Isha Tamang

Big Data Analytics: Challenges and obstacles in deployments

Master's thesis

NTNU
Norwegian University of
Science and Technology

Isha Tamang

Big Data Analytics: Challenges and obstacles in deployments

Master's thesis in Information Systems
Supervisor: Patrick Mikalef
June 2020

Norwegian University of Science and Technology
Faculty of Information Technology and Electrical Engineering
Department of Computer Science

NTNU
Norwegian University of
Science and Technology

Abstract

Big Data Analytics (BDA) is evolving as an essential topic for researchers and practitioners due to its potential to improve business efficiency and productivity in a firm. Despite the opportunities and strategic business values that can be gained from the use of big data analytics (BDA), some various challenges and obstacles need to be addressed during the adoption of BDA. Many researchers describe how values are created from the adoption of big data analytics in an organization. Still, there are very few papers focusing on the challenges and barriers the company faces while adopting and creating values from big data analytics. The main objective of this thesis is to investigate the various challenges and obstacles experienced by the organizations while utilizing BDA tools for creating and converting extensive data into business value.

This study aims to answer the following research questions:
RQ1: How do organizations use big data analytics in the decision-making process?
RQ2: Does big data creates value in an organization, and through what ways?
RQ3: What are the main challenges in the deployment of big data analytics?

The semi-structured interview was conducted with two different companies from Greece and Nepal to answer our research questions. The paper compares the cases and presents how the firms implement BDA tools and strategies for generating business values and achieving competitive advantages. This research also identifies the various BDA benefits and BDA issues experienced by the organizations.

Keywords: Big Data Analytics, challenges, business value, adoption

Preface

This Master thesis report is submitted to the Norwegian University of Science and Technology (NTNU), Department of Computer Science as part of the course TDT4900, Master's thesis. The project work has been performed under the supervision of Professor Patrick Mikalef.

Acknowledgment

I would like to express my deepest appreciation to my supervisor Patrick Mikalef, Department of Computer Science, NTNU, for his supervision and guidance during the thesis period. He has contributed to this thesis research with his experience with research in Big Data Analytics.

I would like to acknowledge with much appreciation to all the interviewees who were participated in the interviews and helped by sharing their knowledge and experiences with Big Data. I would also like to express a special thanks to NTNU and IDI for facilitating a great learning experience. It would not have been possible without them.

Isha Tamang

This page is intentionally left blank.

Table of Contents

List of Tables

This page is intentionally left blank.

List of Figures

This page is intentionally left blank.

Abbreviations

BA	= Business Analytics
BD	= Big Data
BDA	= Big Data Analytics
BDPA	= Big Data and Predictive Analytics
BI	= Business Intelligence
DAMA	= Data Management
DB	= Database
GPS	= Global Positioning System
IS	= Information Systems
IT	= Information Technology
HDFS	= Hadoop Distributed File System
HR	= Human Resource
MSSQL	=Microsoft Structured Query Language
NPS	= Net Promoter Score
PII	= Personally Identifiable Information
RBAC	= Role Based Access Control
SAS	= Statistical Analysis Software
SCM	= Supply Chain Management
SLA	= Service Level Agreement
SSAS	= SQL Server Analysis Services
SSIS	= SQL Server Integrated Services
SSRS	= SQL Server Reporting Services

This page is intentionally left blank.

1 Introduction

The rising technological advancement of big data is perceived as the most important field of future information technology (Lee, 2017). Big Data Analytics (BDA) is an evolving trend with the identified potential to change how companies handle and improve high-value business performance (Popovič et al., 2018). The technological developments in big data infrastructure, analytics, and services allow firms to transform themselves into data-driven organizations. Big data has always been a critical driver for a business organization in strategic decision making. And since the volume of big data generated and gathered in a company is growing at a rapid pace (McAfee & Brynjolfsson, n.d.), it jeopardizes the recognition and retrieval of the relevant information required to handle the corporation and to create value out of it. Therefore, the firm these days are obliged to develop and use upgraded technology for managing big data and information to adapt and survive in the competitive global market (Popovič et al., 2018). BDA is defined as the application that is used for processing and analytics of big data for improving and achieving business benefits (Grover et al., 2018). The use of big data analytics in a company can provide valuable insights and competitive advantages if the system and the required IT infrastructure is implemented and appropriately adopted. The proper acquisition of BDA effectively can aid a business organization to create a competitive benefit by identifying their customer requirements and upgrading its services based on those requirements.

The introduction is divided into five subsections. The motivation of the thesis project is discussed in section 1.1, followed by the project description in sections 1.2. In section 1.3, the purpose of the thesis, along with the research questions, are presented. The research methodology is stated in section 1.4. Then we shall wrap up the introduction by the outline of the thesis in section 1.5.

1.1 Motivation

Over the past few decades, business organizations have been using large databases and analytics for making any real-time business decisions and finding different ways to take advantage of the big data phenomenon (Galbraith, 2014). Since the enormous databases and information in it has the potential to change the industry positively radically, the company need to create capabilities to harness big data to survive in a competitive market (Lee, 2017). However, the quantity of information and data produced, accessible and collected by the companies is growing in a rapid pace which poses a challenge to business as it makes it challenging to recognize and extract the most relevant information needed to manage the market and supply chain (Kache & Seuring, 2017). Despite the enormous opportunities, it is very challenging for the business organization to achieve essential insights and create values from big data analytics. Since it involves defining where, how, and what amount will be produced, it is a complex process to convert IT investment in BDA to useful capabilities (Grover et al., 2018).

The specialization project that was undertaken in fall 2019 "Big Data Analytics: Challenges and Obstacles in Deployment" for the course TDT4501 works as the base for this master thesis. This research will contribute to better analyze the obstacles and barriers of big data analytics on value creation in the context of enterprise and supply chain. The analysis of the data collected from the research can be useful in a deeper understanding of how an organization can use its big data resources to fully exploit BDA's quality to enable better flexibility and improvements in its manufacturing operations. The comprehensive analysis of data analytics used in various companies will provide businesses with a new, practical approach to generate value from business analytics.

1.2 Project Description

This master thesis presents cases from two countries; Greece and Nepal. This paper aims to examine how two different firms with cross-cultural differences are implementing big data analytics to create business values, which is briefly discussed through the multiple case study in this project. The big data analytics tools and technologies used by different companies around the world varies based on their organizational context. In an organizational context, the process of deriving big data consists of data collection, processing of information, and visualization of the knowledge. In contrast, the decision-making process involves the adoption or rejection of the insights and taking action based on it. This paper compares the cases of two different organizations with distinct features and organizational context on how they implement BDA tools and strategies for generating essential business values to the organization.

1.3 Research Question

Big Data Analytics has become a significant field of study for both professionals and scholars, which has the potential to improve and manage the high-value business results of the company. The barriers that an organization encounters during its deployment process has not been addressed well in the past study. This research aims to analyze and explore the main challenges and obstacles that the company experienced during the adoption of BDA. The research questions involved are listed below:

- **RQ1:** How do organizations use big data analytics in the decision-making process?
- **RQ2:** Does big data creates value in an organization, and through what ways?
- **RQ3:** What are the main challenges in the deployment of big data analytics?

1.4 Research Methodology

The research plan is adapted from the standards suggested by (Oates, 2005) for conducting research **(See Figure)**. The study started with systematic mapping and creating an overview of the

field by establishing a conceptual framework for further analysis. The systematic literature review of the existing literature was done as a specialization project, under the principle and guidelines of (Kitchenham, n.d.), which further aided in gathering the research questions for the thesis.
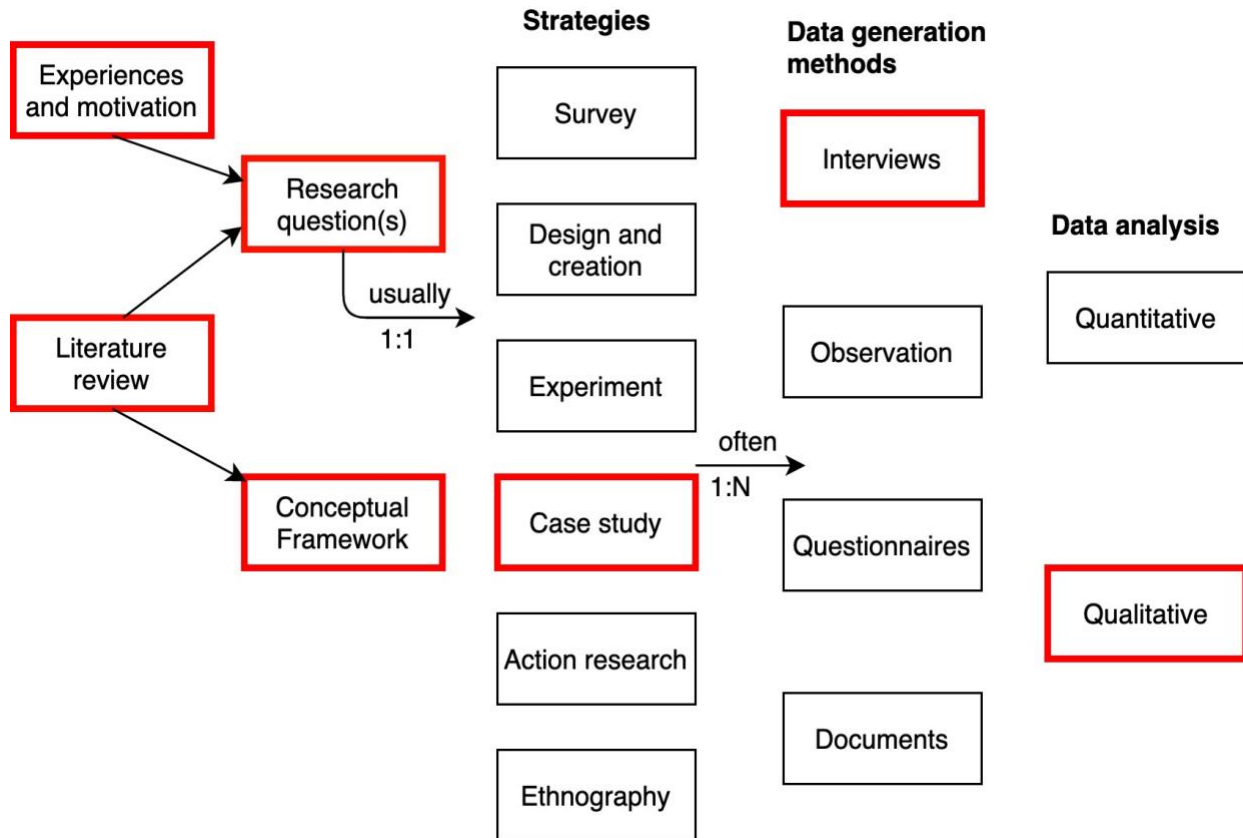
Figure 1. 1 Research method overview

The case study of two different companies is used as the research strategy. Our research strategy is the multiple case study; the data and information for the research are gathered through an interview with one of the employees from each organization. And to report our research questions, a qualitative approach is performed for the study.

