Investigating the Impact of Big Data on Automobile Industry Operations
# Table of Contents

List of Figures 4

**Abstract** 6

1 8

   Introduction 7
   Significance of the Research Area 7
   Problem Statement 8
   Research Aim and Objectives 9
   Research Approach 10
   Project Outline 10
   Conclusion 11

2 13

   Introduction 12
   The 7V’s of Big Data 12
   Fields and Domains using Big Data and Visual Analytics 13
     2.1.1 15
     2.1.2 15
   Types of Big Data Sources 15
   Big Data Visualisation Techniques and Tools for Big Data Visual Analytics 16
   Conclusion 17

3 20

   3.1 20
   3.2 Theoretical Development 19
   3.3 Conclusion 19

4 21
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Introduction</td>
<td>20</td>
</tr>
<tr>
<td>4.2 Selecting an appropriate research approach</td>
<td>20</td>
</tr>
<tr>
<td>4.1.1</td>
<td>22</td>
</tr>
<tr>
<td>4.1.2</td>
<td>23</td>
</tr>
<tr>
<td>Justifying the Use of Quantitative Research Method</td>
<td>23</td>
</tr>
<tr>
<td>4.3</td>
<td>25</td>
</tr>
<tr>
<td>Justifying the use of Survey Based Questionnaire</td>
<td>24</td>
</tr>
<tr>
<td>4.5 Empirical Research Methodology</td>
<td>24</td>
</tr>
<tr>
<td>Research Design</td>
<td>24</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>27</td>
</tr>
<tr>
<td>4.5 Conclusions</td>
<td>27</td>
</tr>
<tr>
<td>5</td>
<td>29</td>
</tr>
<tr>
<td>Introduction</td>
<td>28</td>
</tr>
<tr>
<td>Section A- Demographic Results</td>
<td>28</td>
</tr>
<tr>
<td>Section B &amp; C- Company Big Data Initiative and Impacts Results</td>
<td>32</td>
</tr>
<tr>
<td>Conclusion</td>
<td>41</td>
</tr>
<tr>
<td>6</td>
<td>44</td>
</tr>
<tr>
<td>Research Overview</td>
<td>43</td>
</tr>
<tr>
<td>Meeting the Aim and Objectives of the Project</td>
<td>43</td>
</tr>
<tr>
<td>Statement of Contributions and Research Novelty</td>
<td>44</td>
</tr>
<tr>
<td>Research Limitations</td>
<td>44</td>
</tr>
<tr>
<td>Recommendations for Future Research</td>
<td>45</td>
</tr>
<tr>
<td>7</td>
<td>47</td>
</tr>
<tr>
<td>8</td>
<td>50</td>
</tr>
<tr>
<td>9</td>
<td>55</td>
</tr>
</tbody>
</table>
List of Figures

Figure 2.2-1: 7V's of Big Data 10
Figure 2.2-2: Defining 7Vs of Big Data 10
Figure 4.2-1: Research Onion (Source; Saunders and Tosey 2013) 18
Figure 4.2-2: The process of deduction (Source, Bryman and Bell 2015) 20
Figure 5.2-1: What is your job title in the current company? Error! Bookmark not defined.
Figure 5.2-2: How long have you worked for the organization? 26
Figure 5.2-3: How many people are employed in the organization you work for? 27
Figure 5.2-4: Does your company use Big Data analytics? 28
Figure 5.2-5: Have you ever been exposed to using any form of Big Data in terms of analysing it, visualizing it, or making decisions based on it? 29
Figure 5.3-1: What were the primary data issues in the organization that led it to consider Big Data? 30
Figure 5.3-2: How would you rate the analytical abilities of the company you are employed in? How would you rate the access to relevant, accurate, and timely data in your company today? 31
Figure 5.3-3: What is the company's budget for Big Data initiatives? 32
Figure 5.3-4: Approximately how many staff in your company are dedicated to analytics, modeling, data mining (not including routine reporting)? Of these staff, are most working in or for your consumer facing (B2C) businesses, your commercial or wholesale (B2B) businesses or both? 33
Figure 5.3-5: How does the company plan to measure the success of your Big Data initiatives? 34
Figure 5.3-6 Has the company achieved measurable results from their investments in Big Data? 35
Figure 5.3-7: Impact of Big Data on Company 36
Figure 5.3-8: Questions 11 & 12 11. Since the Big Data initiatives implemented, what tangible benefits have been achieved in the company? What are the tangible benefits the company is aiming to achieve using Big Data initiatives? 37
Figure 5.3-9: What business functions in the company are fueling Big Data initiatives? 38
The current study uses a quantitative research approach to analyse how Big Data initiatives have an impact on the operation functions of automobile companies in the UK. The research had used a survey as the research instrument to gather data from 132 participants that were working in automobile companies in the UK. The survey had looked to examine the opinions that executives had held about Big Data and how it was impacting the company. The survey was distributed online to individuals that worked for automobile companies in the UK using Survey Monkey. The data obtained was then analysed using descriptive statistics to find factors that may be influencing the use of Big Data in the automobile companies.

Based on these results, it is concluded that greater investments in Big Data brings about positive impacts. The results presented conclude that investing more than 1 billion GBP on Big Data initiatives would provide for greater tangible benefits for a business and have a positive impact on the company. The results also found that companies with greater analytical abilities that were on the adequate and above adequate range were able to see measurable results. In the end, Big Data did have a positive and large impact on the operations business function of automobile companies.
1 Introduction to the Research Topic

Introduction

Big Data is recently on the rise as imperative information and tools that need to be incorporated into businesses and even daily life. Pflugfelder (2013) defines Big Data as data which is quite large in volume, high in velocity, extensive in its variety, unable to be handled using conventional systems like relational databases, and needs unique and advanced technology for storage, management, analysis, and visualisation. However, the actual definition of Big Data varies from industry to industry and business to business. Schroeck et al. (2012) found in their research that 18 percent of businesses defined Big Data as a vast source of information, 15 percent of companies named it as real-time information, and seven per cent of these businesses considered Big Data as a source of information from social media. By combining these demarcations the resultant is a definition that portrays Big Data as a source of information that can be structured, unstructured, and semi-structured which is in need of new technology, tools, and techniques for its storage, processing, analysis and visualisation for a large volume of data that is emitted at high speed and variety.

