “With” power to identify unique advantages through analysis and artificial intelligence (Deloitte, 2020). “With” refers to Deloitte’s machine learning algorithms and platforms that are powered by artificial intelligence (AI) and analytics that humans are working with.

The company provides users with an AI platform called aiStudio. This platform compresses key AI solutions allowing users to harvest their data and gain valuable insights on their overall markets, customers and operations (Deloitte, 2020).

Another Deloitte’s AI solution is known as Dara, a digital worker that increases the capacity of workspace by providing quick and cost-efficient solution for process automation. This tool facilitates document processing, communication, visualization, data analysis and other business tasks (Deloitte, 2020).

Ex. 2: KPMG

KPMG (2023) described how society’s AI dependency has impacted many sectors like healthcare, retail, mining and infrastructure in a way that facilitated business conduct and drove profits.

According to KPMG’s (2023) Data & Analytics and Emerging Technology Center of Excellence harnesses the power of AI and allows KPMG firms to help establish, deploy and develop environments to scale AI across organizations.

KPMG’s LINK Go platform, has integrated tools such as AI-based chat bots that offer advanced user experience (KMPG, 2024a). Some of the incorporated tools, methodologies and technologies providing AI solutions include Advanced Machine Learning, Deep Learning (KPMG, 2023).

Ex. 3: PwC

PwC recognized the power of AI for their business. According to Ichpurani (2024), by applying generative AI across industries, PwC would enhance business transformation in tax, healthcare and legal domains by elevating most complex processes such as regulatory compliances.

PwC has collaborated with GoogleCloud. As a part of the collaboration with GoogleCloud (2024), PwC aims to increase its gen AI experience to improve business functions and drive value. Kande (2024) firmly believes that PwC can better support digital and business transformation by leveraging Google Cloud gen AI solutions.

Ex. 4: EY

Jeanne Boillet (2017), one of the key people of EY, explained the company's philosophy regarding AI. According to her, company would use AI to enable employees to work better, smarter and faster rather than simply replace humans in the workplace.

For EY (2024e), data and Artificial Intelligence sit at the core of business transformation. The company believes that AI has the potential to enhance skill development among workforce and their commitment to AI's transformative power can be seen in the products they developed such as EY intelligent Payroll Chatbot (EY, 2024j). That tool is used to modernize payroll and employee care. Another great example of how EY uses AI is their Strategy Edge platform. That platform derives actionable insights from AI-powered advanced analytics applied to diverse data sources.

Ex. 5: Microsoft

AI analytics increase Microsoft's efficiency of operational processes. The company built chatbots in order to speed up the process of answering recurring questions

Microsoft (2018). Afterwards, using the advances in deep learning, coupled with internet-scale datasets and Microsoft Azure's AI supercomputing resources made it possible for the company to create AI models that perform broad range of tasks across different applications (Microsoft, 2023). Velush (2024) concluded that Microsoft uses AI capabilities to capture, review, analyze and report on the most important and actionable insights.

Ex. 6: Amazon

This company's best known AI solution is called Q. Amazon Q Business is a generative AI-powered assistant that can complete various tasks based on data and information from the enterprise systems (Amazon, 2024f). The company leverages Q in QuickSight platform to enhance business productivity with Generative BI capabilities to accelerate decision-making (Amazon, 2024d).

According to Amazon (2024d), the Q makes it easier for business users to understand data with executive summaries and make interactive data stories that help drive decisions from insights.

Ex. 7: Nvidia

Nvidia's CEO Huang (2024) believes generative AI and accelerated computing are two most important technological trends today. According to Varshney and Sessions (2024) NVIDIA uses end-to-end platform called NeMo for developing custom generative AI leveraging its micro services to enable semantic search of enterprise data. Nvidia's (2024c) also leverages AI micro-services in order to help optimize enterprise performance. An example of it is Nividia AI enterprise platform. It is an end-to-end, cloud-native software platform that accelerates data science pipelines and streamlines development and deployment of production-grade co-pilots and other generative AI applications (Nvidia, 2024c). The platform provides easy-to-use

microservices that optimize model performance with enterprise-grade security, support and stability to ensure a smooth transition from prototype to production for enterprises that run their businesses on AI.

Ex. 8: Saudi Aramco

In order to gain remote access to the company's insights, Aramco leverages AI and IoT that facilitate monitoring (Houston, 2021). The company harnesses the power of AI along with Big Data to enhance industrial processes and to optimize many aspects of their operations, therefore for Aramco (2024) AI is considered a key tool in company's digital transformation program because it improves decision-making processes and boosts business performance.

A good practical example of how Aramco uses AI in business is their Virtual assistant ALIA. The Alia Aramco LIFE Intelligent assistant grants access to Aramco-related information and resources (Aramco, 2024b).

Ex. 9: Eli Lilly

The company understands the importance and value of AI for their business. Therefore, Eli Lilly invested in AI and ML in areas including drug discovery, natural-language generation, robotic-process automation and chatbots (Lee, 2023). According to Lee (2023), Eli Lilly's goal is to grow the company's digital worker-equivalent workforce in order to help the company quantify the hours saved by using technology instead of human labor but in a way that augments human productivity, not replacing their roles completely. Eli Lilly recognized the power of AI because it helped reduce the amount of hours of human labor that had been replaced by technology solutions (Lee, 2023).

Ex. 10: VISA

Interesting fact is that Visa had pioneered the use of AI models in payments back in year 1993, becoming the first network who deployed AI-based technology for risk and fraud management and since than had spent on it over $ 3 Billion. According to Taneja (2023) the company's deep learning and AI solutions helps solve challenges for financial institutions, sellers and buyers. Solutions such as Visa's Cybersource Decision Manager, that helps with fraud and risk assessment by applying advanced ML to historical data in order to spot patterns.

Ex. 11: Apple

Apple utilizes technological advances like Artificial Intelligence and Machine Learning in different Apple devices to improve its user experience (Noushad, 2023) and according to Emanuilov (2024) Apple is clearly getting serious about AI and demonstrating innovative approaches that leverage their ecosystem advantages in novel ways. A great example of Apple's AI application is Siri. It is a virtual assistant for Apple system-operated devices that uses voice recognition and is powered by AI (Mixon, 2023).

Another way the company leverages AI is Apple Neural Engine (ANE). That is a marketing name for a cluster of highly specialized compute cores optimized for energy-efficient execution of deep neural networks on Apple devices that accelerate ML and AI algorithms, offering tremendous speed, memory and power advantage for analysis because it can do it without tapping into the cloud or use of excessive power (Zibreg, 2023).

Ex. 12: Berkshire Hathaway

GEICO is a company owned by Berkshire Hathaway and is considered to be Berkshire Hathaway's subsidiary company. According to Chua's (2024) transcript of annual shareholder meeting, that company has ramped up its investments in cutting-edge technologies including deployment of advanced ML algorithms to enable processing data more efficiently. In order to exploit parts of their BI more efficiently GEICO partnered with Tracable. One of the main reasons for that partnership was to accelerate accident recovery with the use of AI. Their proprietary computer vision technology assesses vehicle damage like a human appraiser (Tracable, 2021). By inserting AI in the process of appraising, GEICO's time needed to make an accurate estimate reduced drastically.

Another example of how the company leverages AI is with help of Casepoint platform. The Casepoint (2024b) platform allows Berkshire Hathaway to leverage AI and advance analytics to accelerate review, build confidence in results and make decisions faster or in other words, reduce time and expenses.

Ex. 12: TSMC

TSMC has turned to AI and big data analytics in order to help with advanced manufacturing optimization (Liang, 2023). Machine Learning (ML) also played a key role for company's business improvement. The ML optimized TSMC's (2024c) manufacturing and reduced fab cycle time, while through advanced image recognition TSMC has established quality defense and defect prevention systems that ensure the high quality. Finally, through automation and with the help of the application of deep learning (DL) and image recognition, the company has achieved intelligent packaging fab (TSMC, 2024c).

4.5 Case study: Big Data

Big Data has variations of definitions. Typically, Big Data is characterized by 3V: volume, velocity and variety (Wang et al., 2022). But Talha et al. (2019) characterized Big Data by term 5V: volume, velocity, variety, veracity and value.

Table 1: 5V of Big Data (Talha et al., 2019)

Volume	Amount of data generated
Velocity	Speed of which data is produced and processed
Variety	Heterogeneity of data and their sources
Veracity	Consistency and reliability of data
Value	Profits that can be made from volume of data

According to Sun and Wang (2017) Big Data became a strategic resource for industry, business and national security. Moreover, they affirmed that data became a strategic enabler of exploring business insights and the economics of services. It has also been described as new class of economic assets, just like currency or gold (Djerdjouri, 2020).
After defining Big Data, in order to understand its impact on BI, it is necessary to define Big Data Analytics. There are many interpretation of what Big Data Analytics actually is. Hadi et al. (2015) defined it as a technological trend that explores large amounts of data to reveal hidden patterns and secret correlations. While Kude et al. (2017) claim Big Data Analytics refers to an assortment of large volume of data and technology which is gathered from different sources, making it possible for businesses to gain competitive advantage over rivals. In 2019, Big Data analytics was described as an ability to mine and analyze Big Data that gives organizations deeper and richer insights into business patterns and trends (Ghasemghaei). Moreover, it was viewed it as a tool that

organizations depend on for making decisions based on reliable information that directly impacted efficiency and effectiveness of the organization (Maroufkhani et al., 2020). Bharadiya (2023) concluded that ML and AI enable the organizations to process of large volumes of data efficiently.

Recently offered definition that best fits the scope of this research was provided by Alnoukari (2022) who defined Big Data Analytics as a process of collecting, organizing and analyzing big data to discover patterns, knowledge and intelligence as well as other information within the big data. According to him, Big Data Analytics (BDA) has four different levels of analysis: descriptive, inquisitive, predictive and prescriptive that generated different insights based on the questions they answer. First one relates to "What happened?" question, second answers "Why did it happen?" question, while predictive analysis answers "What could happen?" question and the last one relates to "What should happen?" question.