1.5 Thesis Outline

The thesis proceeds, as mentioned in this section. In Chapter 2, the background of the study is introduced. This section explains the definition of big data and analytics, business analytics and business intelligence, the value of BDA, and the various challenges of BDA from the systematic literature review. Then the research methodology carried out for the study is discussed in Chapter 3 that includes cases and the data collection method. The results of the research and the cases

obtained from the interviews are presented in Chapter 4. Chapter 5 covers the discussions on Research Implications, Practical Implications, and Limitations of the results. Finally, in the end, in Chapter 6, the thesis concludes with a summary of the research question's answers.

2 Background

Big Data has become the most debated subject among researchers and practitioners (Mikalef et al., 2018), proliferating due to the large degree to which data has been produced, exchanged, and used currently (De Mauro et al., 2016). Generally, the term "big data" is defined as the large, varied sets of information that can be collected, exchanged, aggregated, processed, and evaluated (Korhonen, 2014). Big Data is believed to be the future and the next big thing for innovation (Gobble, 2013). Different researchers and scholars provide a different interpretation of big data considering its emerging nature (Fosso Wamba et al., 2015).

2.1 Big Data and Big Data Analytics

Big Data is defined as a comprehensive approach for handling, processing, and analyzing 5 Vs (i.e., volume, variety, velocity, veracity, and value) to generate actionable insights for sustained value delivery performance assessment, and competitive advantage (Fosso Wamba et al., 2015). However, most researchers characterize big data by volume, velocity, and variety (Chen et al., 2015; De Mauro et al., 2016; Grossman & Siegel, 2014; Hazen et al., 2018). Some scholars describe it as a unified approach to organize, process, evaluate the 6 Vs, including valence (Saggi & Jain, 2018a). Volume refers to large amounts of data, either consuming large amounts of storage or involving large numbers of records (Fosso Wamba et al., 2015). Similarly, velocity refers to the fact that Data is produced and continually arrived at an unprecedented speed and must be processed on time (Grover et al., 2018). Variety is defined as the availability of data in a variety of formats, from structured data to unstructured data (e.g., text documents) (Grover et al., 2018). Big data are also attributed to veracity to emphasize the importance of quality data and the level of trust in various data sources (Fosso Wamba et al., 2015). Valence refers to the connectivity of big data in the form of graphs. Verification in service technology and servitization can be challenging as it is complicated to monitor and maintain the necessary level of data quality in all aspects that can be done by incorporating different access rights and the trust between partners (Opresnik & Taisch, 2015). Economic value is extracted from vast volumes of a wide range of data by allowing the high-velocity capture, discovery, and analysis (Saggi & Jain, 2018).

Table 2.1 Definition of Big Data

Author(s) and Date	Definition
(Saggi & Jain, 2018)	Big Data is designed to derive value from massive volumes of a wide variety of data economically by enabling the collection, discovery, and analysis of high-velocity data. It was defined as a systematic method for organizing, processing, and evaluating the six characteristics; volume, variety, velocity, veracity, valence, and value.
(De Mauro et al., 2016)(De Mauro et al., 2016)	Big Data is the information asset defined by a high Volume, Velocity, and Variety that requires specific Technology and Analytical approaches to transform it into a Value.
(Huberty, 2015)	Big Data is the collection of large quantities of data regarding individual behavior through data-driven services.
(Hazen et al., 2018)	Big Data is characterized as information assets with high-volume, velocity, and variety that allow better analysis, decision-making, and automated processing.
(Korhonen, 2014)	Big Data is the broad set of data that can be captured, communicated, aggregated, stored, and analyzed.
(Xu et al., 2016)	Big data describes data sets that are so large, unstructured, and complex that require advanced and unique technologies to store, manage, analyze, and visualize.
(Fosso Wamba et al., 2015)	Big Data is a systematic method for managing, processing, and evaluating 5 Vs (i.e., volume, variety, velocity, veracity, and value) to generate actionable insights for continuous value creation, performance assessment, and establishing competitive benefits.
(Demirkan et al., 2015)	Big Data is the concept used for gathering large and complex data sets that processing with one hand database management systems or conventional data processing applications is complicated.
(Grossman & Siegel, 2014)	Big Data is a data whose volume, velocity, and variety make it difficult for an enterprise to handle, interpret, and extract value using existing or traditional methods and systems. Analytics, therefore, is used to process and extract value from those complex data.
(Zeng & Glaister, 2018)	Big Data is about a large volume of quantitative data, of various kinds, promoting specific decision styles and time frames for decisions.

Big data analytics (BDA) is believed to be the next frontier of innovation (Mikalef et al., 2019), competition and productivity powered by the omnipresent adoption and use of BDA-enabled tools, technology, and infrastructure, including social media, mobile devices, automated recognition technologies that allow the Internet of Things, and cloud-enabled business platforms to achieve and maintain a competitive advantage (Wamba et al., 2017). BDA is considered to be the implementation of techniques of statistical, processing, and interpretation of big data for business advancement (Grover et al., 2018), and the goal is to recognize behavioral patterns within the data, which ultimately allow future behavior to be predicted to some degree. However, it is not limited to social network posts, updates and photos, sensor readings, and cell phone GPS signals (Kache & Seuring, 2017). Since the use of big data analytics seems to be beneficial for supply chain management, the researchers emphasize the importance of BDPA for the transformation of supply chains noting that BDPA will help to reduce supply chain costs and achieve productivity, responding more quickly to changing the environment, provide more leverage in supplier relationships with suppliers and improve sales and operational planning capabilities (Gunasekaran et al., 2017). BDA has high-operational and strategic potential to change the way firms do business (Ren et al., 2017). And since the transformation of the industry is positive, BDPA tools and skills are used by current firms of all sizes to generate market advantages over competitor firms that choose not to employ BDPA or are unable to use it effectively (Gunasekaran et al., 2017). It has been reported that more than 10 percent of their IT budget on data alone and are witnessing a transformation by using Big data and analytics as a strategic asset to direct decision-making and optimize business processes and results (Grover et al., 2018).

Table2. 2 Definition of Big Data Analytics

Author(s) and Date	Definition
(Wamba et al., 2017)	Big Data Analytics is defined as a holistic approach for managing, processing, and analyzing the data-related dimensions of 5 V (i.e., volume, variety, velocity, veracity, and value) to create actionable ideas for sustained value delivery, performance measurement, and competitive benefits.
(Kache & Seuring, 2017)	Big Data Analytics refers to the application of advanced statistics to any form of stored electronic communication that may include. Still, it is not limited to, messages, notifications, and images posted on social networks, readings from sensor readings, and cell phone GPS signals.
(Grover et al., 2018)	BDA is the application of statistical, processing, and analytics techniques to big data for improving the business.

| (Ren et al., 2017) | BDA is described as' the data and technology set that accesses, integrates, and reports all available Data by filtering, correlating, and reporting observations unattainable with past data technologies. |
| (Côrte-Real et al., 2017) | BDA is designed to extract value from an enormous volume of a wide variety of data economically by allowing high-velocity identification, discovery, and analysis. |

2.2 Business Analytics and Business Intelligence

Business analytics (BA) refers to a collection of strategies, organizational processes, and tools used in combination with each other to gain information, evaluate that information, and forecast the outcomes of problem solutions in any of the four SCOR areas (Plan, Source, Make and Deliver) (Trkman et al., 2010). Business analytics involves analyzing organizational data to enhance decision-making and business processes (Shanks et al., 2010), while BA systems include the use of advanced statistical analysis techniques in modeling, simulation, forecasting, and Data mining (Shanks & Bekmamedova, 2012), that allows managers and other decision-makers to view organizational data to enhance decision-making and improve business processes (Shanks & Sharma, 2011). It is observed that analytics could provide additional competitive benefits to the company. Therefore the performance is analyzed to understand and track the related market trends by using the information and analytical approaches extensively (Schläfke et al., 2013). Business Intelligence is described as a process for describing a variety of different information analysis applications that enable informed decision-making based on a broader understanding of organizational data resources (Fink et al., 2017).

2.3 The value of Big Data Analytics

The value that is extracted from big data is the main reason behind the implementation of big data analytics solutions by the companies. It was reported that the company uses BDA to facilitate a wide range of performance dimensions in terms of planning, manufacturing process, and quality assurance (Popovič et al., 2018). The insights of BDA can be used in many fields to create business value such as business process improvement, customer experience, and market enhancement, performance improvement, and the creation of symbolic value such as brand image and reputation (Grover et al., 2018). However, merely the large volume of data in any firm cannot always provide the value in business performance. Therefore, understanding the mediating process and mechanisms is very crucial for the company so that BDA can contribute as a tool for harnessing the strategic business value and keeping companies competitive (Grover et al., 2018).
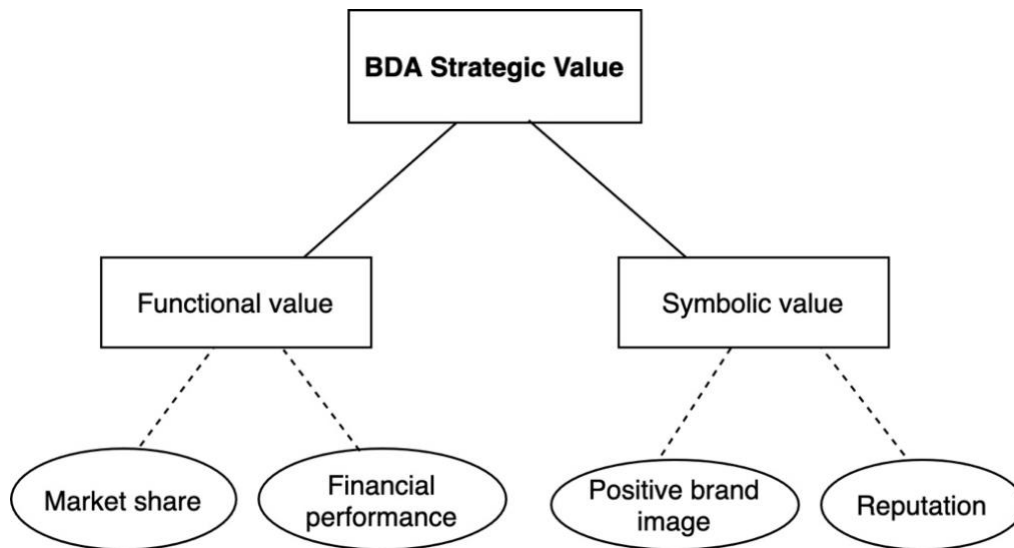
Figure 2. 1 BDA strategic value

Big data analytics enables a firm to facilitate the most efficient, effective and competitive use of the assets owned by the company, and understand the performance as well as the strategies implemented by their competitors in the market (Mikalef et al., 2020). The data experts in an organization may use analytics to identify new opportunities and risks, capture new opportunities through business model design and strategic investments, and convert or reshape existing business models and strategies (Conboy et al., 2020).