Significance of the Research Area

The automobile industry is increasingly becoming competitive in sustaining economies, especially with a fierce competition raging between Western and Eastern manufacturers (Wallner and Kriglstein 2013). The industry has had a major impact on regional and world economies and societies (Lee et al. 2014). With increased competitiveness between companies it has become crucial to make decisions based on real-time data in order to capture a large chunk of the market and interest of consumers. For this reason, many automobile companies around the world have begun to integrate Big Data into their decision making process that ranges from manufacturing to marketing.

Walker (2015) has found that integrating Big Data into business related tasks in the automobile industry can be accomplished successfully through the following;

- Recalculating entire risk assortments within minutes
Identifying fraudulent behavior easily which might affect the automobile industry.

Regulating root causes of problems, issues and failures and defects that could affect in the longer term and shorter term.

Generating sales based on market research of consumer behavior.

With automobiles being an intricate part of developed society it becomes mandatory for companies to ensure that they are providing quality products for the masses. Big Data can play a significant role in business activities of automobile companies. With changing consumer behaviour and more informed consumers it has become essential for companies to integrate real-time information into business decisions.

**Problem Statement**

Automobile manufacturing in the UK has become a vital part of its economy. According to the Society of Motor Manufacturers and Traders (2016) there were 2.63 million cars registered in 2015 which was an increase of six per cent from 2014. Due to the rapid changes and developments in the automobile industry Big Data analysis has become vital to ensure new levels of success in this revolutionary period. For this reason, the current study looks to understand the significance that Big Data plays in the Automobile industry.

In order to compete in an already competitive environment it has become necessary for businesses to understand the value that Big Data can bring to them. This makes it imperative for Big Data users to become capable in making decisions that can serve the purpose of bringing a competitive edge to the business or else integrating Big Data becomes of use now. Schroeck et al. (2012) finds that a vast deal of data that is available to companies is commonly unrelated as it comes from various data sources such as sensors, mobiles, transactions, social medial, log files, audio, video, images, and emails. The processing of such large amounts of data in order to produce meaningful decisions has become critical for businesses in order to thrive and succeed in markets in which consumer trends are none to change rapidly (Shah et al. 2014).

The automobile industry in the UK needs to improve its decision making process in order to advance critical operations in order to compete in a highly competitive regional and
international market. Monaghan (2016) notes that the British car industry has been enjoying prolonged periods of growth as witnessed with a car production increase in June 2016 that rose by 10.4% to 159,000 cars, the highest it has been since June 1998. According to the Society of Motor Manufacturers and Traders (SMMT) by 2017 the UK has the possibility of building a record number of vehicles per year that may overtake France and Spain in order to become Europe’s second largest producer after Germany (Foy 2014). However, Foy (2014) points that such success may be hindered due to the eroding supply chain and operations of the British car industry, primarily smaller companies that provide parts and electronic components that go into cars, making it the biggest concern of the industry. To overcome these concerns many are looking towards including more efficient data that may aid industry leaders in making better decisions for more prosperous business (Shooter 2013).

**Research Aim and Objectives**

Big Data is now widely being used in the automobile industry so that quick actions can be taken saving time and cost prices. Understanding how the automobile industry is able to integrate the analysis of Big Data into its daily operations has become imperative in order to improve its integration and ensure that Big Data is being used correctly to obtain maximum benefit of it. Therefore, the following research question has been formulated.

*How has Big Data impacted the UK automobile industry’s operations?*

Based on the research question the main aim of the research is to investigate the impact of Big Data on the automobile industry; specifically in the UK, operations such as sales, customer retention, the manufacturing process, performance, marketing, logistics, and supply chain management.

In order to achieve the aim of the research and answer the research question the following objectives have been developed.
Research Approach

The current study will be conducted using a qualitative research approach. Based on the sections above, the study’s aim and objectives have been developed in order to pursue the study’s research question using the proposed research approach. In order to build a research approach a literature review was conducted to understand previous studies that have attempted to analyse the influence of Big Data in various industries. The results of the literature review (i.e. chapter two) aided in building the research approach. Under this approach, primary research is conducted using semi-structured interviews as the research instrument for data collection. The justification of this approach will be discussed in detail in chapter three of the study.

Project Outline

The current study is divided into six chapters. Below is the outline of study;
Conclusion

Big Data has been influential in the 21st century by providing industries and companies with detailed information that is used to make more intelligent business decisions. Very little research has been conducted on how Big Data impacts the automobile industry. Therefore, the current study aims to analyse and comprehend how Big Data impacts the UK automobile industry in terms of influencing operations, sales, marketing, and other business aspects. For this purpose the study developed a set of objectives that will be used to fulfill the aim of the study and the primary research question. The study is structured according to a qualitative research approach. Building the research approach designated the need for a literature review which is presented in the next chapter (i.e. Chapter two).
2 Literature Review

Introduction

The literature review chapter is constructed based on the principles of systematic research in order to provide an in-depth analysis of previously published literature on topics related to the current research. The literature review will provide critical insight on various definitions that are relevant to developing the current research and its primary focus throughout the dissertation. In order to conduct this literature review, it was essential to search for relevant papers through a series of databases such as Wiley Online Library, Science Direct, IEEE Xplore Digital Library, and Google Scholar. For the current literature review, the chapter is divided into sections that answer the literature reviews research questions which are as followed:

1. How have various other fields and domains, other than the automobile industry, used Big Data analytics, and visual analytics?
2. What are the types of data sources that have been reported in literature?
3. What are types of Big Data visualisation techniques and tools for Big Data visual analytics?

Previous literature that is able to provide understanding based on these questions were included in the literature review. Based on the analysis of the literature included, the methodology of the current research will be constructed.