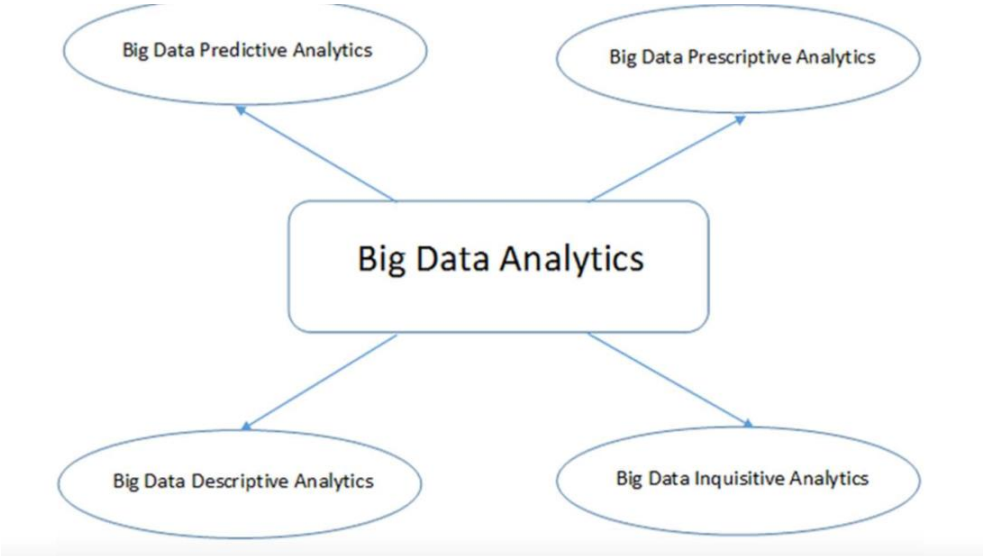

Figure 2: Big Data Analytics Levels (Alnoukari, 2022)

Another element of Big Data Analytics that has an immense impact on Business Intelligence is considered to be Data Lakes. Data Lakes offer rich sources of data to analysts and self-service data consumers, while also serving the needs of BI and Big Data and should be considered as an extension of the BI infrastructure (Llave, 2018). They help drive operational efficiencies and competitive advantage in manufacturing, security, marketing, and IT (Ghasemghaei, 2019). Data Lakes are also considered to be a centralized enterprise data repository that is capable of storing both the traditional structured data and the unstructured data of today in its raw format (Prakash, 2020). The integration of Data Lakes in company's business intelligence facilitates the acquisition of data without caring of its structure because it has a huge capability to store inexhaustible amounts of raw data without performing any data transformation (Alnoukari, 2022). Data Lake provides efficient and scalable storage, since most of the data lakes utilize the cloud object storage capabilities to address the data storage on HADOOP, unlike the traditional data warehouses which use the relational database management systems for data storage (Prakash, 2020).

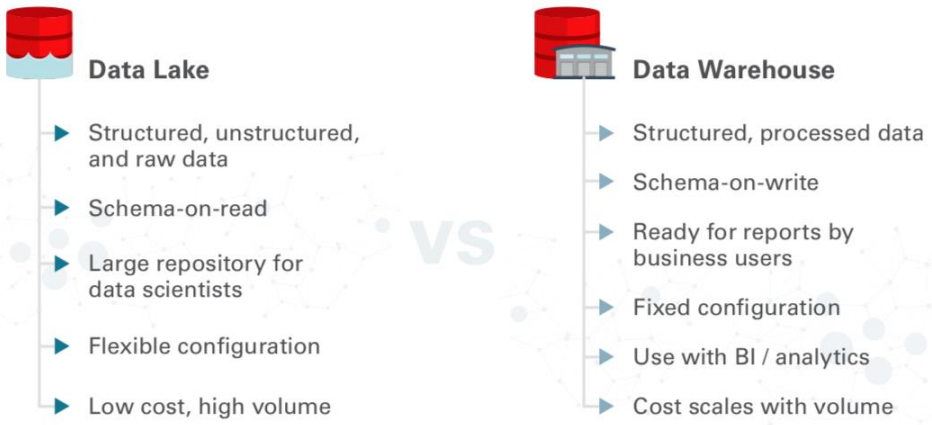

Figure 3: Data Lake vs Data Warehouse (Oracle,2019)

In the following part of the text, a practical example of Big Data trend is described more comprehensively.

Ex. 1: Deloitte

According to Deloitte (2024d), Big Data enables making better business decisions faster and with more confidence. The company realized that by implementing the right analytics strategy and technology, company would be able to balance speed, cost and quality to deliver measurable business value (Deloitte, 2024f).

Deloitte's Analytics & Information Management (AIM) provides services that enable company to manage data from disparate sources and converts it into accurate and actionable information (Deloitte, 2024e). The AIM helps company uncover and unlock the value buried deep inside vast amount of data therefore, the company uses AIM to support fact-driven decision-making and drive competitive advantage using big data (Deloitte, 2024e).

Ex. 2: KPMG

In order to increases operational effectiveness, KPMG (2024b) turned for help to their Clara platform. This platform is combining data-enabled workflow along with other technologies to enable enhanced audit methodologies (KPMG, 2024b). The company uses that data-driven information in order to do auditing on higher level with greater results.

Ex. 3: PwC

By applying analytics technologies, tools and techniques it enables PWC (2024a) to turn dry facts into strategic insights that solve complex business problems.

PwC (2024a) gains their insights with help of data-driven KPI metrics. The company uses the power of data analytics by combining huge proprietary data sets and their own analytics platforms to help organizations work more efficiently and effectively (PwC, 2024a).

Ex. 4: EY

EY leverages Helix platform to derive valuable insights from vast amounts of data. Helix is a global analytics platform, which includes a suite of captured data with analytics tools that increase the depth and breadth of captured data (EY, 2024b). It gives company the ability to analyze larger volumes of audit-relevant data, derive insights and a more in-depth understanding of clients and business operations. EY (2024b) benefits from its global platform EY Helix in terms of increasing employee confidence in financial reporting, providing relevant feedback and insights, better risk identification due to the scale of data analysis.

Ex. 5: Microsoft

Microsoft is a global company operating on an unimaginable amount of information gathered from numerous different data sources. In order to work efficiently with that data, the company uses Data Lakes. A practical example is Microsoft's (2024d) Fabric platform. This platform is used to simplify data integration from different sources into a data lake for an organization to be able to work from the same copy of data across analytics engines and languages. It empowers organization with the capabilities to transform data from various sources into actionable insights. The advantage of Microsoft's Fabric platform is reduced data duplication by using a single copy of data that powers organization workloads.

Ex. 6: Amazon

The company harnesses the power of Big Data to gain valuable strategic insights and optimize operations (Nair, 2023). Amazon (2024c) provides secure, scalable, comprehensive and cost-effective portfolio of services that enable building data lake in the cloud and analyze that data.

According to Amazon (2024c), value of Data Lakes comes from the ability to harness more data, from more sources in less time, therefore empowering users to collaborate and analyze in different ways leads to better and faster decision making.

Ex. 7: Nvidia

Nvidia's CEO believes that every company's business data is their gold mine due to the amount of business data available (Huang, 2024). The company leverages RAPIDS software solution to harness the raw power of NVIDIA GPUs in order to supercharge data processing (Sanikommu, 2024). This software solution helps with cost saving because it decreases infrastructure and operational expenses (Sanikommu, 2024).

Ex. 8: Saudi Aramco

Aramco (2024) uses Big Data analytics to collect, analyze and store ever-growing volume of data. Hence, usage of Big Data and industrial IoT leads to optimization of their operations and enhanced productivity. According to Walls and Barnard (2020) and their story about Aramco, Big Data leverages the power of modern computing to drive greater efficiency.

A great example of how Aramco (2024) uses Big Data in business comes from harnessing the latest advances of Big Data analytics, machine learning, smart sensors and robotics to deliver significant benefits at Khurais (one of their largest oil fields)

resulting in 15% increase in oil production and 100% improvement in troubleshooting response time.

Ex. 9: Eli Lilly

According to Gopal (2019), Eli Lilly's chief data and analytics officer, the company is leveraging data and analytics, along with other efforts, to significantly improve the speed of its development activities. By leveraging big data analytics, the company has reduced the average time from first human dose of a potential new medicine to commercial launch by more than two years (Gopal, 2019).

Ex. 10: VISA

For Visa, leveraging the vast amounts of transactional data is a strategic imperative because it reveals patterns, trends and preferences of consumers and their behavior.

Visa collaborated with cloud-based Big Data and analytics firm, GoodData, to provide its users with better access to aggregated data and analytics (Hinchliffe, 2020). Visa's head of data, security and identity products McSherry (2020) claimed that insight from that collaboration will help sellers, financial institutions and their global business network to better understand and meet customer needs. In today's digital age, Visa (2020) believe that financial institution's ability to convert data into actionable insights and value can help them deliver personalized experiences and develop new revenue streams. In pursuit of driving value for customers, banks and merchants, Visa leverages insights generated by ML and AI that analyze vast amount of data (Clayton, 2022). Depending on the data analysis purpose, different ML and AI solutions are used such as Visa's Cybersource Decision Maker; a fraud and risk assessment tool, or Visa Analytics Platform; a performance insights tool.

Ex. 11: Apple

Apple recognized the value of Big Data analytics and found ways to take advantage of it. With the help of technology, Apple's Big Data analytics helps them drive considerable part of company's decisions and improve customer experience and with designing its new products and services.

The potential of Apple's product Apple Watch and Big Data has led to a partnership between Apple and IBM; a collaboration designed to make the most of digital health information by creating health-related mobile apps later used with Apple devices (V Noushad, 2023). A virtual assistant called Siri is another application and an example of how Apple manages to leverage the power of big data.

Ex. 12: Berkshire Hathaway

GEICO is another subsidiary company of Berkshire Hathaway. According to Chua's (2024) transcript of annual shareholder meeting, that company has ramped up its investments in cutting-edge technologies including big data platforms to facilitate the process and analysis of vast amount of data more efficiently.

Berkshire Hathaway used Casepoint platform to centralize their data repository in order to be able to efficiently collect, process, review, analyze and produce insights (Magness, 2024). Casepoint's (2024) operation solutions enabled Berkshire Hathaway subsidiary company to automate certain operations while reducing cost and increasing efficiency.

Ex. 13: TSMC

TSMC relies on its Big Data platform to achieve high levels of productivity and quality standardization (Hua, 2023). The company uses the power of Big Data in order to optimize advanced manufacturing (Liang, 2023). By leveraging the Big Data from automation, TSMC (2024c) achieved intelligent packaging fab. TSMC established relation between various levels of Big Data processing and ensuring dynamic stability in the production lines, therefore it became a key aspect of TSMC's quality control (Liang, 2023).

4.6 Case study: BI Visualization

Business Data Visualization is the visual representation of data, no matter the size or origin or type (structured or unstructured) with the purpose of visualizing key metrics for easy and fast decision-making and providing interactive data exploration (Zheng, 2017). Few years later, Djerdjouri (2020) offered another definition of BI Visualization, saying it is a tool created from the merge of BI systems and data from various sources, resulting in analytics process that changes data into information that is usually presented through a dashboard or other analytics interface. According to him, visualization tools help users create advanced graphical representations of data that help users uncover patterns, outliers and relevant facts via simple user interfaces.

Data Visualization can also be observed as a process. As five step-wise process of data visualization pipeline in which process starts with data import, than goes to data preparation, followed by data manipulation and afterwards data mapping and with the final step being data rendering (Qui et al., 2020).

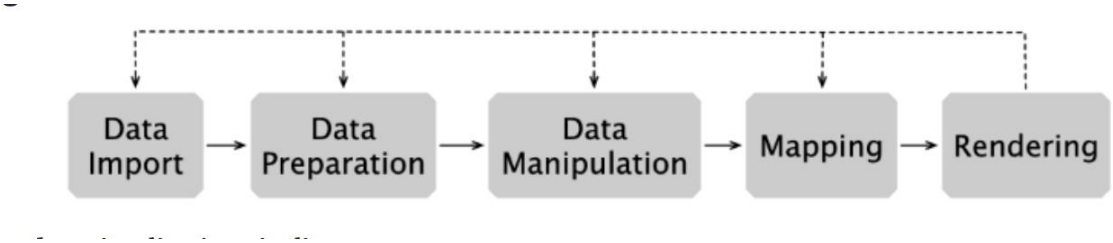

Figure 4: The Data Visualization pipeline (Qin et al., 2020)

Also, it can be separated into two categories. Exploration Data Visualization is described as a case of large quantity of data but not enough knowledge and vague goals, while with the explanatory Data Visualization data is available in quantity but data and the goals are familiar (Gandhi and Pruthi, 2020). Both categories are useful in presentation of data visually but they differ in purpose. They also separated data visualization techniques of

data representation into traditional (pie chart, line chart, graphs, map, heat map etc.) and modern (word clouds, symbol maps, connectivity charts, portfolio wall, kanban board etc.).