The use of BDA is defined as the degree to which BDA has been used to create business insights across primary supply chain activities and therefore, the impacts of BDA use to supply chain performance is examined with two critical dimensions within SCM; (a) Asset productivity, that describes the extent to which a firm makes efficient use of both current and fixed assets and (b) Business growth, which enables a company's business processing capabilities to analyze and integrate information collected from different sources and guide the extracted data to appropriate decision-makers in functional supply chain departments (Chen et al., 2015). By analyzing the information based on its customer, the firm can also create value for product/service innovation. For instance, through analysis of online consumer product reviews or consumer discussion boards, a company may identify the frequently reported product issues or the desired features of specific products or services that provide insights into product/service development (Grover et al., 2018).
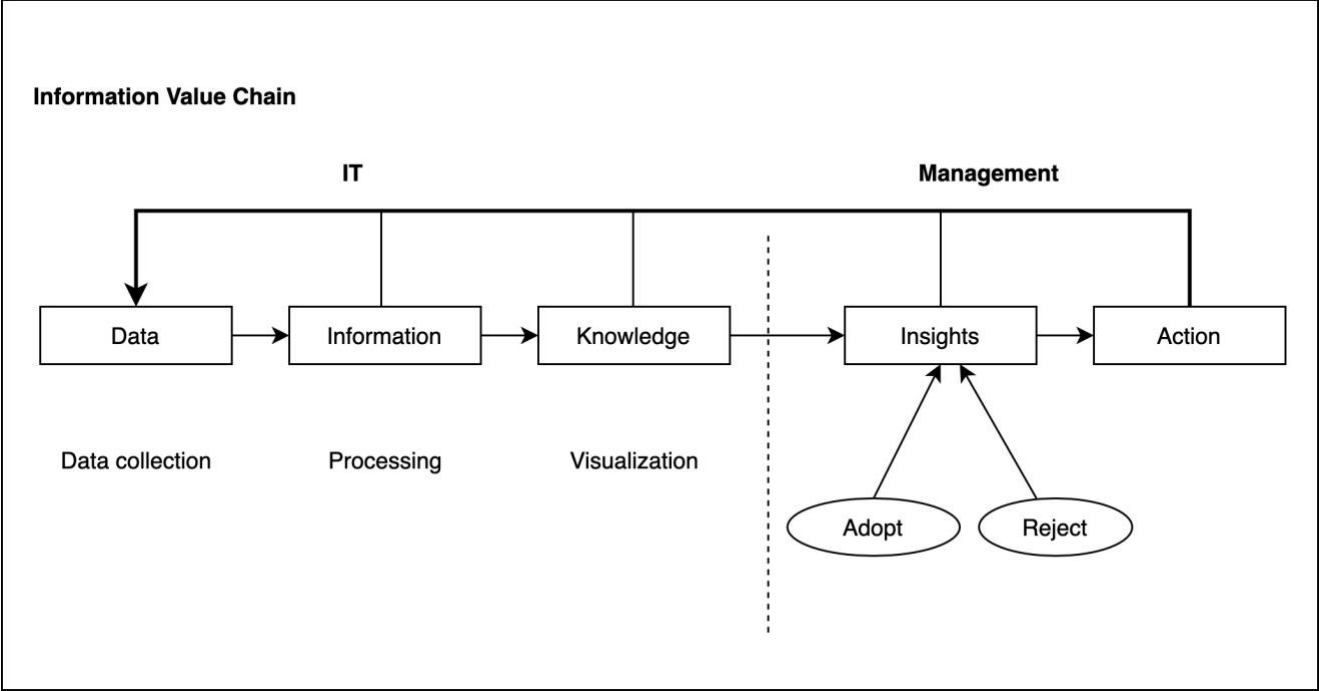
Figure 2. 2 Information Value Chain

The information value chain is the series of steps for turning data into action. The process of making sense from data into knowledge and visualization into insights followed by action is known as datafication (Lycett, 2013). Since the decisions and actions by management results to business value (Abbasi et al., 2016), it has become imperative for any data-driven company to understand this chain for using the insights to make decisions and take any action. Thus, these gears, data, insights, and actions are supposed to shift simultaneously for strengthening the ability of a company to generate strategic business value through BDA formulation and implementation (Grover et al., 2018).

The firm performance studies have indicated that information systems facilitate timely decisions and improve competitive advantages by promoting innovation and offering a means of managing environmental uncertainty (Popovič et al., 2018b). As a result, firms rely on their information systems for the provision of high-quality information that is relevant, reliable, accurate and timely (Popovič, A., Hackney, R., Coelho, P. S., & Jaklič, J. 2012), which facilitates improvements in decision quality and can, in turn, elevate firm performance. However, to select suitable applications and analytical models for the particular business needs, the managers and executives need to understand the big data analytics technologies and their revolutionary effect (Lehrer et al., 2018). Since a vital source of service innovation and a range of innovation opportunities can be provided by the enormous amount of customer knowledge from the sources inside and outside the business, BDA has been associated as the next frontier for innovation by many researchers and practitioners (Mikalef et al., 2019; Mikalef et al., 2020; Lehrer et al., 2018). BDA allows a firm to create a smart data of its customers and interact faster according to the customer's preferences, which helps in improving the customer support services (Lehrer et al., 2018). The interaction with

the clients helps in better understanding their unrecognized needs and expectation from the services provided by the company (Mikalef et al., 2020), which gives the clear insights to the managers for developing new innovative services and products for their targeted customers. Therefore, to grasp the opportunities and benefits from the insights information, business organizations are highly increasing their investment in different technologies (Chen et al., 2012).

2.4 Challenges of Big Data Analytics

Despite many opportunities and benefits with the use of big data analytics in a business firm, many organizations face obstacles in the adaption of BDA. As a result, they fail to achieve their organizational goal. Even though BDA can create value by improving business process effectiveness, efficiency, and productivity, the improvement of business processes is a difficult challenge that requires complicated and robust supporting systems (Grover et al., 2018). There are severe issues for different applications in terms of data, process, analytical modeling, and management to transform BDA into strong ideas for creating value (Saggi & Jain, 2018). Based on the research study carried out by (Kache & Seuring, 2017), the main challenges of big data deployment on a corporate level can be IT capabilities and infrastructure, business strategy and objective, talent management and HR, as well as information and cybersecurity, while the challenges from a supply chain perspective can be governance and compliance, integration and collaboration, IT capabilities and infrastructure, and information and cybersecurity.

In a company, the team with clear BDA strategies that have a clear goal and can formulate the business issue would probably succeed, as the team will be able to identify the success and think logically on their strategy (Grover et al., 2018). However, it is challenging for the manager in a company to think critically about analytics techniques and analyze them based on those data (Saggi & Jain, 2018). Similarly, an organizational structure and the governance framework plays a significant role in collecting and analyzing data over a firm and delivering ideas into where it is most required. The data should be gathered and processed in centralized governance to ensure that all the projects in a firm related to big data apply the common standards, protocols, methods, and tools. (Grover et al., 2018).

2.4.1 Talent Management and Human Resource

The lack of big data expertise, such as data scientists and big data analysts in an organization is one of the major issues that need to be addressed and solved (Mikalef, 2017; Grover et al., 2018). For an organization, it is very challenging to manage their employees and human resources because the company needs a qualified and skilled big data personnel capable of understanding statistical modeling, operating big data systems and analyzing the streams of data, but the companies struggle to recruit such skilled employees (Kache & Seuring, 2017). The reason for this issue could be an improper job description or the lack of knowledge of what they may be required while recruiting the employees. The ignorance of the recruiter or any employees in an organization could be the

reason behind it. However, the quality of accepting the ignorance and turning it into knowledge is crucial for any firm since it is difficult for rivals to mimic such ability of a company (Erevelles et al., 2016). Therefore, a firm must tackle this issue and develop a team of experts with enough BDA skills and knowledge to capitalize on the promise of big data (Grover et al., 2018).

2.4.2 IT capabilities and infrastructure

Strong IT skills and infrastructure are needed to analyze and use data from a large amount of information. The IT capabilities issues include a lack of skilled and qualified IT human resources in a firm. The financial investment cycle could be the reason for the shortage of capable IT infrastructure. The modification or replacement of the current IT infrastructure is often delayed as the capital may not have been entirely amortized by the period of update (Kache & Seuring, 2017). To manage the required IT infrastructure and to prioritize the investments in the system or technology needed for BDA is a challenge for the company.

2.4.3 Information and cybersecurity

There is a huge volume of data in a company that should be managed, but the bulk of data comes with great responsibility. Privacy and security are the popular focus of most of the massive data regulations, policies, and protocols being created (Demirkan et al., 2015). A business organization should ensure the data security that includes access authorization, data auditing monitoring of data exchange, and the structure of the governance (Zeng & Glaister, 2018). A company has access to many sensitive data of the customer, which is to be kept confidential. Such access to sensitive data and information leads to data security issues from a customer point of view. So, the customers may be more careful, or they may not want to share their information with the company, which could hinder an enterprise in data collection of their client (Kache & Seuring, 2017). In a firm, there might be a situation in which third party and workers are involved in data analytics for which a company must address any possible security, confidentiality regulation compliance, or liability concerns that might emerge from such a situation (Grover et al., 2018). Ensuring that the data of their customers in a company is not being shared with anyone or any kind of entity without the owner's consent and managing cybersecurity is a significant challenge for the company in a digital world (Kache & Seuring, 2017). An organization should prepare and plan for cyber-attacks and develop and implement strategies to prevent such potential violations in a timely way from reducing their deleterious effect and from creating data security and data management systems secure (Grover et al., 2018).