The 7V’s of Big Data

Big Data is defined using the 7V’s known as volume, velocity, variety, variability, veracity, visualisation, and value.
Fields and Domains using Big Data and Visual Analytics

Based on the review of literature, there is practically little to no publications available that portray the extent or detailed use of Big Data analytics in the automobile industry. However, many key publications have noted that Big Data analytics is becoming a trend in impacting businesses globally. Wozaniak et al. (2015) examined and determined to comprehend they type of data available to Volvo and how the company was extracting...
such data. Based on the study, it is found that Volvo used data from its production planes and service centres to obtain data about their vehicles to assess information such as customer satisfaction, mileage coverage, and other key factors that would improve decision making. Wozniak et al. (2015) found that Volvo uses data sources from logged production information; product specifications, client information, dealer information, product session information, telematics data, service history, repair history, warranties, and service contracts which are then dispersed throughout the organisation to specific departments, software teams, and engineers to use the data for production or operations improvements. Many other industries are also using Big Data analytics for their services and products.

### 2.1.1 Banking

Big Data analytics can have a profound impact on the future of banking industries. Collecting data at a massive scale can allow banks to comprehend the needs and expectations of their customers. However, banks seem to lack the skills needed to execute and deploy big data initiatives as they leverage more familiar technologies and software-development-lifecycle (SDLC) methodologies. To develop analytic tools that are comprehended by experts in the banking industry it is essential to meld together accurate data interpretation that is on a user friendly interface. CoMotion is an example of a Big Data analytics tool that keeps the user in mind. CoMotion allows for a comfortable and easy experience for bank data exploration (Laberge, Anderson et al. 2012). The analytics tool allows analysts to simply drag and drop data collections that produce variable chart visualisations. The process formally known as “think loop process” allows analysts to dig and separate larger collections of data to explore particular hypotheses based on smaller groupings to understand banks’ network anomalies (Laberge, Anderson et al. 2012).

### 2.1.2 Transport

Implementing Big Data into the transportation industry has allowed for it to become resilient in extreme scenarios. A large portion of the world’s population has shifted to urban living areas requiring cities to deliver services in a sustainable, effective, and efficient manner. Currently, big data analytic research projects are commenced in the transportation industry to deal with massive data coming from roads & vehicle sensors,
GPS devices, customer apps, and other websites. Ben Ayed et.al. (2015) have reported the use of Big Data analytics in Dublin to improve the city’s public bus transportation network and reduce issues with increased traffic congestion. Using advanced analytics on the collected data, specific traffic problems were identified, the optimal time needed to start bus lanes was answered and recommendations were made to the addition of bus lanes (Ayed et.al. 2015).

Ferreira, Poco et al. 2013 study provides insight into the use of taxi trips to allow users to visually query taxi trips allowing taxi companies to make better decisions to schedule driver shifts and increase revenue. The use of Big Data analytics in transportation has also allowed policy makers to develop improved preparation plans and disaster management plans for high risk events such as accidents, public gatherings, and natural disasters. Using smart card data and social media data the resilience of transportation systems can be increased by analysing changes in passenger behaviour, replaying historic events within the specific area to discover anomalous situations, and customer service (Itoh, Yokoyama et al. 2014).

**Types of Big Data Sources**

Unlike typical data, Big Data contains videos, text, audio, images, and other forms of data which is collected from numerous datasets making it difficult to process with traditional database management tools giving rise to a new generation of tools specifically designed to analyse and visualisation Big Data. Santourian et.al. (2014) observes that Big Data is often generated from transactions (i.e. invoices, payment orders, delivery records, and storage records) or unstructured data such as that from text extracts from websites, social media, or images. However, Santourian et.al. (2104) Also notes that Big Data can also be collected in “real-time” from sensors such as those found in smartphones or from logs extracted from behaviour found on line. The rawness of Big Data due to the velocity by which it is being received oftentimes are unable to serve a statistical purpose as they have been collected by third-parties who don’t place emphasis on data collection.

Big Data sources vary across industries as collection of data needs to fit the purpose for they are to be used in analysis. For example, Fiore et.al. (2015) uses data sources that have been made available by project partners or made available through national and
international agencies developing a more static setup for Big Data analysis. This included sources of data coming from satellite imagery, remote sensing data, hyper-spectral imagery, and climate data used to formulate a use case infrastructure to analyse climate change trends in Manaus, Brazil (Fiore et.al. 2015). A study conducted by Baciu et.al. (2015) has reported that use of sources that vary across fields such as extracting data from a website known as Brightkite that collects data from 4.5 million mobile users locations, such as their latitude and longitudes of each of the mobile users over certain intervals of time. Studies that are less scientifically complex in theme use other sources of data; such as text sources which include words, phrases, and even entire documents extracted from social media platforms (i.e. Facebook) is used to analyse and predict events such as market trends, analyses product defects, and management of calamities (Fan and Gordon 2014; Mahmud et.al. 2014).

Large companies also use various data sources to collect raw data in order to turn it into meaningful knowledge that can then be used to improve customer service, examine product defects, analyse organisational changes, and comprehending changing consumer trends (Heer and Kandel 2012; Kateja et.al. 2014). Volvo an automobile manufacturer uses data sources from logged product information; product specifications, client information, dealer information, product session information, telematics data, service history, repair history, warranties, and service contracts which is then dispersed throughout the organisation to specific departments/divisions, software teams, and engineers to use the data for improvements (Wozniak et.al. 2015).

**Big Data Visualisation Techniques and Tools for Big Data Visual Analytics**

Vatrapu et.al. (2015) defines data visualisation as a method to communicate and transfer information clearly and effectively through graphical means. Given the rise of Big Data, analysts have begun to use data visualisation methods allowing them to visualise, recognise, differentiate, interpret, and communicate configured patterns of data based on the new visualisation techniques specifically for massive datasets. With new techniques, data scientists, analysts, and industry leaders benefit from comprehending massive amounts of data, recognition of emerging properties within the data, data quality control, feature detection on a small and large scale, and evidence for formulating hypotheses.
Generally, all visualisation techniques and tools follow a similar pattern which includes the use of processing steps of data acquisition, data transforming, mapping data onto visual models, and lastly rendering or viewing the data (Zhang et al. 2013; Goonetilleke et al. Liu et al. 2015; Fu et al. 2014). Following is a brief discussion of visualisation tools and techniques that have been used across diverse industries and studies to Big Data.