BI Visualizations content includes quantitative data, metrics and KPIs, while using charts, diagrams and dashboards as tools with the purpose of data exploration, analysis and decision-making (Zheng, 2017). The Dashboard is one of the essential and most commonly known windows into the data environment of a company. Dashboards are open browser-based BI visualization tool that typically highlight Key Performance Indicators (KPI's) which help managers focus on the metrics that are most important to them, making them easily accessible by anyone with permission (Djerdjouri, 2020).

Simply explained, Data Visualization is the procedure of representing knowledge in an understandable way for decision-making (Mehboob et al., 2022) and aims to make insights more understandable and accessible using BI tools such as charts, graphs, dashboards and interactive reports (Azmi et al., 2023).

In the following part of the text, a practical example of BI Visualization trend is described more comprehensively.

Ex. 1: Deloitte

When Deloitte (2024a) wishes to present specific business information via dashboards, the company turns for help to Roambi.

Roambi is a Business Intelligence tool used to give users possibility to interact with their data when presenting business information such as KPI's (Deloitte, 2024a).

An example how this tool helps with presentation of KPI's in a quick and efficient way is by using ten visualization templates for intuitive dashboards that allow quick access to important information (Deloitte, 2024a).

Ex. 2: KPMG

KPMG leverages Clara platform for the purpose of giving meaningful business insights.

This platform integrates Data Visualization with new technologies to give better insight into findings and risks (KPMG, 2024b).

Due to Data Visualization tools and the power of other technologies, the platform is able to provide more meaningful engagement with the user and the benefits of this platform can be found in efficient operations due to great data transparency with real-time access to information (KPMG, 2024b).

Ex. 3: PwC

PwC (2019) rolled out a customized data model that would generate descriptive analytical insight to give executives reliable and actionable information on current operations.

Their data integration system was used to produce reports based on standardized framework with personalized dashboards and graphical Data Visualization for managing directors and executives. This unified and customized data model was used to generate descriptive analytical insights to give executives more information on current operation, and it did so through personalized web-based dashboards.

The company recognized a great benefit of BI Visualization solutions. According to PwC (2019) after the implementation of new BI solution for SSGIL, dashboard and reporting solutions saved nearly 50 person-months of effort in preparation every year.

Ex. 4: EY

EY (2024h) considers data visualization to be a process of representing large volume of complex data in a graphical format which is much simpler to understand, hence it

became indispensable part of their business. EY (2024h) visualization tools help the business to understand hidden facts and its significance.

With its Supply Chain Intelligence Platform, EY (2024c) creates dynamic and user-friendly dashboards that allow data exploration. This Platform is an example of a tool that company uses in order to transform complex data into clear, insightful visualization.

Ex. 5: Microsoft

Microsoft, a company well-known for their software products, developed Power BI platform. This is a platform with primary focus on the interactive data visualization solutions. According to DataScientest (2024) Microsoft's Power BI platform is used to convert data collected from different sources into interactive dashboards and reports enhanced by graphs and diagrams for intuitive visualization.

Another Microsoft software, Excel, also enables visualization and exploration of raw data with the purpose of creating the reports and interactive dashboards. However, Power BI is meant to provide more in-depth dashboards and analytics that provide business value and insight while Excel is focused on simpler use cases (Hashemi-Pour et al. 2024).

Ex. 6: Amazon

In 2016, Amazon used AWS Marketplace platform to empower organization to create and work with live interactive dashboards (Pratim et al., 2016). Later on, the company had developed platforms such as DataBrew, Q and QuickSight and leveraged them when in need for Data Visualization solutions.

AWS Glue DataBrew is Amazon's Data Visualization tool used, among other services, to report and visualize data using ML algorithms (Kasthuri, 2021). While,

the QuickSight platform's advantage is an easy-to-use interface that quickly creates data dashboards and other reports (Patel, 2023).

Amazon's (2024d) Q is an interesting example of company's BI Visualization solutions because among other services and with the help of generative AI, it enables the creation of customizable and interactive data stories that are presented on dashboards.

Ex. 7: Nvidia

Nvidia (2024d) has a variety of visualization software's that enable researchers to collaborate with their colleagues remotely and to interactively visualize their scientific datasets in real time. And according to the company, those visualization tools help to speed up data analysis and enable users to visualize large datasets at interactive speeds such as sharing scientific discoveries and publishing results.

One example of Nvidia's (2024d) visualization software is called Nvidia IndeX. It is an interactive visualization framework that allows users to visualize and interact with massive HPC datasets.

Ex. 8: Saudi Aramco

Saudi Aramco gathers vast amounts of data from various sources. Sophisticated algorithms help innovative visualization tools turn their data into meaningful insights (Aramco, 2024b). These innovative visualization tools help the company with decision-making, as well as optimization of their production and operations.

Looking at their company's reservoir simulations is a good practical example of how Aramco uses BI Visualization. Aramco (2024) uses state-of-the-art digital visualization tools to model their reservoirs and management challenges to improve decision-making and optimize development plans.

Ex. 9: Eli Lilly

Eli Lilly leverages platform Magnol.AI in order to allow seamless Data Visualization

Eli Lilly has built MagnolAI, sensor cloud ecosystem, in order to ingest and visualize large amounts of data that can be transformed into meaningful digital insights (Singh, 2023). Singh (2023) claimed Eli Lilly's MagonlAI to be the most comprehensive visual computing solution for big data because it is a powerful tool that has enough scalability to visualize data collected from different devices, profile them and generate reports.

Ex. 10: VISA

Visa's Analytics Platform among other features, has easy-to-use interactive pre-built dashboards and customizable reports that accelerate users ability to identify actionable insights that lead to more precise and data-driven decisions. This BI solution provides the company executives key insights regardless of their skills level, enables managers to create reports that are rich with easy-to-understand insighs, and also facilitates analysts work due to automated reporting options (Visa, 2024e). All of that leads to easier, better and faster decision-making, therefore improves efficiency and data transparency.

Ex. 11: Apple

Not enough verified and reliable data available.

Ex. 12: Berkshire Hathaway

Not enough verified and reliable data available.

Ex. 13: TSMC

Not enough verified and reliable data available.

4.7 Case study: DQM

In order to better understand what Data Quality Management (DQM) is, it is important to know the relevance of Data and the information system itself. Data is one of valuable assets owned by an organization (Hikmawati et al., 2021), because data is the most essential component of any BI system and without the collection, storage, and access to reliable data, a firm cannot get any valuable and accurate insights into their business and the business environment (Djerdjouri, 2020). Data quality is an issue inherent to the concept of business intelligence (Bataweel, 2015), but from another perspective data quality is the capability of data to satisfy the stated business, system and technical requirements of an enterprise (Mahanti, 2019).

Talha et al. (2019) explained how the essence of an information system lies in good quality and sufficiently protected data, or otherwise consequences can be harmful for the organization. According to them, quality and security are two main aspects that add value to data, but they also identified and selected other key Data Quality Characteristics from ISO/IEC 25012 standard that are necessary to set up DQM system.

Data collecting is a common issue regarding data quality that forces companies often to spend a lot of time and resources, leading to possibility of irrelevant data aggregation and increase of the potential overall business inefficiency (Bataweel, 2015). Data collecting leads to data governance. Data governance can be observed as a broad concept of managing data in a certain ways. According to Hikmawati et al. (2021) Big Data governance is responsible for: organization's accountability in information governance, stewardship, data definition, metadata management, master data management, usage standards, data life cycle management, risk, cost control and also included optimization, privacy and monetization. It facilitates data standardization and effective business policy formulation, as well as mitigation of risk or in other words, data governance are policies and procedures used to manage data in an organization, while as a process it ensures that the organization works well with data assets and that those assets are well maintained. (Hikmawati et al., 2021).

Observing from afar, data governance is in charge of the whole lifecycle of data, while Master Data Management (MDM) has a different focus. MDM is a method of maintaining, integrating and harmonizing master data to ensure consistent system information with the primary function to keep the data accurate, current, relevant and contextual to meet different needs across business application and divisions (Hikmawati et al., 2021). MDM solves data quality issues through the MDM process such as data profiling and standardization, caused by data originating from various scattered sources (Hikmawati et al., 2021).

Accurate, complete and current data are fundamental to support decision-making processes (KPMG, 2024e). But when talking about Data Quality Management and its impact on decision-making in time of modern technology, Bharadiya (2023) drew attention to an interesting thought about the consideration of the ethical aspect in AI development and deployment. She claimed they are very important because transparent and interpretable AI models help insure fairness, accountability and transparency in decision-making processes, while avoiding risks associated with biases, discrimination and unintended consequences.

In other words, Data Quality Management (DQM) can be observed as rigorous data standardization that plays a key role in ensuring precision and trustworthiness of data within the BI systems. It essentially strengthens data governance.

In the following part of the text, a practical example of DQM trend is described more comprehensively.

Ex. 1: Deloitte

For Deloitte (2024i) data quality rules are key facilitators in maintaining data quality and the foundation of the company's effective Data Quality Management lies on few key pillars and its key components are:

- Centrally-managed data quality rules
- Defining the rule properties
- Implementation of the rules
- Data quality evaluation
- Usage of rules.

All of those components help to increase the quality of master data, most of which are used by AI.

In order for organization and its stakeholders, to ensure AI deployments can be ethical and trusted, Deloitte uses their Trustworthy AI Framework™. It is an AI solution that requires data governance and regulatory compliance throughout the AI lifecycle ensuring AI deployments can be ethical and trusted. This helps organizations develop ethical safeguards in order to better capitalize on the returns associated with AI, therefore it is considered as means that help company ensure trusted data (Deloitte, 2024g).

Ex. 2: KPMG

KPMG (2024e) understand the importance of structured data, classification and cardinality of data, therefore assists organizations with the implementation of best practices in data governance and data quality management. The company's continuous management, monitoring, analysis and remedial measures aim to deliver quality information to business decision-makers while minimizing risk arising from the use of inaccurate or outdated information.

In order to assure data quality, KPMG has specifically developed the Data Quality Efficiency Index (DAQEI). It has ben created to be the best data management metric

to set a criteria for measuring data quality. DAQEI measures whether good data quality was acquired through poor process efficiency, while at the same time promotes faster delivery of data generated through reliable operational processes to make the basis for decision-making (KPMG, 2024f).

Ex. 3: PwC

In order to ensure data quality, PwC (2020) reviews the system data against five attributes such as equivalence, accuracy, consistency, completeness and integrity. The company measures the quality of features and the predictions using statistical techniques on data analysis (PwC, 2024d).

After measuring the quality, the company creates reports. PwC's (2020) data quality reports help identify exceptions with insufficient or inaccurate details by users, categories, rules and sub-rules.