2.4.4 Decision-making challenges

BDA has power in dealing with real-time risks that guide an enterprise to enhance its decision making for business planning (Xu et al., 2016). The use of business analytics helps an enterprise to provide valuable decision-making by using analytical methods to minimize operating costs and accurately predict market trends (Trkman et al., 2010). However, realizing the full potential of

BDA is indeed a real challenge. Therefore, the decision support system should be very carefully implemented (Shang et al., 2008). Similarly, maintaining the excellent quality of data in order is also vital in decision-making processes. For instance, weak quality data resulting from redundant applications and databases consumes unnecessary data storage costs and is difficult to access data when needed (Beath et al., 2012). According to (Fosso Wamba et al., 2015), there is always a risk of duplicate, inaccurate and redundant data in a system that results in an erroneous decision by the manager and also wastes the organizational resources. This will be the barrier while turning the big data into business value.

This page is intentionally left blank.

3 Research Method

This chapter presents the research and data analysis methods used for this thesis. The research strategy is derived and implemented from the concept and ideas recommended by (Oates, 2005). Since the purpose of this research is to examine the ways in which different companies these days are handling and deploying big data analytics, the cases were studied using an interview as a data generation method, which is described briefly in section 3.1. Further, qualitative data was collected from the semi-structured interviews with two different companies with a cross-cultural background; Company A in Greece and Company B in Nepal. Similarly, the data collection processes, interview processes, and the participants are presented in Section 3.2.

3.1 Cases

A case study focuses on one aspect of an entity that is to be investigated: an organization, a department, a discussion forum, and so on (Oates, 2005). As mentioned earlier, an interviewing method is used for collecting data and studying the case in depth. The multiple cases are discussed briefly in the sub-section below.

3.1.1 Case study 1: Company A

Company A is the largest private insurance firm in Greece that manages all of the insurance business lines and serves more than 1 million individuals and corporate clients. It was founded in 1969 and is part of the Dutch Achmea Group, which is one of the largest insurance groups in Europe. Company A has been a pioneer in the Greek market for 45 years, providing innovative products and services, such as Medi-system Integrated Health System, Capital Investment System, Innovative Assistance covers, and so on. The company has managed to be the only insurer owning a state-of-the-art infrastructure in Health and Assistance following a multi-channel distribution model. Its employee count ranges from 1001 to 5000 with the specialties in life insurance, health insurance, property and casualty, assistance services, health services, and business insurance.

As an insurance company, it uses both structured and unstructured data to meet the needs of its clients and to provide them with the services, which is an operational need. As the name suggests, structured data are organized and formatted well, which makes it easily searchable in the relational database. Mainly, Reinsurance, Ledger, Portfolio, Agent Commission & Bonus, Loss Ratio pre-calculated Application, Production, Bonus, SLAs Payments, Pending Claims, Pending Dossiers, Incurred Losses, Outstanding Payments, and Master Customer Data are the business types that are identified as structured data while the content like the Internet of Things, Real-time customer service emails, NPS survey, security logs, website quotes, social media are characterized as unstructured data in the firm. Since it is very crucial for any enterprise to remain competitive, an insurance company must be prepared to mine information for insights in an innovative way. With the new data sources such as telematics, sensors, government customer interactions, and social

media, the opportunity to utilize big Data is more appealing across new areas of the industry. As per the Role-Based Access Control (RBAC), every employee has specific access to the enterprise data portfolio in order to manage every data usage for satisfying internal and external needs by creating new business insights. According to Data Management (DAMA) strategy, which is implemented by Data Government Dept, company A has already provided the roles and responsibilities to the data owners and data stewards for data maintenance purposes.

The Big Data Analytics technologies for this organization are suggested by the IT function, specific from the Enterprise Data Management Department, following a set of pilot projects with several commercial vendors to decide which technology fits correctly to the company needs. Based on the IT function, the tools adopted by this organization involve Hadoop, Storm, HBase, MongoDB, SSIS, SSAS, SSRS, Power BI, and so on. These tools are stored in a private cloud environment that is managed by a qualified infrastructure staff. The skillsets for analyzing data are prevalent in every function. Following the up-to-date tools and technologies, the firm has a team of 20 accredited experts who are committed to identifying emerging trends and business insights to hit the pinnacle of technology systems every day. The Enterprise Data Management team is in a position to use the core toolset of the Big Data Ecosystem mainly because of its recognized expertise in the field of Big Data exploration. In addition, these tools are used by power users in the company's cross-functional processes for data analysis purposes, in particular by the Analytical Center of Excellence Team and the Data Stewards and Citizens community.

Being an early adopter of the Big Data revolution, they are processing and developing a seven steps approach that is adjusted to design the Big Data Strategy by the informal schemes in the company such as Data Governance team, Analytics Center of Excellent and the crew of the Enterprise Data Management Dept all together.

  i.   **Identify what the company wants:** In the initial stage, the firm decides whether they want to increase the efficiency of customer needs, improve operational efficiency, increase revenues, provide better customer experience, or improve marketing.
 ii.   **Leverage data availability:** Improving data performance management and data exploration for better discovery in unreachable data areas.
iii.   **Identify infrastructural changes:** Through the integration between different departments.
 iv.   **Establish talent pool:** The team must have data scientists to make sense out of data, business analysts to communicate insights to the decision-makers and critical decision-makers themselves who are capable of leading the team.
  v.   **Obsess over customer satisfaction:** The group provides innovative insights into the customer mindset that can be used to enhance and change the current marketing practices.
 vi.   **Ensure usability:** Enterprise data and information should be comprehended and represented in a way that its value is identified by people who are not only data workers,

which can be performed by using graphical representation and by communicating direct instructions to the teams involved.

vii.   **Be agile:** By implementing disruptive technologies, the budget people need to be adjusted and ideologies based on the circumstances and insights we gather. The flexibility of combining the above parameters is capable of guiding the company directly to success.

The multi-functional hybrid model that is introduced and customized according to company needs helps the several self-managed teams in the company to tackle every challenge of the company that meets data exploration. The team consists of a group of skilled employees across the company with a strategist and analytical mindset, and they are involved in activities such as business, technical, data framework, analytics, and visualization using the analytics techniques mentioned in the **figure**. SAS tools such as Enterprise Guide, Miner and Text Analytics, Microsoft Power BI, Excel, and Python are used for analytics and visualization. The output from these tools is used as an input for reporting or presentation requirements. The consumers are business power users, marketing team, sales representatives, audit and risk team members, and C-Level committees.
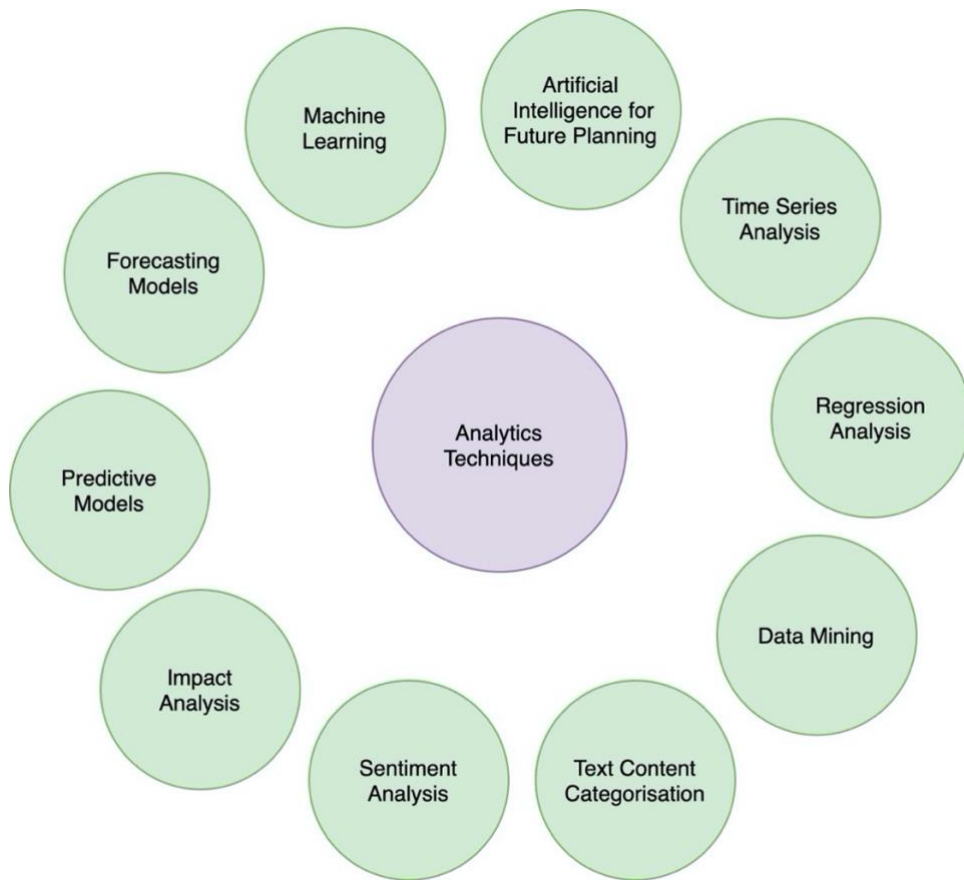
Figure 3. 1 Analytics techniques used by the teams of the Company A

It is essential for an organization to create the best working environment for their data workers regardless of the trained teams or the use of new technologies. Therefore, to motivate them, the company is taking regular training sessions, participating in innovative projects, conducting an open way of thinking, becoming a part of wide data horizons, exploring unreachable data areas, and implementing the agile methodology. The management uses an agile method, focusing on the KANBAN process to evaluate the deliverables that take place every three months from a business owner's feedback. An agile KANBAN process is followed with specific guidelines in every project, which is managed by the Enterprise Project Management Portfolio. Every agile team is self-managed, and every pillar in the KANBAN process contains a feedback action that generates questions and answers for the project following the rituals of the methodology. Despite the tools and techniques used by the management, there exist several barriers to create more values for the company, which is shown in the figure below.
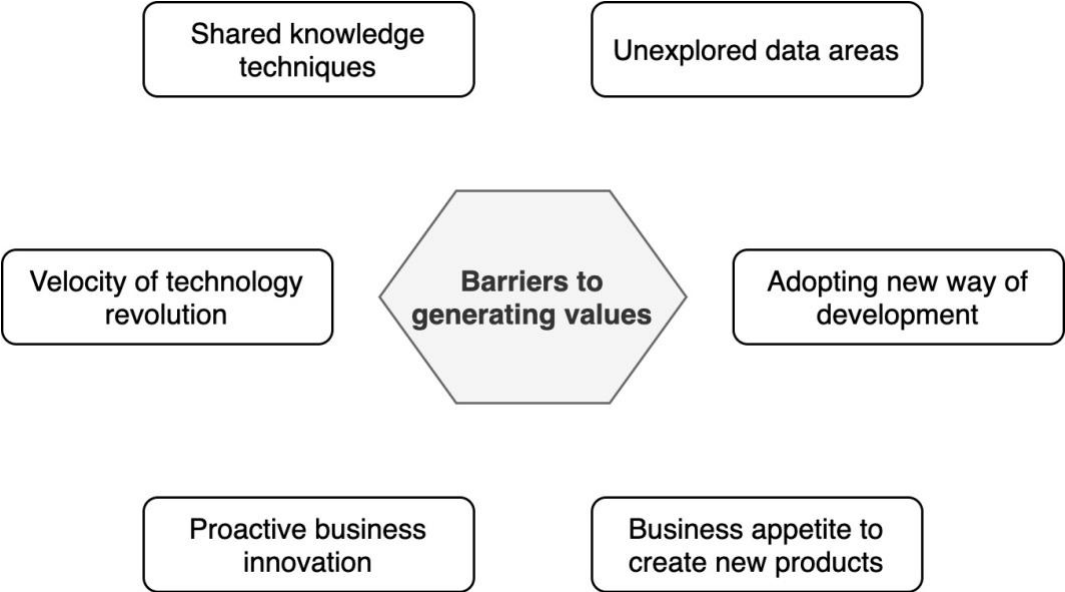
Figure 3. 2 Barriers to generating values

One of the pillars of this firm is to be a data-driven company, and the information on data exploration is of great value for its decision making. Therefore, the company should daily communicate its vision and innovative business goals for better technology adjustments to their associates.