**Conclusion**

Popular domains that highly demand the use of Big Data are healthcare, automobile, transport/Urban infrastructure, banking and retail. The chapter was also able to find sources through which the domains which have been discussed retrieve vital information/data to use as meaningful knowledge. It is evident from the literature review that sources for retrieval of data diverge greatly from normal sources. Firstly, the Big Data sources will contain massive data from sensors such as those on a phone that monitor health. With such massive data, it is necessary to follow specific steps that are laid out for Big Data analytics as the analysis of data is done to the most microscopic level that a researcher can go with such tremendous amounts of data. Finally, data visualisation becomes necessary for producing information which can be used to help in decision making.

Systematic literature review has also revealed the numerous different sources from which Big Data is extracted. Sources vary depending on the domain which is the source to extract specific kinds of data. Literature reveals that typical Big Data contains videos, texts, audio, and images at massive levels of datasets. The complexity of the datasets produces a challenge for traditional database management tools to handle the volume of the data that is being analysed. Common sources for Big Data generation have been found to be payment orders, delivery records, invoices, and storage records. However, sources have the possibility of being "real-time" if it is collected by sensors such as those present in smartphones. Unstructured data is also commonly seen in Big Data ranging from social media posts, images, text extracts from websites, or even whole websites. Regardless of what type of data it is, sources from which it is obtained will vary from industry to industry. Sources of data can come from social media data such as Facebook...
wall posts, comments, likes, and Twitter tweets to name a few; while more experimental and scientific sources also provide for specific data such as temperature, humidity, and wind speeds data in “real-time” for analysing and making predictions towards climate change.
Chapter 3 Conceptual Framework

3.1 Introduction

The chapter presents the conceptual framework for automobile company executives to adopt. This is achieved through using the category of adopters under diffusion of innovations theory proposed by Rogers (2003).

3.2 Theoretical Development

To develop the conceptual framework the diffusion of innovations theory was heavily relied upon as proposed by Rogers (2003). Based on the theory, diffusion is the process by which innovation is communicated over a period of time among those participating in a social system. According to Rogers (2003) there are four main elements that influence the spread of a new idea; innovation, communication channels, time, and a social system. Currently, automobile companies are slowly creeping into the use of Big Data as a means for handling operations within the company, as evident from the literature review. The process of diffusion relies extremely on human capital. This means that innovation needs to be widely adopted within a setting in order to self-sustain itself.

There are various strategies available to help an innovation reach the stage of critical mass. This includes the strategy of when an innovation is adopted by a highly respective person in an organisation and develops an instinctive desire for a specific innovation. Rogers (2003) argues that one of the best strategies is to place an innovation into a group of individuals who are able to readily use the technology and provide positive reactions resulting in benefits to early adopters. By using the adoption process under the diffusion of innovation theory automobile companies can target high level respected executives to shift their support towards big data initiatives in the company.

3.3 Conclusion

The proposed conceptual framework provides automobile companies with strategies that adopt big data initiatives in order to promote innovation. The best way to do so is to present innovation to highly respectable executives in the company in order to promote the adoption of innovation in order to self-sustain it.
Chapter 4 Methodology

4.1 Introduction

The current chapter presents the process of developing the research methods needed to complete the experimentation portion of the current study. The chapter will discuss in detail the various stages of developing the methodology of the current study. This includes a detailed discussion of the philosophical background of the research method chosen. In addition to this, the chapter describes the data collection strategy including selection of research instrumentation and sampling. The chapter closes with a discussion on the analysis tools that will be used to analyse the data collected.

4.2 Selecting an appropriate research approach

Creswall (2013) stated that research approaches are plans and procedures that range from steps including making broad assumptions to detailed methods of data collection, analysis, and interpretation. The several decisions involved in the process are used to decide which approach should be used in a specific study which is informed using philosophical assumptions which are brought to the study (Creswall 2013). Included in this are procedures of inquiry or research designs and specific research methods that are used for data collection, its analysis, and finally its interpretation. However, Guetterman (2015); Lewis (2015); and Creswall (2013) argue that the selection of the specific research approach is based on the nature of the research problem, or the issue that is being addressed by any study, personal experiences of the researchers’, and even the audience for which the study is being developed for.

The main three categories with which research approaches are organised include; qualitative, quantitative, and mixed methods of research. Creswall (2013) comments that all three approaches are not to be considered so discrete or distinct to one another. Creswall (2013) states, “qualitative and quantitative approaches should not be viewed as rigid, distinct categories, polar opposite, or dichotomies” (p.32). Guetterman (2015) points out that a clearer way of viewing gradations of differences between the approaches is to examine the basic philosophical assumptions that are brought to the study, the kinds of
research strategies used, and the particular methods that are implemented in conducting the strategies.

5.1.1 Underlying Philosophical Assumptions

An important component of defining the approach to research involves philosophical assumptions which contribute to the broad research approach of planning or proposing to conduct research. It involves the intersection of philosophy, research designs and specific methods as illustrated in the Fig. 1 below.

Saunders et al. (2009) define research philosophy as a belief about the way in which data about a phenomenon should be gathered, analysed and used. Positivism reflects the acceptance in adopting the philosophical stance of natural scientists (Saunders, 2003). According to Remenyi et al. (1998) there is a greater preference in working with an “observable social reality” and that the outcome of such research can be “law-like” generalisations that are the same to those which are produced by physical and natural scientists. Gill and Johnson (1997) add that it will also place a greater emphasis on a highly structured methodology in order to allow for replication for other studies. Dumke
(2002) agrees and explains that a positivist philosophical assumption produces highly structured methodologies and allows for generalisation and quantification of objectives that can be evaluated by statistical methods. For this philosophical approach, the researcher is considered an objective observer who should not be impacted by or impact the subject of research.