Ex. 4: EY

EY relies on three pillars to maintain consistent and effective Data Quality Management Framework: people, processes and technology, each having different and significant role.

Schlener et al. (2023) described Data Quality as a crucial business component for EY, because it can have significant impact on the accuracy, effectiveness, and reliability of business decisions and operations. They also said, that facilitating high-quality data is essential for EY's effective decision-making, operations and maintaining competitive advantage in data-driven business landscape.

An example of how EY is using DQM is for enhancement of data quality for credit risk model, because it leads to better model performance and decision-making (Schlener et al., 2023).

Ex. 5: Microsoft

To Microsoft (2024f) data quality is crucial because it ensures accurate, reliable and trustworthy information intended for decision-making. Also, the company operates on an assumption that data quality prevents costly mistakes, builds credibility and enables personalized experiences.

To give a practical example of the company's DQM, Microsoft's Azure Operator Insights platform was chosen. This platform monitors data quality when data is ingested into Data Product input storage and afterwards data is processes and made available for further usage (Microsoft, 2024f).

Ex. 6: Amazon

Amazon leverages ML and uses DQM to enhance constraint suggestions and detection of anomalies in historic data quality time series (Schelter et al., 2018). To do so the company developed the Apache Spark platform. This platform supports the incremental validation of data quality on growing datasets and leverages (Schelter et al., 2018). Another example of Amazon's DQM is their platform called Amazon Glue Databrew which helps cleans, filter and manage data in order to get high quality results (Kasthuri, 2021).

Ex. 7: Nvidia

Nvidia's DQM solution for enabling rapid datasets iteration is found in NeMo platform.

This platform and its micro service called NeMo Curator ensures an expected level of quality from acquired data (Maghoumi and Liu, 2024). NeMo Curator helps with data quality filtering which ensures high level of data insight. It is used to categorize documents into high- and low- quality buckets with the help of predefined heuristics-

based and ML-based qualitative criteria that way ensuring high quality of data used (Maghoumi and Liu, 2024).

Ex. 8: Saudi Aramco

To assure the company's data quality, two solutions were identified.

According to Nawab (2020), the Saudi Aramco project teams include quality manager that oversees all the quality specifications to be met at each phase throughout the project lifecycle. Except for that, Aramco has measures that collectively ensure that the company maintains high data quality standards across its operations, such as automatic data collection. Automatic data collection enables more reliable analysis and informed decision-making, because it reduces human errors that can occur in manual processes, therefore allowing better and more reliable analysis (Aramco, 2021).

Ex. 9: Eli Lilly

For Eli Lilly company, the reporting on data quality effectively across the data life cycle is essential (Carter, 2023). To ensure quality and processes to be in compliance with regulatory requirements, Eli Lilly recognized that could be done by leveraging AI (Lee, 2023). So the company turned for an efficient solution to their MagnolAi platform.

MagnolAI Data collects data, which is than profiled, aggregated and synthesized from across clinical trials generating reports of data quality (Singh, 2023).

Ex. 10: VISA

Visa (2020) committed to maintaining data quality within their network by ensuring data accuracy and consistency through the monitoring capabilities of the Visa Data Quality Program which comprises of Data Governance, Data Quality Platform and Compliance. According to the company, this Program's results revealed an improved quality of data delivered through their system, better data insights and improved transactional reconciliation. Visa has been committed to sustainable innovation by creating a governance structure that prioritizes the responsible stewardship of data and works across all areas of innovation to ensure that any deployment or use of data is responsible, secure, compliant and reliable (Taneja, 2023).

Ex. 11: Apple

Not enough verified and reliable data available.

Ex. 12: Berkshire Hathaway

Not enough verified and reliable data available.

Ex. 13: TSMC

Not enough verified and reliable data available.

4.8 Case study: Predictive Analytics

Djerdjouri (2020) defined analytics as the scientific process of transforming data into insight for making better decisions. In order to increase their bottom line and profit, the organizations are leaning toward predictive analytics, a branch of advanced analytics that predicts the future by analyzing current and historical data (Kumar and Garg, 2018). They explained how based on current and historical data, a data analyst can predict the future following 6 steps involved in predictive analytics.

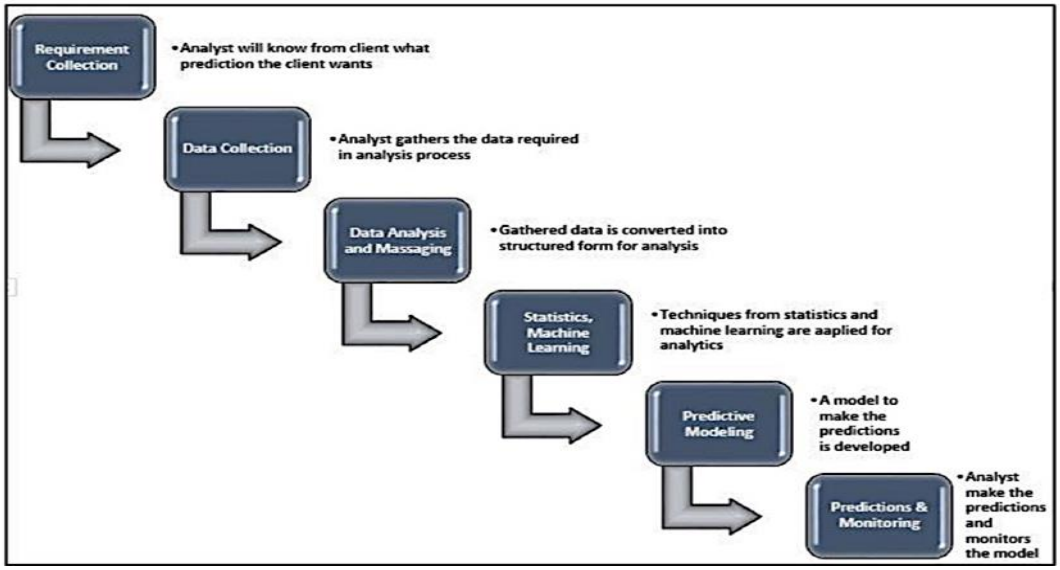

Figure 5: Predictive Analytics process (Kumar and Garg, 2018)

Predictive Analytics is a prominent trend in which machine-learning algorithms help businesses make accurate predictions about future outcomes by sifting through vast amounts of historical data to identify patterns and trends (Bharadiya, 2023). Predictive Analytics use different business tools like statistics, machine learning, forecast and other in order to provide an accurate projection of future happenings and the reasoning for why it could happened (Duan et al., 2020). The development in the field of AI and the

advancement of computer techniques brought revolution in the field of predictive analytics making the following techniques popular to use for developing predictive models:

-Decision Tree - Ensemble Learning - Gradient Boost Model

-Regression Model - Support Vector Machine - Time Series Analysis,

-Artificial Neural Network - k-nearest neighbors

-Bayesian Statistics - principle component analysis (Kumar and Garg, 2018).

Hence, with the help of ML and AI, organizations leverage Predictive Analytics to optimize business process (Ongsulee et al., 2018).

Predictive Analytics is intended to provide insight into future events by including methods that produce predictions using supervised and unsupervised learning (Ghavami, 2019). In supervised learning the system is given a target (aka. output or label) of interest, while in unsupervised learning outcomes are not specified (Halper, 2017). In simple terms, Predictive Analytics use historical data and statistical models to forecast future outcomes, such as customer behavior or market demand (Azmi et al., 2023). Whether from historical data internal to an organization or data acquired from an external source, Predictive Analytics can be observed as a set of methodologies and tools that automatically identify patterns and generate forecast (KPMG, 2021). And it can be divided into two categories: descriptive and prescriptive.

Descriptive Analytics enables subject matter experts to generate insights by applying data exploration and visualization tools to historical data using dashboards and BI report, while Prescriptive Analytics combines forecasts (predictive analytics) with mathematical optimization, operations research and decision sciences to identify the best course of action (KPMG, 2021).

The applications of Predictive Analytics are present in a variety of domains, from clinical decision analysis, stock market, retail, banking, oil and gas industry to government and public sector (Kumar and Garg, 2018). For BI, predictive analytics is a process that transforms data into meaningful and valuable information and ensures more effective strategic, tactical and operational insights, as well as the decision-making (Gurcan et al.,

2023). It enables organizations to forecast demand patterns, identify seasonal trend and anticipate market fluctuations, as well as optimize inventory levels, streamline supply chain management and reduce cost, thus allowing organizations to optimize pricing strategies, maximize revenue and respond quickly to market changes (Bharadiya, 2023).

In the following part of the text, a practical example of Predictive Analytics trend is described more comprehensively.

Ex. 1: Deloitte

Deloitte's Predictive Project Analytics (PPA) provides objective insights and enhanced capabilities to address potential problems before they materialize by leveraging advanced analytics to evaluate the likelihood of project success and gives practical and actionable advice (Deloitte, 2019).

Deloitte's (2019) PPA capabilities enable the organization to focus in the appropriate areas of risk and allocate resources to achieve better results and it also helps managers anticipate potential project delivery risks and focus on enhancing project performance.

Ex. 2: KPMG

KPMG (2024c) utilizes AI technologies in their Intelligent Forecasting platform to help make business forecasts intelligent and actionable. This platform is based on predictive modeling and advanced analytics to provide value-added data and insights into business.

Some of the advantages of their Intelligent Forecasting are: improved accuracy of business decisions, facilitation of recognition of true drivers of business value, eliminated biases from forecasts (KPMG, 2024c).

Ex. 3: PwC

PwC (2024d) uses recall and precision analysis to assume and fine-tune the accuracy of the predictive model.

An example of their Predictive Analytics is Predictive Analytics Suite (PAS), prognostic model used to employ an algorithm based on AI and machine learning that makes objective predictions by integrating the relevant internal and external data (PwC, 2024e). This PAS solution facilitates the reduction of planning efforts and increase in prediction accuracy.

Ex. 4: EY

The company developed Risk Navigator. It integrates powerful predictive analytics, risk monitoring and forecasting tools in order to make better-informed business decisions (EY, 2024i). EY (2024d) analytics established reliable and dynamic forecasting tools and methodologies that provide near real-time data insights that increase reliability as well as support reporting and effective management.

EY (2024i) benefits from Risk Navigator by increased speed-to-value and better risk management.

Ex. 5: Microsoft

Microsoft (2018) understands that even small improvements in collections efficiency adds up to millions of dollars, therefore considers data and predictive insights a key assets to help them make strategies and focus on most important operations.

Microsoft (2018) uses past data and predictive insights for several reasons such as:

- to analyze customer behavior to be more predictive and proactive
- to improve customer satisfaction

- to optimize efficiency

Good example of their Predictive Analytics is their Azure Machine Learning solution. It is a cloud-based service that detects patterns in processing large amounts of data, to predict what will happen when new data is processed (2018). In other words, it helps Microsoft do Predictive Analytics

Ex. 6: Amazon

Amazon uses algorithms and NLP to extract web data of user's purchase history in order to predict product recommendations.

Amazon has powerful tools like SageMaker and Comprehend that allow data scientists and analysts to leverage ML algorithms to build predictive models (Nair, 2023). This type of data-driven approach enables company to maintain optimal levels of inventory and lower the risk of overstocking.