The skilled and experienced employees are the critical assets of any business organization. Currently, the accessible job descriptions are business analysts, data analysts, and data scientists with a comprehensive knowledge of the insurance sector. The human resource recruitment process is conducted from recruiters' offices, job search engines, universities' career offices, distinguished

candidates, social media, and forums with data experts. Since it takes at least six months for a new employee to be productive, the training is provided and customized according to the usage of the tools. The shared knowledge through actual or pilot projects is the standard process for new entry resources to follow the operational team's workflow to be productive and continuously improve their skills. Also, training for basic insurance terminology and business process is the main factor in combining technical and business skills through IAG[1] projects. Data workers are the leader of innovative projects and can improve their expertise in the new technologies and consolidate their knowledge in every function across the company by joining several agile projects. The main goal of data specialists is to drive a disruptive technological project to gain new innovative services and business value. According to Big Data Sector, company A is highly qualified than the median opportunity offers of what included in the Greek market. The data workers hired to this c company are provided several benefits; as a result, there is no resignation yet. Training, new technology toolset, continually improving data analytics skillset, and a perfect competitive package are the factors that make the data workers faithful in their role. Since the big data skillset is limited for new resources, junior or entry-level resources are hired and trained by participating them in a new technology course internally or externally. As a result, it has to tackle this challenge with holistic training for new technologies and insurance business in a short period to be adjusted to its needs. Besides recruiting expert and specialist candidates, the organization invests in extending training and sharing knowledge sessions, which are the fundamental actions for opposing these kinds of shortages.

3.1.2 Case Study 2: Company B

Company B is a national level finance corporation of the 'C' class, which is established and authorized by Nepal Rastra Bank[2]. It is assisted by the team of experienced business leaders, organizations, bankers, economists, chartered accountants, and reputed individuals from the country who stand out in their field of business or profession. Company B provides the complete financial services for its valued customer and is committed to offering a wide range of banking products and services adopted with state-of-the-art technology to meet the unique requirements of all the customers/ clients and thereby delight them by exceeding their expectations. As a finance company, Company B has various types of data, such as data of customers, their accounts, and their transaction details. The reports that need to be generated vary depending upon the departments. Each department has their own sets of requirements, and some of them have standard reports which need to be made periodically. Ram, as an IT Head, generates reports from those data in a presentable manner so that it could be reported to whoever desires it in the future.

Big Data generally refers to a large number of datasets that need to be processed and generate some values from it, which is not possible through the traditional computational tool. But in this case, Data is not so large as compared but large enough to be processed and generate some

---

1 https://iag.gr/anagnostopoulos-law-firm-services/
2 https://www.nrb.org.np/

informative reports. The Data is large enough that one could not find anything useful unless they are processed. Without BDA, the raw Data does not make any sense to the one viewing it and the management team. Therefore, MSSQL and Oracle are used as databases for storing the data. As a finance company, a massive amount of transactions is performed day-to-day, and everything is stored in the database, which, if looked individually, does not make much of a sense. With custom queries and data manipulation, such data are brought in some form, which represents some information that is valuable to the management teams, and those need to be reported to the governing body.

To manage and extract value out of BDA, the firm emphasizes the proper technical resources to handle the load effectively. Since the primary function of the finance company is to provide loans and manage accounts, the BDA is given more priority to the accounts, loans, and operations department where the enormous amount of customer's data and information are gathered and generated. It is essential for each department to communicate appropriately with one another while making any business decision so that the decision-maker could be able to listen to everyone's point of view, and there may not be any miscommunication regarding the facts. So, the meetings are held frequently between the departments involved in BDA. Likewise, for analyzing the market environment and the competitors, the reports related to financial profit or loss are generated, which could be used for self-comparison as well as other competitors. BDA has been used to create documents of the customer, find out the ones with missing details and maintain them, which is carried out by reviewing the history and performance of the customers, viewing the insight of the company's performance, and generalizing the credit patterns and the customer's behavior. It has allowed the management team to infer the trend favored by the customer and patterns of the customer in credit operations as well.

3.2 Data Collection

Data collection is the process of gathering information from all relevant sources to find answers to the research problem and to assess the results. The purpose of our thesis is to study the case of Company A and Company B on how they are dealing with big data analytics for achieving competitive advantages. Therefore, we used the semi-structured interview as our data collection method for exploring the views, experiences, and beliefs of an employee working with big data analytics in an enterprise. The interview was the most appropriate approach for our research topic that provided a deeper understanding of the study and detailed insights from the individual participants.

3.2.1 Interview

The personal interview with two to three Norwegian companies was planned at the initial stage of the research. But due to the pandemic situation created by the Coronavirus at the data collection phase, it was not favorable to conduct personal interviews with any firm in Norway. Fortunately,

we had good contact with Alexander, the Chief Digital Transformation and Information Officer of company A in Greece. With his help, an interview was held online through skype for gathering the required information from company A. Since the purpose of this research is to analyze and investigate the two different firms on how they adopt big data analytics and compare the various challenges experienced by these two distinct companies, we chose Company B in Nepal for collecting data from the company with a totally different culture and background.

Before conducting any interview, the guide is prepared with the questions and topics that must be covered. The systematic literature review of different papers related to the research topic helped in planning and preparing the instructions for the interview. The guidelines used for the interview are shown in **APPENDIX B.**

3.2.2 Participants

The participants for the interview were selected from the IT Department, who has experience working and managing Big Data in the company. The selected interviewee from Company A is Alexander, the Chief Digital Transformation and Information officer of Company A. He has a bachelor's degree in mathematics from the University of Patras and also a Ph.D. candidate at the same University at the Department of Computer Engineering and Informatics. His main areas of interest include Information Technology, Big Data, Agile and Lean methodologies, and Business transformation and operational excellence, etc. He is also a member of the Executive Board of Company A, a member of the Achmea's IT Policy Board of all subsidiaries in Europe, Member of SAS community Advisory Board and a member of the IT committee of the Association of Insurance Companies of Greece.

Similarly, for gathering data from Company B in Nepal, an interview was carried out with Ram, the IT Head of Company B. Ram has a master's degree in Computer Application from Purbanchal University, Nepal. His main job is to manage and provide support to overall IT Services and infrastructures, including the core banking system, networking, server maintenance, and active directory and some other tasks as required.
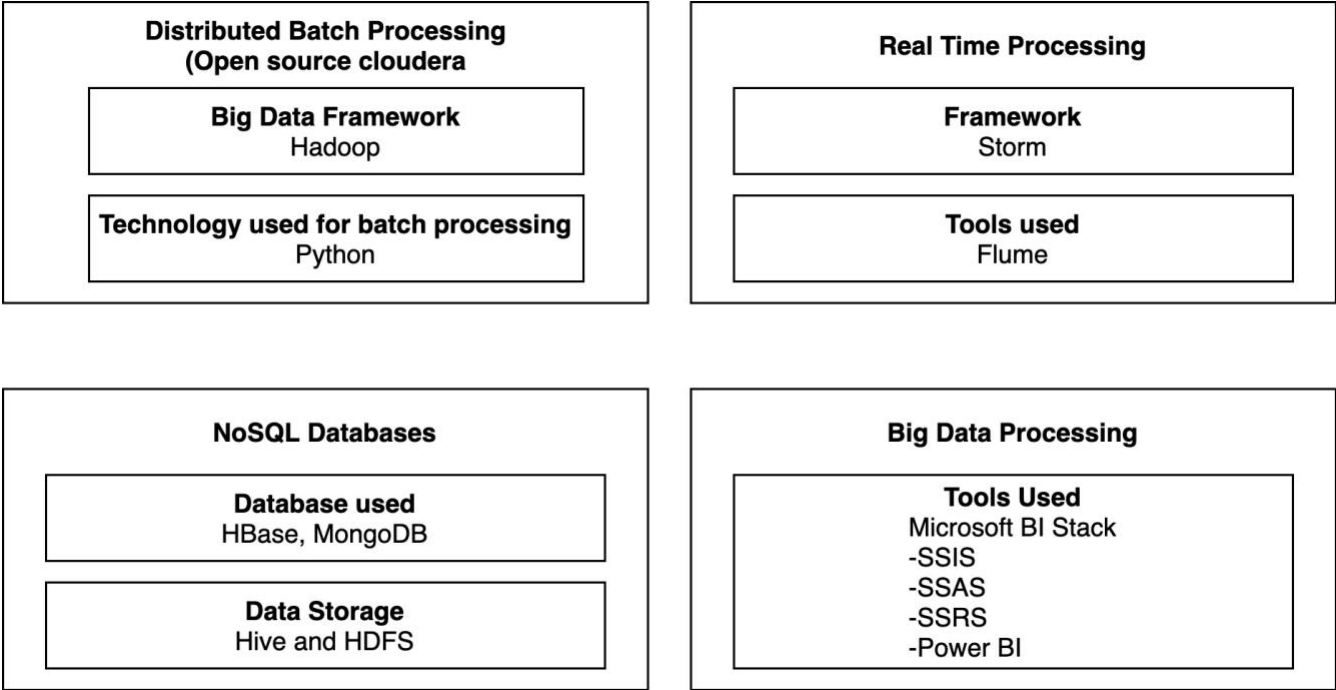
This page is intentionally left blank.

4 Results

As mentioned earlier in section 3, our research method was an interview with two international companies. In this section, we discuss the results and findings from the interviews.