The current study chooses positivist assumptions due to the literature review’s discussion of the importance of Big Data in industrial domains and the need for measuring its success in operations of business. In order to identify a positive relationship with Big Data usage and beneficial business outcomes, theory needs to be used to generate hypotheses which can later be tested of the relationship which would allow for explanations of laws that can later be assessed (Bryman and Bell, 2015).

5.1.2 Selecting Interpretive Research Approach

Interpretive research approaches are derived from research philosophy that is adopted. According to Dumke (2002) the two main research approaches are deductive and inductive. The inductive approach is commonly referred to when theory is derived from observations. Thus, the research begins with a specific observation and measures. It is then from detecting some sort of pattern that a hypothesis is developed. Dumke (2002) argues that researchers who use an inductive approach usually work with qualitative data and apply various methods to gather specific information that places different views. From the philosophical assumptions discussed in the previous section, it is reasonable to use the deductive approach for the current study. It is also considered the most commonly used theory to establish a relationship between theory and research. The figure below illustrates the steps used for the process of deduction.
Based on what is known about a specific domain, the theoretical considerations encompassing it lead to the deduction of a hypothesis or hypotheses that will later be subjected to empirical enquiry (Daum, 2013). It is through these hypotheses that concepts of the subject of interest will be translated into entities that are rational for a study. Researchers are then able to deduce their hypotheses and convert them into operational terms.

**Justifying the Use of Quantitative Research Method**

Saunders (2003) notes that almost all research will involve some sort of numerical data or even contain data that could be quantified in order to help a researcher answer their research questions and meet objectives of the study. However, quantitative data refers to all and every data that can be a product of all research strategies (Bryman and Bell, 2015; Guetterman, 2015; Lewis, 2015; Saunders, 2003). Based on the philosophical assumptions and interpretive research approach, a quantitative research method is the best suited for the current study. Mujis (2010) defends the use of quantitative research because unlike qualitative research which argues that there is no pre-existing reality, quantitative research assumes that there exists only a single reality about a social condition which cannot be influenced by researchers in any way.
4.3 Selecting an Appropriate Research Strategy

There are many strategies available to implement in a study as evidence from Fig. 1. There are many strategies available for mono-quantitative methods such as telephone interviews, web based surveys, postal surveys, and structured questionnaires (Haq 2014). Each instrument has its own pros and cons in terms of quality, time, and cost of data. Brymand (2006); Driscoll et al. (2007); Edwards et al. (2002); and Newby et al. (2003) note that most researchers use structured questionnaires for data collection they are unable to control or influence respondents which leads to low response rates but more accurate data obtained. Saunders and Tosey (2015) have argued that quantitative data is simpler to obtain and more concise to present. Therefore, the current study uses a survey based questionnaire (See Appendix A).

Justifying the use of Survey Based Questionnaire

Surveys are considered the most traditional forms of conducting research and useful in non-experimental descriptive designs that look to describe some sort of reality. Survey based questionnaires are often restricted to a representative sample of a potential group that is of the study’s interest. In this case, it is the executives currently working for automobile companies in the UK. The survey instrument is then chosen as for its effectiveness at being practical and inexpensive (Kelley et al., 2003). Due to the philosophical assumptions, interpretive approach, and methodological approach chosen, the survey design for the current study is considered the best instrument that is in line with these premises in addition to be cost effective.

4.5 Empirical Research Methodology

Research Design

This section describes how research is designed in terms of the techniques used for data collection, sampling strategy, and data analysis for a quantitative method. Before going into the strategies of data collection and analysis, a set of hypotheses were developed.
Hypotheses Development

The current study is using a quantitative research approach making it essential to develop a set of hypotheses that will be used as a test standard for the mono-method quantitative design. The following are a set of hypotheses which have been developed from the examination of the literature review.

<table>
<thead>
<tr>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₁ - The greater the company’s budget for Big Data initiatives (More than 1 million GBP) the greater the company’s ability to monetize and generate new revenues.</td>
</tr>
<tr>
<td>H₂ - The greater the company’s budget for Big Data initiatives (More than 1 million GBP) the greater decrease in expenses is found.</td>
</tr>
<tr>
<td>H₃ - The greatest impact of Big Data on a company is changing the way business is done.</td>
</tr>
<tr>
<td>H₄ - Big Data integrating in a company has resulted in competitive significance.</td>
</tr>
<tr>
<td>H₅ - The analytical abilities of a company allows for achieved measureable results.</td>
</tr>
<tr>
<td>H₆ - Investing in Big Data will lead to highly successful business results.</td>
</tr>
<tr>
<td>H₇ - A business’s operations function is fuelling Big Data Initiatives and effecting change in organisation of operations.</td>
</tr>
<tr>
<td>H₈ - The implementation of Big Data in the company has positive impacts on business.</td>
</tr>
</tbody>
</table>

Data Collection

This section includes the sampling method used to collect the number of respondents needed to provide information which is then analysed after collection.

Sampling Method

Collis (2009) explains that there are many kinds of sampling methods that can be used for creating a specific target sample from a population. This current study uses simple random sampling to acquire respondents with which the survey will be conducted. Simple random sampling is considered the most basic form of probability sampling. Under the method, elements taken from the population are random with all elements having an
equal chance of being selected. According to the Office of National Statistics (ONS) as of 2014 there are about thirty five active British car manufacturers in the UK, each having an employee population of 150 or more. This is why the total population of employees in car manufacturers is estimated to 5,250 employees. The sample therefore developed used the following equation;

\[
\frac{z^2 \times p(1-p)}{e^2} \left[ \frac{1}{1 + \left( \frac{z^2 \times p(1-p)}{e^2N} \right)} \right]
\]

Where; \(N\) is population size, \(e\) is margin of error (as a decimal), \(z\) is confidence level (as a z-score), and \(p\) is percentage value (as a decimal). Thus, the sample size is with a normal distribution of 50%. With the above equation, population of 5,250; with a 95% confidence level and 5% margin of error, the total sample size needed for the current equals 300. Therefore, \(N=300\) which is the sample size of the current study.