Ex. 7: Nvidia

For Nvidia (2024e) prediction and forecasting are powerful tools to help enterprises model future trends. With their accelerated data science, Nvidia (2024f) can take massive-scale data sets and craft highly accurate insights to fuel data-driven decisions. For those reasons the company designed Nvidia Time Series Prediction Platform (TSPP). A tool made to easily compare and experiment with arbitrary combinations of forecasting models, time-series datasets and other configurations providing company ability to accurately apply forecasting in different markets such as supply chain or financial one (Kranen et al., 2022).

Ex. 8: Saudi Aramco

Saudi Aramco leverages Predictive Analytics to draw meaningful insights (YahooFinance, 2024). The company's experts use AI and Big Data advanced analytics to get meaningful insights to proactively detect and predict potential issues before they occur (Sayce, 2022).

According to Sayce (2022) Aramco uses AI as brains for their Center of high-tech operations, enabling employees to predict the performance of critical Aramco facilities such as oil and gas fields and refineries to make advance and real-time data-driven decisions to improve efficiency.

Aramco (2024b) is using improved data coupled with leaps made by computational power to deliver simulations allowing them to predict future of their business with a great degree of accuracy. According to Wallace (2020) and her story about Aramco, previously mentioned data-driven predictions help reduce energy use and minimize flaring.

Ex. 9: Eli Lilly

Eli Lilly and Company (2018) collaborated with Evidation Health and gained access to their Andromeda data platform. This platform enabled them to process raw data of clinical studies and on which their predictive models are based.

Another platform Eli Lilly utilizes is the MagnolAI platform. The solutions from this platform are leveraged in clinical trials to help them better understand the disease journey, develop medicine and predict solutions (Carter, 2023). Singh (2023) pointed out the main benefit of Eli Lilly's MagnolAI platform is in improvement of health outcomes.

Ex. 10: VISA

The increasing use of digital channels for transactions has made difficult to detect and prevent fraud, therefore Visa had addressed this challenge by using predictive analytics and data mining to improve the customer experience while also reducing fraude (Uddin, 2023).

To do so, Visa relies on the power of Artificial Intelligence (AI) and Machine Learning (ML) to analyze data and foresee outcomes. Great example is Visa's AI platform and their ML model that generates a highly accurate risk score, with the purpose of helping detect and prevent fraud faster than a human could (Barding, 2023). Another example is Visa's Cybercource Decision Manager, a fraud and risk assessment tool that applies advanced ML to historical transaction data to spot patterns (Taneja, 2023). According to Uddin (2023), Visa's use of Predictive Analytics and data mining has allowed the company to effectively balance the need for excellent customer service with the need to reduce fraud, resulting in a more secure and personalized experience for customers.

Ex. 11: Apple

Machine learning (ML) is a type of AI that allows software applications to be more accurate at predicting outcomes without being explicitly programmed to do so, therefore Apple is trying its best to utilize that technological advances to improve its user experience (V Noushad, 2023).

Ex. 12: Berkshire Hathaway

Not enough verified and reliable data available.

Ex. 13: TSMC

TSMC (2024) improves its forecast capabilities by applying intelligent manufacturing technologies widely across the company departments. Due to their forecast capabilities, the company manages to maximize cost effectiveness and accelerate innovation (TSMC, 2024).

4.9 Case study: Data Security

Obtaining relevant information and knowledge from Big Data presents different risks at different stages of obtaining that data, therefore security is and essential aspect that adds value to data and effective implementation is required before any data exploitation (Talha et al., 2019). In the era of Big Data there is a certain advantage of IoT's ability to access information from anywhere at any time and on any device to collect data, but it also poses a security threat due to high potential of hacker attacks (McGilvray, 2021). Data privacy is particularly critical in the context of IoT, because the collected data is typically very rich and often includes meta-data that needs to be carefully protected with procedures such as: data confidentiality technique and mechanisms are access control and encryption (Bertino, 2016).

The Data Security features of business intelligence are important in increasing its effectiveness (Bataweel, 2015) and require 3 things: confidentiality, integrity and availability (Bertino, 2016). Data Security is focused on confidentiality, integrity and availability in such manner that confidentiality is intended to protect data from unauthorized access, integrity from unauthorized changes and availability from unauthorized users (Talha et al., 2019).

Organizations must comply with an alphabet soup of legal and regulatory requirements specific to data protection, security, privacy and the ability to share data, such as GDPR, DPA, HIPPA, CCPA, APPI (McGilvray, 2021). A good example of responsible security management can be seen in Meta and IBM collaboration, when they launched the AI Alliance to support open and responsible AI innovation while ensuring user trust, safety and security (Kaur, 2024). An important concept in the field of cloud computing and network security is Ensemble Security. It refers to a comprehensive approach to securing computer network and systems by integrating and coordinating various security components to create a strong and effective security system (Dornala 2023). AI systems can be protected from risks including cyber risks that may cause physical and/or digital harm to organizations and their stakeholders, but end-users should have access to resources to understand how AI is using their information (Deloitte, 2021).

In the following part of the text, a practical example of Data Security trend is described more comprehensively.

Ex. 1: Deloitte

Deloitte (2024g) leverages System Information and Event Management (SIEM) technology solution to provide real-time situational awareness for identifying, understanding and responding to security threats. This SIEM technology helps organizations detect and respond timely to security threats before causing damage to operations (Deloitte, 2024h).

In regards to Data security management, Deloitte's (2021) Trustworthy AI Framework™ is interesting to observe because it is an effective tool used for diagnosing the ethical health of AI, while maintaining customer privacy and abiding by relevant policies.

Ex. 2: KPMG

With the increased administrative effort come more extensive compliance obligations. Therefore, KPMG (2024a) uses LINK Go platform that successfully responds to all those requirements.

KPMG (2024a) considers LINK Go platform secure and compliant data management, in accordance to GDPR, and provides all data and documents stored securely and highly encrypted in one location. This platform assures that the company's work is in compliance with all obligations, therefore facilitates decision-making process.

Ex. 3: PwC

PwC (2024h) incorporates four key elements to their Data Security and those include: privacy, strategy and transformation, implementation and operations and Incident and threat management.

To protect against prompt injection attacks, PwC and Google Cloud (2024) collaborate on the development of cutting-edge solution that uses modular security stacks to enhance the level of LLM's security.

Ex. 4: EY

EY's (2021b) data protection framework is based on the principles of EU GDPR and addresses the issues raised by modern data management tools and systems.

The ability to provide quality services to clients worldwide comes from well-articulated protection of data and complex security strategy that is implemented in order to protect information assets from unauthorized collection, use or destruction.

Ex. 5: Microsoft

Microsoft (2024e) leverages platforms such as Fabric and Purview for protecting sensitive data by several different methods such as tagging data and capturing user activities. These platforms help ensure company compliance with data privacy regulations and requirements. Another benefit of Microsoft's (2024e) Fabric platform is ensuring data is secured from unauthorized access while it enables user to discover, classify and protect data.

Ex. 6: Amazon

Amazon AWS places great emphasis on security and compliance, therefore ensuring analytics adhered to the highest standards (Nair, 2023). According to Singh (2024), Amazon utilizes identity verification systems powered by data science to enhance the security of customer accounts.

To enable data security and control across various levels, Amazon AWS uses services such as Identity and Access Management, CloudTrail and Key Access Management to (Nair, 2023). These data-security solutions help to ensure that customers can trust the authenticity of reviews when making purchasing decisions (Singh, 2024).

Ex. 7: Nvidia

Compliance with data protection regulations is an important consideration for Nvidia. The company leverages several solutions to ensure that, but NeMo Curator and H100 GPU solutions are the most interesting.

Nvidia's NeMo Curator provides GPU-accelerated PII detection and redaction module that can specifically set categories to redact and ways of redaction (Maghoumi and Liu, 2024).

Kumar and Sakata (2023) explained how Nvidia's H100 GPU solution is used to provide technical assurance that both customer input data and AI models are protected from unauthorized view or modification during interface. According to them, this solution provides end users an added layer of trust to adopt and use AI-enabled services, as well as it assures enterprise their AI models are protected during use.

Nvidia's accelerated confidential computing with H100 GPU solution enables users to work in a versatile, scalable and secure framework which enables possibilities to innovate with AI while maintaining security, privacy and regulatory compliance (Kumar and Sakata, 2023).

Ex. 8: Saudi Aramco

Aramco (2024b) uses Biometric Authentication to enhance security by enabling biometric login to Aramco LIFE platform.

Ex. 9: Eli Lilly

In the period of pandemic, Eli Lilly's company was focused on giving access to data so the company could continue to work normally. Their CISO Harper (2020), explained how at the time the company was focused on what type of data and which users were accessing their network because the company was concerned about security threats. So at the time, the company leveraged engagement model of security situations, such as insider threats to ensure their data security (Harper, 2020).

Ex. 10: VISA

All entities that collect and process or transmit Visa cardholder data (including financial institutions, merchants and service providers) are required to be in compliance with Payment Card Industry Data Security Standards (PCI DSS). PCI DSS is a comprehensive set of international security requirements for protecting cardholder data, developed by Visa (2010). One of those is known as Secure Software Standard. This standard provides security requirements for payment software that protects the integrity and confidentiality of sensitive data that is used in payment transactions (Visa, 2024f). Another one is called the PCI Payment Application Data Security Standard (developed to create security standards for payment application vendors, mitigate risk and support the overall compliance with PCI DSS (Visa, 2010). With the integration of different security programs, Visa works hard to ensure the highest standards to protect sensitive data.

Ex. 11: Apple

Apple pays great attention to data security. That is why Apple's iOS is known for its robust security features, which protect data and privacy (Roberts, 2024).

Ex. 12: Berkshire Hathaway

Berkshire Hathaway leverages Casepoint platform to ensure data security, because Casepoint (2024) has established comprehensive security measures at all levels with ISMP including administrative, technical and physical safeguards to protect data from loss, misuse, unauthorized access, disclosure, alteration and destruction.

Ex. 12: TSMC

TSMC (2024d) is determined to maintain its competitive advantage and safeguard customer and business partners' interests by establishing "Information Security Statement" which further explains how the company makes great efforts to enhance its Information Security and Proprietary Information protection mechanisms.

TSMC Corporate Information Security (CIS) department works continuously to strengthen information security and confidential information protection by putting into play different security mechanisms such as their certified Cloud security solution. It ensures data protection for users to securely run operations in the Cloud (TSMC, 2024b). The company has also established an integrated and automatic security operation platform, that continuously drills the handling procedures of information security attacks and conducts external security risk assessment in order to ensure high data security (TSMC, 2024d).

4.10 Case study: NLP

Natural Language Processing (NLP) is the application of mathematical algorithms and computational techniques to the analysis of natural language, speech and text (Deloitte, 2021b). It involves analyzing, understanding and generating responses ultimately to enable interfacing with systems using human rather than computer languages (Halper, 2017). Natural Language Processing can be defined as an AI technique used to extract information from unstructured data sources such as text documents, images and videos (Bharadiya, 2023).