4.1 Tools and Technologies used

The tools and technologies used by Company A are shown in the figure below.

Figure 4. 1 Big Data Analytics tools and technologies used by Company A

Company A is using a distributed batch processing technique for processing the large volume of data in an organization. And according to them, it is speedy to perform a repetitive task using this technique. Hadoop is used as a framework for the distributed storage and processing of huge data on massive commodity hardware clusters. Similarly, Flume is used for data ingestion in HDFS. Storm framework is used for real-time processing.

There are many other tools and methods that can be used by the company for the analysis of a large volume of data. However, Company B uses relational databases such as MSSQL and Oracle. All the information is recorded in the form of a table using a spreadsheet.

4.2 Big Data Value Creation

There are data workers in the company dealing with a massive number of data and analyzing it for creating the best possible results from it. Since both Company A Company B are the data-driven firm, the growth of the business highly depends upon the quality of data generated and value included with those data. During the interview, we asked our interviewee about the key factors for the success of big data projects. And according to them, the proper infrastructure, data analysts, and the knowledge tools for dealing with big data along with an understanding of how big data is translated to competitive advantages and strategic value are the crucial elements required for achieving the best possible outcome from Big Data Analytics.

A framework for strategic value creation is proposed by the company in Company A, which includes capacity building and capability realization processes. Thus, they try to identify how significant early investments in big data analytics can enhance the speed at which operating profits improve. A big data scientist uses advanced analytics methods to codify the approach of the best, most experienced solution for a company's challenge and builds an analytic model that captures the logic of their decision. While other staff working with those data uses that pattern for making their decisions where advanced analytics and business intelligence can rapidly create real value to the business organization. The spectrum of decisions ranges from big, one-off strategic choices to day-to-day frontline decisions that add up to a great deal of value over time. Every team of data workers follows a specific process when a business owner publishes a light business case for the overview. The team is able to estimate its effort, and when it finishes the implementation process, then the results are evaluated by business owners. The data strategy of the organization is to unite internally to improve externally. A unified effort of all functional teams ensures that everyone is reading from the same playbook, resulting in excellent user experience.

On the other hand, the data value creation method is utterly different in Company B in Nepal. They use relational databases for storing, processing, and accessing their essential data. Data consists of data such as thousands of customer's data, their customer profile, their account profile, and also the transaction profile. The huge amount of transactions is performed every day. All these records of transactions with their customers' details are stored in the database by the data entry personnel. Such data are analyzed and transformed into meaningful information that allows management teams to generate reports and generalize the pattern favored by the customer and patterns of the customer in credit operations. The group generally relies on the data for making any decision because the data tend to show the exact figures and values necessary for making any business decision. It involves decisions related to the operation of the company, performance of the products, company's performance in each department, and measures to increase productivity, types of customers, their preferences, and the decisions to lure the potential customers.

As we know well, big data are massive in size with comparison to the regular data. Without proper tools and implementation, they seem to be getting out of the picture as it barely makes sense to the

individual looking into it, which, when transformed, manipulated and processed brings insight into the company allowing the company to realize what Data actually means. It will actually reflect the overall performance of the company and the factors taking part in the operation. This adds value to the company allowing better decision making in the future. However, for extracting the strategic market advantages and keeping the firm competitive, it is essential for any company to understand the BDA tool's methods and mechanisms properly.

4.3 Big Data Analytics Benefits

The response from our interviewees regarding the advantages that the companies can achieve from the use Big Data Analytics are presented as the table below:

Table 4. 1 Benefits of Big Data Analytics to the firm

Benefits of BDA	Description
1. Better consumer experiences	- Provide a quick response to the customer's question using smart data. - Understand the client's expectation and their changing requirement.
2. Product and service innovation	- Better customize the services based on the response and feedback from the customer. - Create a new Business Model Innovation.
3. Improve Performance	- Observation of the employee's performance in a firm. - Increase productivity and efficiency.
4. Market Segmentation	- Accurate market segmentation and the estimation of the targeted customer.
5. Financial Improvement	- Reduction of operational cost. - Predictive analysis and comparison of Profit and loss from the past. - Analysis of probable risk and its impact on the business.

Company A is following the 5Vs of Big Data and improving in volume, velocity, variety, veracity, and value. For those reasons, they are able to interact faster manipulating `smart data' when they have to answer in a customer question, have an accurate target in the market segmentation, reduce operational costs while improving automated processes, create new innovative products formatted to their customer's needs, adjust in every data ecosystem change without risky impact and reduce resource effort in central points of their data processes. For capturing the value, an agile method is used following business guidelines according to the light business case. The business owner is obliged to quantify the new requirement before a project is published, and an evaluation of the predictive metrics and actual metrics is done after the completion of the project. Big Data Analytics has benefitted in the operational section of the company, and by improving the operational processes, they are reducing costs providing an extra benefit to the financial improvements. Likewise, data availability aids marketing to make a new business development by creating better-customized products for the customer.

Similarly, with the help of BDA, Company B has become able to enlarge its operational efficiency within the organization. The company generates reports related to all the financial profit and loss, which are stored in the database and used later for comparing the improvement. And the clear insight of the organization's performance helps to improve in the future.

Since there is always room for improvement, our interviewee also mentioned that the implementation of the tools and techniques in a correct place and effective utilization could benefit the organization much more than it is expected.

4.4 Big Data Challenges

Despite the use of trending big data analytics tools by data experts, the company has to experience many obstacles while adopting it and fully converting raw data into business value. The primary purpose of our research is to investigate the challenges faced by the enterprise while deploying BDA tools. After the literature review, we discovered four main problems that are experienced by any firm implementing BDA for creating business values; Talent management and human resources, IT capabilities and infrastructures, information and cybersecurity, and decision-making challenges. We asked our interviewee regarding the barriers while using BDA tools, and here we will be discussing the response from them. The identified challenges from the results of our interview with the participants are listed in a table as follows.

Table 4. 2 Big Data Analytics Challenges identified

Identified Challenges	Description
1. Legal issues	- Solvency law for the company. - General Data Protection Regulations (GDPR) and local legislation. - Privacy and security of personal and sensitive information of consumers
2. Ethical issues	- Inadvertent or unauthorized disclosure of Personally Identifiable Information (PII). - Misrepresentation of data quality. - Misuse of data in a way that misrepresents the truth. - Understanding the available options and the associated risks.
3. Organizational and human resource management	- Lack of knowledge on what is required for the position. - Improper job description. - Poor recruitment of big data experts. - Organizing and managing the training session for newly hired employees.
4. IT capabilities	- Shortage of professional data expert in the company. - Lack of coordination and miscommunication between the staff in a technical department dealing with big data and non-technical department.
5. Technical issues	- Coping with the trending and latest big data ecosystem technologies and investing in that advanced technologies.
6. Scarcity of Resources	- Inadequate infrastructures required for the analysis of data due to incorrect estimation of the budget for the latest BDA tools and technologies.

Being an insurance company, Company A group has to comply with legal requirements in its use of data analytics such as Solvency law for the insurance sector, GDPR, and the local legislations. Similarly, there are some gray areas when it comes to the ethical collection, use, and analysis of data from organizations. Even though IAG3 has taken all the appropriate organizational and technical measures to ensure conformance to regulations and guidelines as well as respect to data subject's fundamental rights and freedom, there are specific points to ponder and always have in mind: inadvertent or unauthorized disclosure of Personally Identifiable Information (PII), misrepresentation of data quality and completeness, misuse of data in a way that misrepresents the truth, always understand available options and the associated risks. The continuous rising of Big data and the improvement of data ecosystem technologies are the most critical factors for creating value for the company but are also barriers when you are not able to invest in them and follow their innovation.

Likewise, Using MSSQL and Oracle, Company B has managed to increase operational efficiency within the organization, and clear insight into the organization's performance helps improve where needed. However, some reports required by the team cannot be accessible due to the technical constraints as it only provides information in tabular form. Some reports take a tremendous amount of time as the data to be taken into consideration is large in quantity. Thus, the processing time is considerably high, even for a system with eight cores (2.8 GHz), 32 GB RAM. And since the system is always connected to the internet, the concern for security is still there. No matter how secure the environment is, it is always some potential threat. In addition, the lack of a skilled workforce has ever become the main challenges while adopting any new technology or tools in an organization. Since it is a finance company and the management team are not so familiar with technical issues and does not have enough knowledge regarding what skills and tools are required for producing maximum benefits from the big data, they are not able to hire enough qualified and professional data analysts or data personnel needed for the firm. As a result, every employee at Company B is not competent in the task that uses analytics tools. Thus, it is challenging to manage everything single-handedly every time.

To sum up, the main obstacles encountered in the implementation of the analytics project are the uncommon business and technical glossary across the company, the corporation between industry and IT team members in order to have a smooth and common compromise, the unknown data areas which are unreachable such as IoT processes, new legislation that may change project plan prioritization, a lack of technical skills, the scarcity of resources and an incorrect estimation effort.

---

3 https://iag.gr/anagnostopoulos-law-firm-services/

5 Discussions

5.1 Research Implications

From the research perspective, the findings of this study contribute to the existing literature in various aspects. The results from the empirical study illustrate the value that the business enterprise can have from the insights using advanced big data analytics tools and technologies. First, it shows how a company identifies big data from regular sized data and improves its strategic business value following the five dimensions of big data; volume, velocity, variety, veracity, and value. It has been stated by the practitioners that big data and the normal data can be distinguished based on the inclusion of series of features widely known as the four Vs (Abbasi et al., 2016). By improving the Vs of big data, many data-driven companies are able to manipulate smart data and interact quickly with their customer when they have to answer their questions. BDA can be used to upgrade the next generation of smart products and services and facilitates ever-increasing customer segmentation by allowing the company to offer even more precisely targeted services and significantly improving the customers' experiences (Grover et al., 2018). The consumers who use the services are considered as the producer of knowledge, and they are associated with the competitive benefits of the organization (Kamioka & Tapanainen, n.d.). To support this statement, the company can learn about the expectation and requirements of its targeted customers, which they can consider while developing new innovative products for their clients.

The insights of BDA can be used not only in creating strategic values but also the symbolic values such as positive brand images, prestige, and reputation of the company. The companies have been reported using BDA to promote a broad range of performance dimensions in terms of planning, production process, and assurance of the quality (Popovič et al., 2018). And since the data tends to give the actual statistics and values required for making any business decision, the managers and the team generally rely on the data available in their database to make any critical decision. In favor of this statement, the scholars have also mentioned that the businesses mainly rely on their information systems to provide relevant, reliable, timely and accurate high-quality information that enables improvements in decision quality and, in turn, can enhance the performance of the firm (Popovič et al., 2012). In comparison to the human resources department, it has been found that the departments with a strong history of data-driven decision makings, such as finance and operations, prefer to exploit big data (Abbasi et al., 2016). The organization is attempting to identify how early investments in big data analytics boost the speed of the operating profits so that they could invest more in new technology and improve their productivity and performance. Regarding the benefits from BDA, the deployment of big data analytics across the supply chain is an appropriate tool for improving the use of the asset base (Kache & Seuring, 2017).