Survey

The survey develop (see Appendix A) has a total of three sections, A, B, and C with a total of 39 questions. Each section has its own set of questions with an objective to accomplish. The survey is a mix of closed end questions that look to comprehend the demographic makeup of the respondents, the Big Data initiatives of the company, and the impact that Big Data was having in their company. The survey is designed to take no longer than twenty minutes. The survey was constructed on Survey Monkey.com an online survey provided website. The survey was left on the website for a duration of 3.5 weeks in order to ensure that a maximum number of respondents were able to answer the survey. The only way that the survey was allowed for a respondent is if they passed a security question which asks if they are working for an automobile company in the UK at the time of taking the survey. Gupta et al. (2004) believes that web surveys are visual stimuli, and the respondent has complete control with regard to whether or how each question is read and understood. That is why Dillman (2000) argued that web questionnaires are expected to closely resemble those that are taken through the mail/postal services.
Data Analysis

The collected data is then analysed through Statistical Package for Social Science (SPSS) version 24 for descriptive analysis. The demographic section of the survey will be analysed using descriptive statistics. Further analysis of the data also includes the use of descriptive statistics.

4.5 Conclusions

The chapter provides descriptive and in-depth discussion of the methods involved in the research of the current study. The current study is looking towards a quantitative approach that takes into account positivism as its philosophical undertaking, using deductive reasoning for its interpretive approach, is a mono-quantitative method that involves the use of a survey instrument for data collection. The methodology chapter also provided the technique for data analysis which is descriptive statistics through frequency analysis and regression analysis.
6 Chapter 5 Results and Analysis

Introduction
The chapter provides the findings of the current study based on the survey results obtained. It provides a straightforward statement of the results using descriptive statistics which would later be further analysed using SPSS v.24 software. The need for SPSS is to conduct a regression analysis to provide detailed examination of the data.

Section A- Demographic Results

The study had called for 300 respondents to answer the survey using Survey Monkey, left online for 3.5 weeks. However, the total of completed surveys obtained was 132, making the survey’s response rate to only forty-four percent (44%). It was not the best response rate, but it did still provide a broad range of participants to analyse.

The first question of the survey’s section A called for respondents to identify their job title for the current automobile company that they were working for. From Fig. 5.2-1-1 it is seen that operations managers and supervisors made up the greatest number of respondents in the study. Operations managers had composed 14 percent of the respondents, followed by foreperson, supervisor, lead person of 13 per cent, and the project managers that made 12 percent of the respondents.
Respondents were also asked to provide an indication of the number of years that they have been employed in the specific organisation. Allowing for such insight would provide a sense of experience that the participant may have had while working in the company.

This is illustrated in Fig. 5.2-2 in which 42 per cent of respondents have indicated that they have worked for the company for five to ten years. Of the respondents thirty-three per cent have indicated that they have worked for their company for 10-15 years, while
thirty per cent indicated less than five years, and the remaining 27 per cent indicated employment for over fifteen years.

The survey also asked respondents to indicate the number of employees that worked for the firm that they were employed in. Having such knowledge would allow the researcher to understand the extent of operations that are being conducted in the automobile company. Having such an understanding provides insight into the scope of use in terms of Big Data being implemented in the company (see Fig.5.2-3).

A total of 46.97 percent of respondents indicated that they worked for companies that employed 50 to 250 employees. Also, 35.61 per cent of employees indicated that they were employed by companies that had more than 250 employees working for them. Lastly, 17.42 percent of respondents indicated that the companies they worked for had 10-15 employees. The large number of respondents indicated that they worked for
companies with more than 50 employees indicate that they companies included in the study are small-to-medium businesses and large enterprises.

![Graph showing percentage of companies using Big Data analytics](image)

**Figure 5.2-4 - Does your company use Big Data analytics?**

Of the respondents participating 72.73 per cent indicated that their company was using Big Data analytics. This was crucial as it provided insight into the amount of automobile companies that actually do have Big Data analytic systems. As seen in Fig. 5.2.-5 only eighty-one (81) respondents from 132 actually had direct exposure to Big Data in terms of either analysing, visualising, or making business decisions based on it. The pool of respondents was considerably smaller than anticipated but these slight details will provide a greater insight into the workings of automobile companies in regards to their use or integration of Big Data into the company. Based on the demographic analysis, participants that completed their survey had some access or interaction to Big Data analysis. But there is still a large group of people in these companies that do not have any exposure or access to Big Data.
Section B & C - Company Big Data Initiative and Impacts

Results

The next section of the questionnaire, section B aimed to analyse the respondents answer to identify the extent of integration or implementation of Big Data initiatives in the automobile company that they worked for. The purpose of this section was to understand the extent of which Big Data is present in automobile companies. This information can provide a point of comparison with the next section which looks to understand and examine the effects of having Big Data indicatives in the company.

The Fig. 5.3-1 illustrates the main issues that may have caused the automobile company to actually go ahead with the plan to implement Big Data initiatives. Based on the graph it is concluded that factors of analysing streaming data and data sets greater than 1 TeraByte (TB) were the greatest cause of initiating Big Data into the company, as per the response of 19.70 percent of respondents respectively.
Another issue that instigated the need for Big Data analytics in companies was analysing data sets from 1 TB to 100 TB as indicated by 18.18 per cent of respondents. Next in the rank was the issue of analysing new data types which led to using Big Data analytics as indicated by 13.64 per cent of respondents.

Fig. 5.3-2 illustrates the reaction of respondents to two questions.

- **Questions 2. How would you rate the analytical abilities of the company you are employed in?**
- **Question 5. How would you rate the access to relevant, accurate and timely data in your company today?**
Figure 5.3-2 - How would you rate the analytical abilities of the company you are employed in? How would you rate the access to relevant, accurate, and timely data in your company today?

There is a strong correlation to the access of Big Data and the analytical abilities of the company. Based on the illustration 55 people had access to Big Data thought the access was adequate with 42 of them believing that the analytical ability of the company was adequate. Furthermore, 69 participants indicated that access to Big Data was more than adequate with 57 of the participants believing that analytical ability of the firm was more than adequate. It can be concluded that the greater the access to Big Data the adequate or more than adequate analytical abilities of the firm.