Data preprocessing is a fundamental task that directly affects the success of the analysis, especially for Natural Language Processing studies (Gurcan et al., 2022). For instance, when utilized for text, NLP parses sentences into entities (people, places, things), concepts (words and phrases that indicate ideas), themes (groups of co-occurring concepts) and sentiments (positive, negative, neutral) in order to generate quality response (Halper, 2017). NLP is used in text and social media analytics tools to analyze issues and give opinion. For example, popular case of NLP is analyzing tweets or reviewing sites for feedback on products (Halper, 2017). It can be found in interactive applications, such as chatbots or other customer experience applications (Halper, 2017). NLP techniques enable AI-powered chatbots and virtual assistants to understand and interpret customer queries and provide accurate responses (Bharadiya, 2023).

Khurana et al. (2023) classified NLP into two parts; Natural Language Understanding (NLU) and Natural Language Generation (NLG) that evolves the task to understand and to generate text.

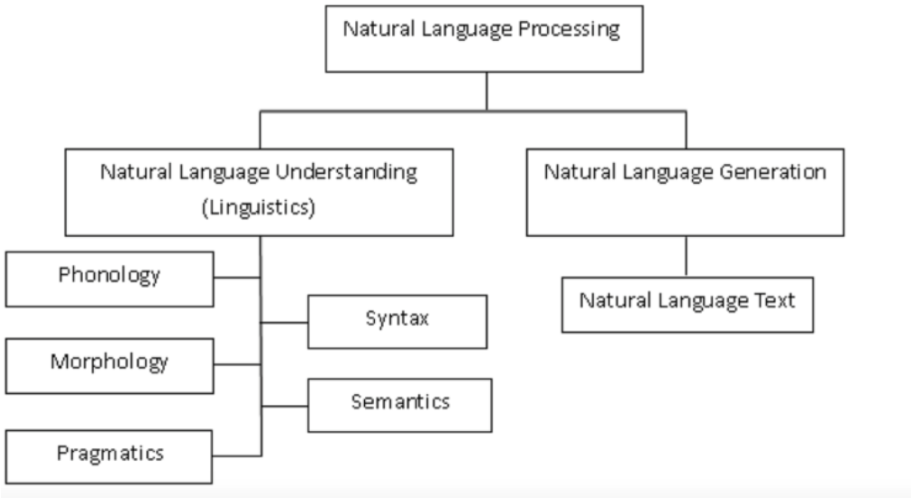

Figure 6: Broad classification of NLP (Khurana et al., 2023)

According to them, NLU enables machines to understand natural language and analyze it by extracting concepts, entities, emotion, keywords etc., while NLG is the process of producing phrases, sentences and paragraphs that are meaningful from an internal representation.

ReaLM is advancement in NLP and AI. It stands for Reference Resolution As Language Modeling, and unlike traditional AI models that only focus on the words said, it understands full context around the request. Large language models represent a significant advancement in the field of AI and NLP due to models that are trained on massive amounts of text data and are able to generate human-like text, answer questions and complete other language-related tasks with high accuracy (Kasneci et al., 2023).

ChatGPT is a great example of large language based models, which Hetler (2023) defined as artificial intelligence (AI) chatbot that uses Natural Language Processing to create humanlike conversational dialogue which van respond to questions and compose various written content.

Another NLP application can be seen in data visualization and is better known as Visualization-oriented Natural Language Interface (V-NLI). V-NLI acts as complementary input modality for visual analytics and accepts the user's natural

language queries as input and outputs appropriate visualization, however designing and implementing V-NLIs is challenging due to the ambiguous and underspecified nature of human language and the complexity of maintaining context in a conversational flow (Shen et al., 2022).

Visual Question Answering (VQA) can be considered as product of NLP and visualization. VQA is a semantic understanding task that aims to answer questions based on given visualization and possibly along with the informative text (Shen et al., 2022).

In conclusion, companies use data gathered from the IoT devices that is based on NLP and AI technologies, to better target their future customers (Mah et al., 2022). Finally, NLP is a process that can convert more unstructured data for further analysis than any group of human, therefore its greatest benefit is the ability to process large amounts of data quickly (Henry and Krishna, 2021).

In the following part of the text, a practical example of NLP trend is described more comprehensively.

Ex. 1: Deloitte

Deloitte leveraged NLP to enable rapid multi-lingual communication en masse. For instance, Deloitte's (2023) Global teams have implemented NLP-powered chatbots in organizations to allow for two-way dialogues and were trained to offer empathetic responses therefore bridging the gap between live agents and traditional automation.

Ex. 2: KPMG

KPMG's (2023) AI development platform offers developer and user interfaces to build, train, configure and deploy customized AI-enabled technology solutions which

in return help to work cohesively and seamlessly as AI is scaled across the organization.

KPMG's (2023) LINK Go platform incorporates AI technologies such as Large Language Models (LLM) and Generative AI, because of which the company believes that this platform helps them set apart from other firms and gives them their competitive advantage.

Ex. 3: PwC

PWC (2024b) understands that if generative AI strategy is aligned with existing digital tools, benefits can be enormous.

According to GoogleCloud (2024), PwC's Legal AI Studio platform features capabilities that help users quickly summarize and interpret long and complex documents, while also provides options to rapidly generate different documents needed.

Ex. 4: EY

EY's (2024k) ability to rapidly use impactful type of information fund in unstructured data and to drive value from it changed the company Application of modern AI and NLP. The company used NLP to custom-train an algorithm to extract requirements that would than populate a central database, enabling the company's analysts to rapidly search for key words, phrases and characters by both state and business function.

Ex. 5: Microsoft

Microsoft (2024g) uses text analytics, translation and language understanding services to facilitate application building that supports natural language. The company leverages Azure AI Language platform for advanced NLP analytics (Microsoft, 2024g).

Ex. 6: Amazon

Amazon is using NLP, algorithms and extracted web data from history of user purchases to make product recommendations. According to Tondak (2023), AWS uses Amazon Comprehend for NLP tasks.

Great example of NLP service and product is Alexa. Amazon's Alexa leverages both NLP and NLU technologies to convert speech into words, sounds and ideas (Gonfalonieri, 2018).

Another good example is Amazon Comprehend. A Natural Language Processing (NLP) service that uses machine learning to uncover valuable insights and connections in text (Amazon, 2024e). According to Tondak (2023) benefits of Amazon Comprehend are recognized in better answers from textual content and automated document organization that enables enhanced data seek and navigation possibilities.

Ex. 7: Nvidia

Nvidia leverages NeMo Curator services to provide text cleaning and language identification, which both help with LLM and enabling high-quality datasets generation for LLM training (Maghoumi and Liu, 2024). Except for that, NeMo Curator microservice are used to accelerate data processing pipeline for LLM training (Maghoumi and Liu, 2024).

Ex. 8: Saudi Aramco

Aramco finds NLP a tool that provides opportunity to increase efficiency, enhance safety and quality. The company uses NLP in form of Chatbots and for voice-controlled operations of well logging tools, as well as for automatic summarization of reports and according to Katterbauer et al. (2020), Aramco's other areas of NLP applications are: machine translation, information retrieval, sentiment analysis, information extraction and Q&A.

Ex. 9: Eli Lilly

With teams across the globe working in a variety of languages, the pharmaceutical multinational giant Eli Lily couldn't afford a translation bottleneck, so they turned to NLP and developed Lilly Translate (Olavsurd, 2022). A home-grown IT solution that uses NLP and deep learning to generate content translation.

According to Olavsurd (2022), Eli Lilly's IT solution Lilly Translate enabled the company to achieve greater efficiency gains, significant cost reductions, higher quality content and a way to lead future tech innovations to scale enterprise value. When the company overcame their challenge, automation has led to big cost savings.

Ex. 10: VISA

For Visa to achieve high accuracy and low latency results, company leverages NLP to model Visa transactions, thus enabling the model to learn from history of each made transactions and give great insights while significantly improve model accuracy. According to Visa's president of Technology Taneja (2023), company's goal was to have 100% of Visa employees working with generative AI in some capacity so they could improve engineering efficiency, increase employee productivity and develop even more sophisticated models. He further explained the benefits of NLP solution such as ChatGPT that can help with content summarization, research and analysis,

therefore enable the employee to focus more time on strategic and high value activities.

A great example how the company leverages NLP in their actual practice is Visa's VisaConcierge platform. The platform provides users the access to virtual assistants (chatbots), that are available 24/7 to help solve issues quickly and effortlessly.

Ex. 6: Apple

Apple recently presented ReALM, a new approach for reference resolution using LLMs so the model could understand what ambiguous phrases are referring to (Emanuilov, 2024). Apple's new AI model ReaLM is a language model designed to understand and effectively handle various contexts and provide answers about content running on the screen or in the background (Zope, 2024). According to Emanuilov (2024), Apple's ReaLM surpasses GPT-4 in handling domain-specfic user pronouncement and is potentially an optimal solution for real-world reference resolution systems offering robust and efficient framework for tackling reference resolution tasks. It can be considered as a highly upgraded version of SIRI. The practical application of Apple's ReaLM could make interaction with AI Siri feel more natural and intuitive (McCoy, 2024).

According to Emanuilov (2024) Key insights that enable Apple's ReALM's great performance are:

- Converting on-screen info to text so the language model can "read" the screen
- Fine-tuning the model on domain-specific data so it learns background knowledge
- Using an efficient text-only architecture rather than expensive multimodal models.

Benefit of Apple's ReaLM are seen in its promising results for practical implementation on devices without sacrificing performance because it excels in on-screen reference resolution even in the absence of visual cues (Emanuilov, 2024).

Ex. 12: Berkshire Hathaway

Not enough verified and reliable data available.

Ex. 12: TSMC

Walters (2024) explained how large-scale AI models used for NLP need massive amounts of data to be effective, and this data must be stored and processed in data centers, which rely on high-performance AI chips that TSMC manufactures. According to him, TSMC is responsible for around 90% of all AI chip manufacturing and is therefore considered to be the start of the AI pipeline.

Finding proof of how exactly TSMC leverages NLP for their Business Intelligence proved to be an impossible task. But after taking into consideration what Walters (2024) described, one thing is certain; TSMC definitely plays a key role in overall NLP solutions.

CHAPTER V:

COMPARATIVE ANALYSIS AND FUTURE PERSPECTIVES

5.1 Comparative Analysis

Comparative analysis 1: description

Following the advancement in technology, many BI trends emerged over time. This dissertation has explored the following 10 BI trends throughout 10 case studies:

1) Mobile
2) Self-service
3) Cloud
4) AI
5) Big Data
6) Visualization
7) Data Quality Management (DQM)
8) Predictive Analytics
9) Data security
10) Natural Language Processing (NLP).

In that process, certain links between trends were noticed. But to better understand it, it is necessary to understand key elements of Business Intelligence and BI trends. As Edirisinghe (2022) explained, there are several definitions of Business Intelligence (BI), but all of them see it as part of the decision-making process. Having that in mind, BI trends can than be observed as BI tools and processes used to assist that decision-making. If Business Intelligence is observed from the perspective of one system that serves to help with decision-making, than these specifically chosen 10 trends can be considered key elements within that system. Each responsible for a specific process involving data, with

the purpose of creating useful insights that improve decision-making. Each of these trends are single entity's with its individual characteristics that, when looked form afar, form a circle through which data travels and in the end impacts the company's business.