Another interesting point regarding the decision-making process is the bias nature of the managers or the one involved in making decisions. The managers who have already experienced a similar situation would probably be biased with the outcome from the analysis of big data and make decisions based on their experiences. As a result, they are able to make decisions very quickly, but there is also a possibility of making a wrong move as the data changes every minute in a firm. Likewise, datafication which is the process of making sense out of the enormous volume of data into insights and action is a tough job for the data scientist, since some of the vital information might be omitted while processing the data into knowledge and ultimately visualizing it into insights (Lycett, 2013). Therefore, during the information value chain process, the managers and the technical data workers dealing with those data must also think about the ethical issues connected with it such as misrepresentation of data quality, misuse of data or misrepresentation of the truth, and unauthorized disclosure of Personally Identifiable Information (PII). It is imperative to consider the ethical issues that may result in obstacles for the business in the future (Mikalef et al., 2019). Our findings also present the legal requirements and issues the company has to follow while using data analytics.

Managers should know the fact that even though the continuous rise of big data and advancement of data infrastructure technology are the significant elements for generating value for the business, it can create obstacles if they are not able to invest in them and follow their innovation. Therefore, managers should be aware that the failure in addressing these issues can lead to losing the opportunities to improve organizational performance.

5.2 Practical Implications

The results of this study provide several implications for practitioners. First, the study shows that big data analytics is not only limited to adopting advanced technology and analyzing the huge volume of data by the IT workers but also overcoming the numerous obstacles and hindrances that come along with it in any business organization. The most important thing for the company's managers to know regarding the success of any big data project is to understand how big data usage is converted into competitive advantages and strategic value. There are several barriers identified in this research that needs to be undertaken by the managers for generating full business values from the data analytics to their company. The most obvious challenge for any data-driven firm is to improve business performance and make the right decision considering the legal and ethical issues associated with its big data analytics. The lack of qualified data professionals who has a better understanding of the big data systems and its statistical modeling are the main challenges many business organizations are facing these days. The ignorance of recruiters regarding the requirements and a proper job description for big data experts position as well as failure in providing an appropriate training session for the newcomers are the possible reason behind the shortage of IT capabilities. Thus, it is known that the popular job descriptions for the current time are business analysts, data scientists with a broad knowledge of the specified sector.

By explicitly identifying the significant issues of Big Data Analytics, this study can help managers to take those issues into account and tackle the problems that arise while working with the data in an organization. As mentioned in the case study of Company A, an agile methodology following the project guidelines can be implemented as a big data project management system for capturing the business value.

Finally, our study encourages the managers to invest in the new data ecosystem tools and technologies since they are continuously growing with high market competition globally. It has been found that the inadequacy of resources can also adversely affect the value generation process, which could be resolved by separating budgets for the required infrastructures and investing in the trending tools beneficial for the data-driven company. In addition, the data scientists and the analysts should be learning adequate skills every day to overcome the technical issues and cope with the emerging tools.

To sum up, the case study results and challenges identified from the sample of these two different companies can direct future enterprises and managers to formulate better management strategies and governance policies to address and overcome deployment obstacles and barriers. The study offers not only the key issues these companies need to tackle but also the steps they may take or the possible choices they have for resolving the potential obstacles.

5.3 Limitations and Future Research

Even though this study showcases various barriers during the BDA adoption process, it is constrained by some limitations which could be addressed by future work. First, our research study was limited, with only two cases from Greece and Nepal. Due to the pandemic situation created by Coronavirus disease all around the world, the data collection method was only bounded between these two countries. It was not possible to conduct a personal interview with the participants. So, the interviews were conducted through an online platform with the employee from Company A in Greece and Company B in Nepal. Also, there was only a single respondent from each company, so it was not possible to collect full information from a single interviewee, and those data were limited to their perspective.

Thus, the future study could follow a different approach by interviewing multiple respondents within a single firm and with varying types of companies adopting BDA. The current global market is highly dependent on the huge volume of data that can be used for creating business insights and values. However, there is no factual evidence that could prove if BDA provides full value to the industry. So, future studies could address these things as well with as much sample as possible.

This page is intentionally left blank.

6 Conclusion

The main outline of this thesis is to understand the meaning, use, and barriers involved in BDA. Through this study, the significant challenges that the industry faces while converting big data into strategic business value are observed and discussed. The big data analytics and its associated notions have become a topic of keen interest for the researchers. Despite the use of BDA for gaining and creating business values in the industry, many organizations fail to fully benefit from it because of the lack of organizational knowledge about its proper utilization or failure in the management and allocation of work among the skilled worker. This study discusses the challenges and the obstacles experienced by the management while adopting BDA for achieving or creating strategic business values. According to many practitioners and scholars, the most obvious problem associated with big data analytics is to improve business performance and make the right decision through the implementation of BDA in a company. However, the challenges bounded to the deployment of BDA are not just limited to it. As mentioned in the paper, the inadequacy of required IT resources and the lack of skilled IT personnel (such as Data scientist, Data analyst, etc.) in an enterprise would obviously lead to the failure in the adoption of BDA system since the unskilled employees do not have specified knowledge about how to retrieve and analyze the relevant information from the database of the company, as a result, they won't be able to take a correct decision.

There are serious issues for converting BDA into powerful ideas. From the case study of two different companies, it is found that a lack of skilled IT employees in the industry who analyzes, interprets, and handles the big data analytics system of the firm is the major challenge that acts as a barrier in obtaining full value from BDA. Every task related to big data cannot be single-handled by just one person. Similarly, the shortage in IT capabilities and required IT infrastructure is another major obstacle that needed to be considered by the managers because, without the right technology and resources, nothing is possible to gain in the right way. There should be changes and upgrade in the system used for analytics to be updated about the industrial world. Therefore, the company must have enough funds and capital to invest in the right IT infrastructure.

The big data involves the records and information of the customers (that includes ratings and reviews from them), which helps a firm to understand and have knowledge of their requirements and expectation from the services provided by the company. This can definitely aid a company to improve its product or services based on their consumer's need and expectation. Yet, it is a challenging task for a firm to maintain their client's trust for them to keep that information confidential because the customers may have trust issues and would not share their sensitive information to the company. Likewise, the information security concern of the customer challenges the company, which can be solved by planning and implementing a data security strategy to reduce the deleterious effect from cyber-attack or to make the data management system more secure. The ethical issues related to big data such as misrepresentation of the truth, misuse of sensitive data of customers, and unauthorized disclosure of Personally Identifiable Data (PII)

can create a barrier for an organization to capture full value from the data. The legal issues such as local legislation, GDPR, solvency law is to be considered by the firm so that they may not suffer later. Similarly, it is found that the decision-making process that requires appropriate analysis and interpretation is also a tough task for the managers since one wrong decision could lead to failure in the competitive market.

References

Abbasi, A., Sarker, S., & Chiang, R. H. (2016). Big data research in information systems: Toward an inclusive research agenda. *Journal of the Association for Information Systems, 17*(2), 3.

Beath, C., Becerra-Fernandez, I., Ross, J., & Short, J. (2012). Finding Value in the Information Explosion. *MIT Sloan Management Review*, *53*(4), 18–20. https://search.proquest.com/docview/1023761998?accountid=12870

Chen, Chiang, & Storey. (2012). Business Intelligence and Analytics: From Big Data to Big Impact. *MIS Quarterly*, *36*(4), 1165. https://doi.org/10.2307/41703503

Chen, D. Q., Preston, D. S., & Swink, M. (2015). How the Use of Big Data Analytics Affects Value Creation in Supply Chain Management. *Journal of Management Information Systems*, *32*(4), 4–39. https://doi.org/10.1080/07421222.2015.1138364

Conboy, K., Mikalef, P., Dennehy, D., & Krogstie, J. (2020). Using business analytics to enhance dynamic capabilities in operations research: A case analysis and research agenda. *European Journal of Operational Research*, *281*(3), 656–672.

Côrte-Real, N., Oliveira, T., & Ruivo, P. (2017). Assessing business value of Big Data Analytics in European firms. *Journal of Business Research*, *70*, 379–390. https://doi.org/10.1016/j.jbusres.2016.08.011

De Mauro, A., Greco, M., & Grimaldi, M. (2016). A formal definition of Big Data based on its essential features. *Library Review*, *65*(3), 122–135. https://doi.org/10.1108/LR-06-2015-0061

Demirkan, H., Bess, C., Spohrer, J., Rayes, A., Allen, D., & Moghaddam, Y. (2015). Innovations with Smart Service Systems: Analytics, Big Data, Cognitive Assistance, and the Internet of Everything. *Communications of the Association for Information Systems*, *37*. https://doi.org/10.17705/1CAIS.03735

Erevelles, S., Fukawa, N., & Swayne, L. (2016). Big Data consumer analytics and the
transformation of marketing. *Journal of Business Research*, *69*(2), 897–904.
https://doi.org/10.1016/j.jbusres.2015.07.001

Fink, L., Yogev, N., & Even, A. (2017). Business intelligence and organizational learning: An
empirical investigation of value creation processes. *Information & Management*, *54*(1),
38–56. https://doi.org/10.1016/j.im.2016.03.009

Fosso Wamba, S., Akter, S., Edwards, A., Chopin, G., & Gnanzou, D. (2015). How 'big data'
can make big impact: Findings from a systematic review and a longitudinal case study.
International Journal of Production Economics, *165*, 234–246.
https://doi.org/10.1016/j.ijpe.2014.12.031

Galbraith, J. R. (2014). Organizational Design Challenges Resulting From Big Data. *Journal of
Organization Design*, *3*(1), 2. https://doi.org/10.7146/jod.8856

Gobble, M. M. (2013). Big Data: The Next Big Thing in Innovation. *Research-Technology
Management*, *56*(1), 64–67. https://doi.org/10.5437/08956308X5601005

Grossman, R. L., & Siegel, K. P. (2014). Organizational Models for Big Data and Analytics.
Journal of Organization Design, *3*(1), 20. https://doi.org/10.7146/jod.9799

Grover, V., Chiang, R. H. L., Liang, T.-P., & Zhang, D. (2018). Creating Strategic Business
Value from Big Data Analytics: A Research Framework. *Journal of Management
Information Systems*, *35*(2), 388–423. https://doi.org/10.1080/07421222.2018.1451951

Gunasekaran, A., Papadopoulos, T., Dubey, R., Wamba, S. F., Childe, S. J., Hazen, B., &
Akter, S. (2017). Big data and predictive analytics for supply chain and organizational
performance. *Journal of Business Research*, *70*, 308–317.
https://doi.org/10.1016/j.jbusres.2016.08.004

Hazen, B. T., Skipper, J. B., Boone, C. A., & Hill, R. R. (2018). Back in business: Operations
research in support of big data analytics for operations and supply chain management.