The next graph indicates the amount of spending that is placed on a Big Data initiative’s budget. Oftentimes, it was seen, as from the literature review, that funding Big Data analytics in a company allowed for greater business gains. Therefore, it was essential to understand the budget amount that was invested in Big Data initiatives.
A majority of respondents, about 47 per cent indicated that their company had a Big Data initiative budget of £1 million to £10 million GBP. Another 40 per cent of respondents have indicated that their company spent £100,000 to £1 million GBP on their Big Data systems. The amount of staff dedicated to Big Data analytics is also thought to play a part in advancing the goals that may be set for an automobile company in regards to Big Data. The figure below takes two questions;

**Questions 7- Approximately how many staff in your company are dedicated to analytics, modeling, data mining (not including routine reporting)?**
Question 8 - Of these staff, are most working in or for your consumer facing (B2C) businesses, your commercial or wholesale (B2B) businesses or both?

Based on the illustration, nineteen (19) respondents indicated that 501-1000 employees are dedicated to analytics for both B2B and B2C evenly. The category of using Big Data analytics for both B2B and B2C comprises the most agreement of respondents with 72 of 132 indicated so.
The figure above represents the respondents answers to their automobile company’s plan for measuring the success of Big Data. Of the 132 participants 44.70 per cent responded that the company is planning on using quantitative metrics that are associated with business performance to analyse if Big Data is actually successful. Another, 30.30 per cent indicated that their company was planning on using qualitative metrics that are tied to business performance. Using business performance as a means of analysing the success of Big Data is coherent to the results of the literature review that indicated previous studies of do such. As an automobile company, they need to know the results of using Big Data analytics and that is only by using business performance indicators regardless of being qualitative or quantitative.
Fig. 5.3-6 portrays the response of participants in regards to actually achieving measurable results from Big Data. According to 68.18 per cent of respondents the company that they worked for did indeed show measurable results from their investments in Big Data. However, 31.82 per cent indicated that there was indeed no measurable result in investing in Big Data. Based on these results and those presented in 5.3-2 the results support H₅ which states that analytical abilities of a company allows for measurable results.
Fig. 5.3-7 presents the answers of respondents of the impact of Big Data on automobile companies. An estimate of 60% of participants indicated that Big Data initiatives have been started and the company has benefited with a decrease in expenses. This response coupled with the responses seen in Fig. 5.3-3 supports hypothesis $H_2$ that the greater company’s budget (>1 million GBP) would decrease expenses. In addition, over 70% of respondents indicate that their companies had started and benefited from Big Data initiatives by monetising from the initiatives. These results coupled by those presented in Fig. 5.3-3 supports $H_1$ which suggested that larger investments (<1 million GBP) would result in the company’s ability to monetise and generate new revenues.
Fig. 5.3-8 presents the actual and projected benefits with Big Data initiatives. Over 60% of respondents indicated that their automobile company had witnessed actual benefits in increase of sales and product innovations since their Big Data initiatives. Other actual benefits that overcame project benefits include improved customer experience, higher quality products/services, efficient operations, and improved decision making. Coupled with the results from 5.3-3, the data supports hypotheses H₆ and H₈.
Fig. 5.3-9 presents the results of question 13 in section C of the questionnaire. Respondents were asked which business function may be fueling the drive for Big Data initiatives. From the sample 34.09% indicated that operations were the main business function fuelling Big Data in the company. After operations, the second highest function was customer service with 18.94% respondents indicating this. The business function thought to be the least influential in driving Big Data in automobile companies was Information Technology with 9.09% indicating it. The results of this partially support H7 because according to question 15 section C, 25% of respondents indicated that in the next five years Big Data will impact and fundamentally change the way business is done in the organisation as opposed to 15.91% respondents that indicated it will change the way the business will organise operations.

**Conclusion**

Based on the results of the study, hypotheses H1, H2, H5, H6, H8 and part of H7 have been supported. This leads to the conclusion that Big Data initiatives in automobile companies
have had a significant impact on operations of the company. Of these operations, the companies have significantly benefited from increased sales, greater innovations of products, improved customer care, and efficient decision making. Greater investment of more than 1 billion GBP have led to better results obtained from Big Data initiatives.
Chapter 6 Conclusion and Discussion

Research Overview
The current study aimed to analyse the impact that Big Data initiatives had on automobile companies in the UK especially on its operations. The current study was developed using a quantitative approach which meant the use of philosophical assumptions from the positivist school of thought and producing a methodology that would follow deductive reasoning. Under these assumptions the quantitative approach was selected and has used the instrument of survey to gather data. This data was then analysed using descriptive statistics to examine the results and link it to a set of proposed hypotheses. The results presented conclude that investing more than 1 billion GBP on Big Data initiatives would provide for greater tangible benefits for a business and have a positive impact on the company. The results also found that companies with greater analytical abilities that were on the adequate and above adequate range were able to see measurable results. In the end, Big Data did have a positive and large impact on the operations business function of automobile companies.

Meeting the Aim and Objectives of the Project
The main aim of the research was to investigate the impact of Big Data on the automobile industry; specifically in the UK, operations such as sales, customer retention, the manufacturing process, performance, marketing, logistics, and supply chain management. The current study was able to accomplish this using the objectives. The aims and objectives of the current study were supported by the revelation that the following hypotheses are supported by the results and analysis in Chapter 5.

$H_1$- The greater the company’s budget for Big Data initiatives (More than 1 million GBP) the greater the company’s ability to monetize and generate new revenues.

$H_2$- The greater the company’s budget for Big Data initiatives (More than 1 million GBP) the greater decrease in expenses is found.

$H_5$- The analytical abilities of a company allows for achieved measurable results.

$H_6$- Investing in Big Data will lead to highly successful business results.
H7- A business’s operations function is fuelling Big Data initiatives

H8- The implementation of Big Data in the company has positive impacts on business.