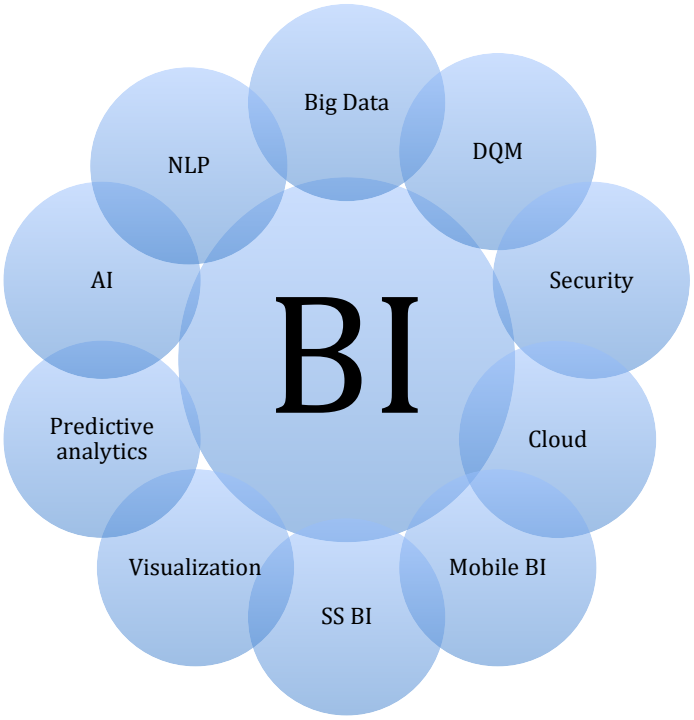

Figure 7: Business Intelligence (BI) trends circle

Big Data analytics plays a key role in Business Intelligence and impacts all other trends in certain way. Therefore, it can be viewed as the starting point of that BI system circle. Primary responsibility of this trend is to collect and organize data. In that process of data collection, companies may face the quality issue of that data. Hikmawati et al. (2021) solved that problem with Master Data Management approach (MDM), method of

maintaining, integrating and harmonizing master data that ensures data is accurate, current, relevant and contextual to meet different needs across business application. MDM is important, if not crucial to Data Quality Management (DQM). DQM does rigorous data standardization that helps ensure precision and trustworthiness of data. Essentially, strengthens data governance because weak data governance may lead to misinformed decisions and security vulnerabilities.

After acquiring relevant information from big data, different risks appear at different levels of obtaining that data.

Figure 8: Life Cycle Model for Big Data Security (Talha et al., 2019)

The link between Big Data and Data Security becomes obvious, and at the same time crucial for the business organization. Primary focus of data security trend in the circle of BI is ensuring standardized and collected data, networks and systems are protected from unauthorized access, but doing so while being in compliance with legal and ethical requirements.

Collected, standardized and protected data in the era of technology is no longer stored in big data farms, requiring large infrastructures. Instead, the technology progressed, thus allowing data to be stored and accessed via cloud. A trend that used to be a "game-changer", but now is a simple "must-have" for any organization. Cloud technology is directly responsible for Mobile BI users ability to access stored data at any time and anywhere, showing yet another connection between trends in the Circle of BI.

While the link between the Cloud and Mobile BI was data, in a manner of storage and access, the link between Mobile BI and SSBI are clearly users. For the needs of Self-service BI trend, according to Michalczyk et al. (2020) there are 2 types users: causal and power users or as Lennerholt et al. (2021) called them: non-technical and technical users. Both types of users are able to leverage BI Visualization, but not exactly in the same way. The charm of BI Visualization trend is that regardless of their skills level, both types of users can leverage this trend to create visual representation of data that helps decision-making. The most common tool in this trend is Dashboards. A tool typically used to highlight Key Performance Indicators (KPI's) (Djerdjouri, 2020). Therefore, the role of this trend in the Circle of BI trends can be identified as reporting.

Based of those and other similar or different data reports on current and historical data, the foundation of Predictive Analytics trend can be seen. Predictive Analytics can also be regarded as a last step before decision-making. This trend relies mostly on popular statistical methods, among which the "decision tree" stands out. What dashboards are to Visualization, the decision tree is to Predictive Analytics trend. The definition of Predictive Analytics, given by Bharadiya's (2023), shows the connection between this and the remaining two trends. According to her, Predictive Analytics is a prominent trend in which machine-learning (ML) algorithms help businesses make accurate predictions about future outcomes. ML is a discipline within AI that helps computer software get a better decision (McGilvray, 2021). Even though AI in business context is sometimes synonymous with ML and predictive analytics, it is a trend explored on its own but the link between the trends is obvious.

AI's role in the Circle of BI trends is best described as process that facilitates and accelerates work, decision-making and business intelligence overall. AI simulates human-like intelligence and capabilities, enabling data extraction faster and more efficient. The most common AI application is Chatbot; virtual assistant designed to simulate human conversation. NLP techniques play a crucial role in successful creation of a Chatbot, therefore it is safe to say that AI and NLP are interconnected. Consequently, it is simple to establish the link between these two trends because NLP enables effective AI.

Similar to Predictive Analytics where statistical methods are used, NLP is the application of mathematical algorithms, with of course other computational techniques that are used to extract information from unstructured data sources. The advancement in NLP and AI is substantial and has led to chatbots, Large Language Models (LLM's) and other NLP applications that help process large unstructured data and convert it into useful insights. Finally, NLP would not be effective without the access to Big Data.

And that is the point where it becomes evident that the round of these trends comes back to its starting point in the business intelligence trends circle.

Table 2: Purpose of trends and its connection

Trend	Connection	Leads to
LLDBIG DATA	Data Collection	DQM
DQM	Data Quality	SECURITY
SECURITY	Securing data	CLOUD
CLOUD	Data storage	MOBILE BI
MOBILE BI	Easy Data access	SS BI
SS BI	Easy data leveraging	VISUALIZATION
VIZUALIZATION	Reporting data	PREDICTIVE
PREDICTIVE	Predicting	AI
AI	Task facilitating /acceleration	NLP
NLP	Enabling /humanizing AI	BIG DATA

Comparative analysis 2: application

Observing 10 BI trends through 10 case studies gave a description of trend applications and examples of how companies leverage them for their benefit. Case studies included examples of how global companies with different types of business and different business needs were developing and leveraging different applications. Sometimes the applications (platforms) they used seemed to be integrated with more than one BI trend, but often their primary task was described.

The application of ten trends in question were observed through the operations of the following companies:

Table 3: List of companies observed in Case Studies

Company	Sector
Deloitte	Auditing and consulting
KPMG	Auditing and consulting
PwC	Auditing and consulting
EY	Auditing and consulting
Microsoft	Technology
Amazon	E-commerce and Technology
Nvidia	Technology
Saudi Aramco	Oil & Gas
Eli Lilly	Pharmaceuticals
VISA	Finance
Apple	Technology
Berkshire Hathaway	Diversified Investments
TSMC	Semiconductors

The results of this part of comparative analysis are divided into 4 groups, each containing 3 companies. First ten companies are grouped together based on the sector company they are operating. Fourth group shared a different feature that will be explained more extensively in the last part of this chapter.

Deloitte leverages several different trends and applications. The company's cloud solution allows quick and rapid access, while Roambi application enables oversight, interaction and presentation of specific business information. To enable decision-making based on facts and maintain competitive advantage company leverages platforms such as AIM, PPA and their Trustworthy AI Framework™ that provide objective insights and enhanced capabilities to address potential problems before they materialize. To provide real-time situational awareness of security threats, Deloitte relies on their SIEM technology solution.

KPMG has several different applications covering their BI needs, but BI solutions that originate from LINK GO platform covers Mobile BI, SS BI, Cloud, AI, NLP and security trend. That platform overlaps with Clara platform when it comes to company's needs in Mobile BI and cloud, enabling users enhanced and real-time access to audit information and reports. In order to maintain the quality of those reports, company developed Data Quality Efficiency Index (DAQUEI). That, combined with their Intelligent Forecasting platform, enables more intelligent and effective business forecast.

When it comes to prediction PwC puts its trust in their PAS model, based on AI and ML. Except for SSBI and NLP where the company leverages own platforms, the company collaborated with Google Cloud for their platform to keep up with the need for BI trends.

EY's main application of BI trends is seen in EY Strategy Edge, platform that generates actionable insight giving the company the power of intelligent data. At the same time, Helix platform is in charge of their Big Data. It facilitates the process of analyzing large amounts of audit-relevant data and gives deeper understanding of clients and operations. While Risk Navigator platform is used to support effective management.

Interestingly, only 1 out of these 4 same-sector companies outsourced platforms and tools to leverage most of BI trends.

Microsoft, the company operating on an unimaginable amount of information, handles their BI trends needs through 3 platforms; Azure, Fabric and Power BI. Platforms enable technical and non-technical business users to transform raw data from “Lakes” into actionable insights and to simply collaborate with other users.

Similar to other companies, Amazon also recognized the importance of cloud service and turned to their impressive AWS platform. Their AWS platform provides wide range of BI services that incorporate different BI trends in order to efficiently analyze data while cutting costs and remaining secure and compliant with regulations. Amazon leveraged NLP and NLU technologies to create application called Alexa, a globally known virtual assistant that has capabilities to interact with users on high-quality level.

Nvidia’s BI solution Time Series Prediction Platform (TSPP) enables the company to create highly accurate insights that drive decision-making. To ensure level of data quality needed for accurate insights, company leverages NeMo platform and its services. This platform provides several different BI solutions that give the company capabilities to turn data into actionable knowledge.

Common to the three companies coming from technology sector is that they recognize the value, importance and impact of the cloud on their business.

The largest energy company, similarly to other companies observed, understands the impact Cloud has on an enterprise and leverages Mobile Business intelligence application “The Aramco Mobility Center” to enable decision makers access to information at the right time. However, Aramco is also very focused on trend of data security because the

company's belief of its impact on the brand. While Eli Lilly's approach was more focused on collaboration. The pharmaceutical company took advantage of collaboration with different partners in order to access large amounts of valuable data, therefore enabling their big data analytics to significantly impact medicine development.
Visa's Analytics Platform is yet another example how company incorporated many trends into 1 main application. For the platform to work successfully, it depends on DQM and according to Taneja (2023) Visa has been committed to sustainable innovation by prioritizing the responsible stewardship of data to ensure is responsible, secure, compliant and reliable.

Saudi Aramco, Eli Lilly and Visa are three companies that have different focuses regarding BI trends, presumably because of the sectors they come from and the market demands of those sectors. But overall, each of them, including the other 7 companies observed have data at the center of their business and continuously works on finding ways to turn that data into valuable and actionable insights.

Leveraged BI trends in their business operations were observed through case studies, but due to lack of available data about specific trends for these 3 companies, comparative analysis of their trends applications is separated from the rest.

Table 4: Separately observed companies within the Case Studies

Company	**Sector**
Apple	Technology
Berkshire Hathaway	Diversified Investments
TSMC	Semiconductors

Companies Apple, Berkshire Hathaway and TSMC are global and successful companies who leverage Business Intelligence in their own specific ways to gain useful business insights needed to become and stay successful.

Berkshire Hathaway reached outside of their company in pursuit of solution for centralization of vast amount of their business data. Casepoint platform provided that solution in form of a repository large enough to collect, analyze and store that data. Except for Big Data, company also leveraged the same platform when in need for solutions for Data Security, mobile BI, SSBI and AI. Leveraging this platform helped the company to reduce costs, but also led to increased efficiency from enabling employees to make faster decision based on actionable insights.