Annals of Operations Research, 270(1), 201–211. https://doi.org/10.1007/s10479-016-2226-0

Huberty, M. (2015). Awaiting the Second Big Data Revolution: From Digital Noise to Value Creation. Journal of Industry, Competition and Trade, 15(1), 35–47. https://doi.org/10.1007/s10842-014-0190-4

Kache, F., & Seuring, S. (2017). Challenges and opportunities of digital information at the intersection of Big Data Analytics and supply chain management. International Journal of Operations & Production Management, 37(1), 10–36. https://doi.org/10.1108/IJOPM-02-2015-0078

Kamioka, T., & Tapanainen, T. (n.d.). ORGANIZATIONAL USE OF BIG DATA AND COMPETITIVE ADVANTAGE – EXPLORATION OF ANTECEDENTS. 17.

Kitchenham, B. (n.d.). Procedures for Performing Systematic Reviews. 33.

Korhonen, J. J. (2014). Big Data – Big Deal for Organization Design? Journal of Organization Design, 3(1), 31. https://doi.org/10.7146/jod.13261

Lee, I. (2017). Big data: Dimensions, evolution, impacts, and challenges. Business Horizons, 60(3), 293–303. https://doi.org/10.1016/j.bushor.2017.01.004

Lehrer, C., Wieneke, A., vom Brocke, J., Jung, R., & Seidel, S. (2018). How Big Data Analytics Enables Service Innovation: Materiality, Affordance, and the Individualization of Service. Journal of Management Information Systems, 35(2), 424–460. https://doi.org/10.1080/07421222.2018.1451953

Lycett, M. (2013). 'Datafication': Making sense of (big) data in a complex world. European Journal of Information Systems, 22(4), 381–386. https://doi.org/10.1057/ejis.2013.10

McAfee, A., & Brynjolfsson, E. (n.d.). Big Data: The Management Revolution. 9.

Mikalef, P. (2017). Big Data Analytics Capability: Antecedents and Business Value. 14.

Mikalef, P., Boura, M., Lekakos, G., & Krogstie, J. (2019). Big data analytics and firm

    performance: Findings from a mixed-method approach. *Journal of Business Research*,

    98, 261–276.

Mikalef, P., Krogstie, J., Pappas, I. O., & Pavlou, P. (2020). Exploring the relationship between

    big data analytics capability and competitive performance: The mediating roles of

    dynamic and operational capabilities. *Information & Management*, *57*(2), 103169.

Mikalef, P., Pappas, I. O., Krogstie, J., & Giannakos, M. (2018). Big data analytics capabilities:

    A systematic literature review and research agenda. *Information Systems and E-*

    Business Management, *16*(3), 547–578.

Oates, B. J. (2005). *Researching Information Systems and Computing*. SAGE.

Opresnik, D., & Taisch, M. (2015). The value of Big Data in servitization. *International Journal of*

    Production Economics, *165*, 174–184. https://doi.org/10.1016/j.ijpe.2014.12.036

Popovič, A., Hackney, R., Coelho, P. S., & Jaklič, J. (2012). Towards business intelligence

    systems success: Effects of maturity and culture on analytical decision making. *Decision*

    Support Systems, *54*(1), 729–739. https://doi.org/10.1016/j.dss.2012.08.017

Popovič, A., Hackney, R., Tassabehji, R., & Castelli, M. (2018). The impact of big data analytics

    on firms' high value business performance. *Information Systems Frontiers*, *20*(2), 209–

    222. https://doi.org/10.1007/s10796-016-9720-4

Ren, S. J., Wamba, S. F., Akter, S., Dubey, R., & Childe, S. J. (2017). Modelling quality

    dynamics, business value and firm performance in a big data analytics environment.

    International Journal of Production Research, *55*(17), 5011–5026.

    https://doi.org/10.1080/00207543.2016.1154209

Saggi, M. K., & Jain, S. (2018). A survey towards an integration of big data analytics to big

    insights for value-creation. *Information Processing & Management*, *54*(5), 758–790.

    https://doi.org/10.1016/j.ipm.2018.01.010

Schläfke, M., Silvi, R., & Möller, K. (2013). A framework for business analytics in performance

    management. *International Journal of Productivity and Performance Management*.

    https://doi.org/10.1108/17410401311285327

Shang, J., Tadikamalla, P. R., Kirsch, L. J., & Brown, L. (2008). A decision support system for

    managing inventory at GlaxoSmithKline. *Decision Support Systems*, *46*(1), 1–13.

Shanks, G., & Bekmamedova, N. (2012). Achieving benefits with business analytics systems:

    An evolutionary process perspective. *Journal of Decision Systems*, *21*(3), 231–244.

    https://doi.org/10.1080/12460125.2012.729182

Shanks, G., & Sharma, R. (2011). *Creating value from business analytics systems: The impact*

    of strategy. 14.

Shanks, G., Sharma, R., Seddon, P., & Reynolds, P. (2010). The Impact of Strategy and

    Maturity on Business Analytics and Firm Performance: A Review and Research Agenda.

    Business Analytics, 11.

Trkman, P., McCormack, K., de Oliveira, M. P. V., & Ladeira, M. B. (2010). The impact of

    business analytics on supply chain performance. *Decision Support Systems*, *49*(3), 318–

    327. https://doi.org/10.1016/j.dss.2010.03.007

Wamba, S. F., Gunasekaran, A., Akter, S., Ren, S. J., Dubey, R., & Childe, S. J. (2017). Big

    data analytics and firm performance: Effects of dynamic capabilities. *Journal of Business*

    Research, *70*, 356–365. https://doi.org/10.1016/j.jbusres.2016.08.009

Xu, Z., Frankwick, G. L., & Ramirez, E. (2016). Effects of big data analytics and traditional

    marketing analytics on new product success: A knowledge fusion perspective. *Journal of*

    Business Research, *69*(5), 1562–1566. https://doi.org/10.1016/j.jbusres.2015.10.017

Zeng, J., & Glaister, K. W. (2018). Value creation from big data: Looking inside the black box.

    Strategic Organization, *16*(2), 105–140. https://doi.org/10.1177/1476127017697510

Appendix

Appendix A presents the interview guidelines used for conducting interview as a data collection method.

Interview Questions

Terminology
BDA = Big Data Analytics
BD = Big Data

Introduction

Presentation (A short description of who we are and what the project is about)

I am Isha Tamang, a final year master's student of NTNU. As part of my master thesis, I am investigating the adoption and usage of BDA in the company with the aim of collecting for my research work. So, as part of the study, I am conducting an interview. As a case study we have chosen a company from Nepal and Greece.
The project is about the challenges and obstacles that many organizations are facing during the adoption of big data analytics for creating values out of it. So, I am here to interview you. I would appreciate your feedback on the matter that I asks you.

Procedure for the interview

1. Can we record the conversation for later transcription? Presentation of information sheet.

What the interviews will be used for?
- The interviews will be used for collecting and analysing data for my thesis report.

Rights to the interviewees
- The interviewee can at any time choose to cancel the interview
- Anonymized
- Interviewees may choose not to be cited or undo participation
- Transcription will be sent to the interviewee by email for approval and/or correction.

Background

1. What is your Position?

2. What kind of challenges do you see for the clients you advise?

3. Do you have many competitors?

4. Are there many competitors who have the same product types?

5. Are the services you deliver specially tailored for each customer or is there more standard solutions.

6. Do customer requirements / needs change often?

7. Is it lack resources (for product and service development) and resource persons related to their activities?

8. What is your definition of BD? (BDA)?

9.What are your responsibilities (especially related to BDA)?

Generally

1. Why do you use BDA?

2. Do you consider the adoption of BDA as a success?

ADOPTION PHASE:

1. Did you experience any challenges during the implementing phase?

2. How were these challenges handled?

DAY-TO-DAY operation:

1. What do you consider to be the greatest challenges with handling day-to-day operations of your BDA solution?

2. How are you dealing with these?

3. What values do you seek to realize with BDA?

4. How do you ensure that those values could get realized?

5. Do you use much time on experimenting with data and analytics?

Data

1. Can you tell us about the Data your organization use for BDA? (What Data, internal/external, what types)

Technology

1. Can you tell us about the technical solutions you use? *(Hadoop, SQL, Oracle, other…)*

Organisation

2. If businesses have to build up some kind of capabilities to manage to extract value out of BDA, what could those be? *(Technology skills, data driven culture, resources or other)*

3. Can you tell us about who is involved in BDA? What departments? *(Data scientist, How many, What level, Full time or part time, Outsource / in house)*

4. In which departments are BDA a priority?
5. How is the communication between the involved departments? Meetings, frequency, participants - how many)

6. How did you procure technical skills that were needed? *(Train your own people, Hire new people, Outsource, Had adequate skills beforehand)*

7. Can you tell us about resource investments? *(people, technology etc)*

8. Is it more "pricey" than first anticipated?

9. Do managers understand the value of BDA?

10. To what extent can you rely on data concerning decision making?
(Data vs. intuition, what degree data, extent intuition)

11. Has adoption of BDA changed how decisions are made
(decision making)

12. What are some of the main difficulties you face in determining the areas that big data projects will be focused on?

13. Are results of Big Data analytics implemented into the business strategy?
Performance

14. Do you use big data analytics to scan the environment and competitors? If yes in which way?

15. Have you applied big data analytics to improve coordination within your company or with other business partners? By what means?

16. Have you managed to gain any important corporate insight through big data analytics? Has the company gained new insight concerning its customers, products, marketing strategy etc? If yes, how did you manage that?

17. Has big data analytics helped you integrate new knowledge that you were previously unaware of?

18. Through big data do you manage to reconfigure your existing mode of operation? If yes, please elaborate on how.

19. Would you say that big data and analytics has helped you gain a lead over your competitors?

20. Has it helped in other areas (e.g. slicing costs, reducing personnel, increasing operational efficiency, delivering innovative products/services)?

21. Would you say that the investments and efforts put in big data analytics have paid off yet or would they need more time to become visible?

Ending

1. Are there other positive or negative experience?

2. Any thoughts you want to share with us?