The global technology company Apple manages to benefit greatly from technology improvements. Significant benefit appears in the way the company finds to leverage NLP. Their new ReALM model that is supposed to understand ironic or sarcastic phrases that previous solutions were unable to. This NLP solution combined with their AI solution Siri, helps the interaction with the virtual assistant to be more natural. That helps both the customer and the company with increase of customer satisfaction and collection of more raw data that can be processed into insights.

TSMC business relies mostly on manufacturing AI chips. Hence, the most important application of BI for this company is in predictive analytics. The application of Predictive Analytics solutions helps the company to significantly lower costs and drive innovation. TSMC is also highly focused on Data Security, because they believe that is what drives their company's competitive advantage.

Coming from different business sectors equals different primary business needs, therefore different primary trends to leverage. That is why, when Berkshire Hathaway's business

operations struggle with enormous amounts of data, the company outsourced Big Data solution to solve the issue. While the needs of global manufacturing company to improve productivity, steered TSMC towards leveraging Predictive Analytics application. And Apple as a technology giant, leaned on technology innovation to lead the company's business operations leveraging NLP and AI solutions. Finally, Comparative analysis has shown different ways of different companies working with the same goal: improvement in business through intelligence.

Comparative analysis 3: advantages

The explained trends in CA 1 and their described applications in CA 2 are leveraged with the purpose to facilitate tasks, speed up work, create insights and to overall create advantages for the companies. In order to get those results, as seen in previous CA 2, each company leveraged different platforms. Thus, as it was done in CA 2, trends are grouped accordingly with the companies who leveraged them.

Deloitte's AIM solutions help the company uncover and unlock the valuable insights out of vast amount of data. Their AI Framework™ platform helps ensure trusted data, although SIEM technology helps detect and respond timely to any security threats. The company's BI tool called Roambi helps present insights quickly and efficiently, but the most interesting advantage gained by BI trend are NLP- powered chatbots who became effective solution with capabilities of live agents and traditional automation.

KPMG relies on Clara platform to help them consistently execute auditing tasks on high level. Although, their Link Go platform helps the company set apart from others and gain their competitive advantage, while leveraging DAQEI to make basis for decision-making.

PwC's decision making was facilitated greatly when it comes to Self-service BI, due to their Employee Service Platform. The platform enhanced productivity by enabling users to solve issues without assistance. The company's predictive solutions helped increase prediction accuracy, but an interesting benefit from leveraging trends comes in form of infrastructure optimization. Achieved by outsourcing BI solutions from their collaboration with Google.

Similar to PwC, EY leveraged cloud solutions and recognized the benefit of decrease in operation costs. The platform used to gain those benefits, EY Strategy Edge, has also helped increase project efficiency and make better decisions.

The advantage in efficiency of operational processes Microsoft (2024c) gained by leveraging AI, but had help from their Fabric and Purview platforms to ensure compliance with data privacy regulations.

Amazons AWS platform with its variety of services working under that platform enhances company's business productivity. It achieves that with help of Generative BI capabilities that accelerate decision-making, while the company's data-security solutions helps them gain advantage on the field of customer's trust in the business. On the other hand, Nvidia's approach to data as a "gold mine", drives the company to different software solutions that enable cost reduction of infrastructure and operational expenses.

Saudi Aramco leveraging their Big Data and AI solution gained not only reduction of expenses, but also increase in production. Eli Lilly being in pharmaceutical sector gave a different, but specific example of advantage gained by leveraging BI. The company's Big Data analytics enabled significant time-reduction on process of medicine going from testing to commercial launch. While the power of AI helped the company replace an amount of human labor with technology solutions to speed up and increase productivity. At the same time, Visa strategic imperative lies in Big Data, while web-analytics of payments data help the company gain competitive advantage. Apple is customer oriented company, and with their innovative approach to AI and NLP is helping the company to boost innovations consequently leads to improved customer satisfaction. Less focused on AI, but with more attention on data centralization and automation, Berkshire Hathaway has profited from leveraging platforms in way of cost reductions and efficiency increase. Getting that same benefit of increased efficiency and also and costs reduction, TSMC gained from leveraging predictive analytics.

While doing the comparative analysis in regards to advantages, it is hard not to notice common understanding among observed companies when it comes to advantages from leveraging BI trends.

Common statements that area applicable to all of the observed companies regarding benefits of leveraging BI trends are:

- Big Data is ”the king”
- Without DQM, “the king” is “dead”
- Important to maintain that data secure
- Leveraging cloud cuts infrastructural costs
- Increased speed and efficiency give businesses advantage
- AI facilitates the previous point

Previous statements helped identify the six key words that influence current BI trends.

Figure 9: The six influential key words of BI trends

5.2 Future Perspectives

During this research and taking into account case studies and literature review, realization occurred regarding concerns about possible challenges of some BI trends, such as:

- Lack of standardization among cloud services (Bigelow, 2022)
- Occasional negative impact of AI (KMPG, 2023)
- Big Data Visualization lead to loss of information (Gandhi and Pruthi, 2020)
- Overwhelming executives with large volumes of data from different sources (PwC, 2024a)
- Data Lake = data swamp (Amazon, 2024c)
- Misspelling words, irony, sarcasm and informal phrases = main challenges of NLP (Khurana et al., 2023).
- User-friendliness doesn't necessarily equal neat results (Hashemi-Pour et al., 2024)
- Poor data quality can lead to poor business decision and missed opportunities (Schlener et al., 2023)
- Data privacy and reliability from Data Lakes (Prakash, 2020)
- Problem of prescriptive analytics is dealing with uncertainty (KPMG, 2021)
- Data Security processes slow down managing data (Talha et al., 2019)
- Cyber security gap is a key challenge for all organizations making the move to cloud (PwC, 2024g)

But this thesis identifies these challenges as the basis for future perspectives of BI trends. The first half of previously mentioned challenges are addressed and the problem-solving ideas or in other words future perspectives, are presented in the following text.

Data lakes are future of Big Data analytics. Although Amazon (2024c) raised a question about data lakes potentially turning into data swaps, the future of data lakes seems bright. Especially thanks to centralized repository that it provides, along with other advantages.

Table 5: Advantages of Data Lake

DATA LAKE ADVANTAGES	
High volume	Cost saving
Centralizes repository	Time saving
Structured, unstructured and raw data	

The immense impact that the cloud had on businesses intelligence is remarkable. Easy and anytime data access became a standard, therefore looking forward into the future I expect this trend to evolve further into creating a new standard. Multi-clouds and Hybrid clouds are expected to be that new standard. Enabling work optimization by leveraging new and different platforms from multiple clouds, regardless of limits that standard one-cloud provider has is the next step on for BI. The significant difference between Multi and Hybrid cloud is that unlike Multi-cloud, Hybrid cloud is combination of multiple clouds out of which at least one is private while the others are public.

The (negative) impact of AI mentioned previously by KMPG (2023) is real concern in need of real solutions. In my opinion the adequate solution to this issue is generative AI, a fast-growing trend that is a sequel to traditional AI. It does not exclude traditional (aka. narrow and general) AI, but it is elevated with new models and solutions enabling better performances and less inadvertent errors.

Currently, Natural Language Understanding (NLU) and Natural Language Generating (NLG) are considered to be sub-sets of NLP. Thanks to NLP and AI many businesses leverage services of chatbots. But Gen AI combined with or maybe even imbedded in NLP will innovate the way machines “talk”. The high power of machine learning inside the Gen AI should give BI applications such as chatbots the abilities to identify, process and deal with irony, sarcasm and other challenges NLP faces today and a way to talk more humanly. Therefore, looking into the future I expect the roles within NLP structure to change in a matter where NLG will no longer be a sub-set of NLP, in fact it will be the other way around.

As AI is becoming inevitable in all aspects of Business Intelligence, particularly in organizations of global proportions, it stands to logic that AI will soon be an active part of BI Visualization and maybe even transform it into a trend called AI Visualization.
Gandhi and Pruthi (2020) and PwC (2024a) raised the issues about large quantity of data might lead to data loss and to overwhelmed executives, but imagine virtual assistant helping out with Data Visualization. As research describes AI has the ability to outwork a human and see patterns faster and since AI is involved in construction of those reports from the start, it would assure no data loss. Leaving managers, executives, analysts and other whom may leverage Visualization, in a position to make further decision what to do with the acquired knowledge. Solution would be less time consuming, more efficient and would facilitate decision-making.

Company’s abilities to adapt their strategies to the pace of technology advancements that impacts BI trends, will define their position on the market. Leveraging Predictive Analytics to foresee future business outcomes was good, but looking into the future it is most likely companies will rely more on Prescriptive analytics as it will give them input what they should do, instead of what just what is going to happen. But it all starts with

the quality of data. Therefore, maintaining quality and security of data must be primary objective of every BI strategy.

The second half of challenges from the beginning of this chapter have been mentioned on purpose, but deliberately not addressed due to their role in recommendation for future research.

CHAPTER VI:

CONCLUSION

The dynamic nature of the market and competitors dictates the pace in which companies find themselves in need of quick answers and solutions. That is why Business Intelligence (BI) plays a key role in business organizations. Complexity and high-cost of implementation are recognized as challenges for the organizations, but global companies understand the necessity of the solution and the long-term benefits it brings.

The technological improvements had led to increase of data that is being collected, processed and analyzed continuously. At the same time traditional BI evolved and offered new solutions, nowadays known as trends. Many of them emerged over time, but this research focused on specific ten trends because they are considered the most promising, and together form the BI trend Circle. The Circle shows ten trends that are part of BI, and when observed for afar as a unified system, it is noticeable how interdependent these trends are.

Depending on the sector the company operates and their needs, companies leverage some trends more than others. For instance, companies coming from technology sector are more focused on cloud solutions for their business. However, all trends and are leveraged to gain advantages in forms of task facilitation, efficiency optimization and cost reduction.

Global companies mostly do not outsource platforms and tools when leveraging BI trends. Instead they develop the applications (platforms) themselves. Most of those platforms are integrated with tools used for multiple trends. Based on the samples used in case studies, it can be concluded that global companies understand the value of data and its role in BI. Furthermore, the importance of quality of the acquired data as well as keeping it secure is a priority for every business in order to maintain competitive advantage. To accomplish that, Big Data, DQM and Data Security trends are leveraged. When reporting, for example on KPI’s, every company’s managers and executives rely

the most on BI Visualization due to its the easy-to-use and easy-to-understand characteristics.

Previously mentioned technology advancements significantly impact BI and its trends, particularly NLP and AI. What started as simple text analysis, led to development of new application and solutions such as chatbots and virtual assistants that are becoming more "human". AI is an essential piece of Business Intelligence, particularly in organizations global size. The capabilities AI has are immense. Its role in BI gives opportunity for current trends to evolve and new ones to be created. The future perspectives of Business Intelligence will rely on development of AI, but that development will depend greatly on AI's compliance with laws, regulations and ethical standards that need to be followed.

Finally, further research on this topic is recommended, but should be adapted to companies of different sizes (small and/or medium). In addition, further research should address new emerging trends, as well as their advantages and challenges.

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