Statement of Contributions and Research Novelty

Based on the literature review conducted in chapter 2 there is little to no academic research on the impact of Big Data on automobile companies. Due to this significant gap in research the current study can contribute to literature using the insight provided by results of this study. The study was able to analyse how executives in automobile companies in the UK perceive the contributions made by Big Data in their companies. This insight can then be used to attract other researchers to study the phenomena. Big Data and its emergence in the current markets is fairly new making the idea behind the current a novel idea.

Research Limitations

The research was severely limited due to the number of respondents being a lot less than those proposed; 300 respondents were needed however, only 132 had completed the survey. This may be due to the fact that the survey was distributed online. This makes it difficult to tell how many people had seen the survey link but had not participated. There is also the idea that the survey may have been too long making respondents weary to answer the questions due to the great length of time it took to answer. It is due to the sample constraint that the results obtained from the current study cannot be generalised to the population sampled. It is recommended that other forms of distributing surveys should be used in order to garner maximum number of respondents. There is also the inability of automobile companies to speak to researchers on the phone which led to the drop in using interviews in the study. With interviews a greater deal of insight can be brought to the results obtained from the survey. Complementing these would have made the results of the study more accurate and reliable.
Recommendations for Future Research

It is recommended that future studies take into account the loopholes of the current study. From the literature review it was known that very little literature is available on the impact of Big Data on automobile companies. Due to this lack, future researchers are encouraged to research this industry because there will be drastic changes that may result in increased use of Big Data. Future researchers are recommended to use a mixed methods approach to obtaining and analysing data. With a mixed methods approach qualitative and quantitative data can complement each other to make assumptions stronger and test hypothesis in a manner which is highly effective.
References


# Appendix A - Survey

## SECTION A

This portion of the survey looks to understand some background information about the participant.

1. **What is your job title in the current company?**
   - [ ] Operations Manager
   - [ ] Quality Control, safety, environmental manager
   - [ ] Accountant, bookkeeper, controller
   - [ ] Office Manager
   - [ ] Foreperson, supervisor, lead person
   - [ ] Marketing Manager
   - [ ] Purchasing Manager
   - [ ] Project Manager
   - [ ] Human resources manager
   - [ ] Professional Staff

2. **How many people are employed in the organization you work for?**
   - [ ] Less than 10 employees
   - [ ] 10-50 employees
   - [ ] 50-250 employees
   - [ ] More than 250 employees

3. **How long have you worked for the organization?**
   - [ ] Less than 5 years
   - [ ] 5-10 years
   - [ ] 10-15 years
   - [ ] More than 15 years

4. **Does your company use Big Data analytics?**
   - [ ] Yes
   - [ ] No

5. **Have you ever been exposed to using any form of Big Data in terms of analysing it, visualizing it, or making decisions based on it?**
   - [ ] Yes
   - [ ] No
Section B- Big Data Initiatives

1. What were the primary data issues in the organization that led it to consider Big Data?
   - Analysing data from diverse sources
   - Analysing streaming data
   - Analysing new data types
   - Analysing data set >1PB
   - Analysing data set 100 TB-1PB
   - Analysing data sets 1 TB – 100 TB
   - Analysing data set <TB

2. How would you rate the analytical abilities of the company you are employed in?
   - World class!
   - Adequate
   - Less than adequate

3. What is the company’s budget for Big Data initiatives?
   - More than 10 million GBP
   - 1 million -10 million GBP
   - 100,000 -1 million GBP
   - Less than 100,000

4. Express how challenging it is to source analytical skills in general.
   - No issues in finding skills
   - Somewhat challenging
   - Challenging
   - Very difficult to find such or hire
   - Impossible to find or hire

5. How would you rate the access to relevant, accurate and timely data in your company today?
   † minimal
   † less than adequate
   † adequate

6. How would you rate your company on the ability, by executives and business leaders, to use data and analytics to improve or transform the business?
   † minimal
   † less than adequate
   † adequate

7. Approximately how many staff in your company are dedicated to analytics, modeling, data mining (not including routine reporting)?
   † 50 or fewer
   † 51-100
   † 101-250
   † 251-500
   † 501-1000
   † 1001-2000
   † More than 2000

8. Of these staff, are most working in or for your consumer facing (B2C) businesses, your commercial or wholesale (B2B) businesses or both?
   † Only B2C
   † Mostly B2C
   † Both, about evenly
   † Mostly B2B
   † Only B2B
9. How does the company plan to measure the success of your Big Data initiatives?
† With quantitative metrics tied to business performance
† With qualitative metrics tied to business performance
† With quantitative metrics tied to IT performance
† With qualitative metrics tied to IT performance
† No specific measurement methodology in place

10. What types of Analytic products is the company using or considering? (check all that apply)
† Statistical or Mathematical packages (e.g., SAS, R, Matlab); if so, which one?
† Data visualization products (e.g., Tableau, Spotfire)
† Streaming analytics
† Custom analytics

11. What analytic functions/features are most important to the company? (check all that apply)
† Advanced analytics
† Executing existing algorithms faster
† Executing existing algorithms on much larger data sets
† Data visualization
† Text analytics
† Social network analytics

12. How are the company’s Big Data initiatives staffed and managed? (check one)
† All internal
† Mostly internal, with some help from third parties
† Mostly third parties under our direction and supervision
† All third parties with minimal supervision
† Don’t know

13. Is this incremental new spending or reallocation?
† Incremental
† Reallocation

Section C - Impact of Big Data on Company

1. Has the company achieved measurable results from their investments in Big Data?
   □ Yes
   □ No
   □ Not Available

2. The company has experienced a decrease in their expenses from integration of Big Data.
   □ Started and Benefits
   □ Started and no Benefits
   □ Not Started

3. The company has experienced new avenues of innovation from the integration of Big Data.
   □ Started and Benefits
   □ Started and no Benefits
   □ Not Started

4. The company has been able to launch new products and services from the integration of Big Data.
   □ Started and Benefits
   □ Started and no Benefits
   □ Not Started
5. The company has been able to monetize its big data initiatives and has experienced new revenues.
   □ Started and Benefits □ Started and no Benefits □ Not Started

6. The company has been able to accelerate its capabilities deployment with integration of Big Data.
   □ Started and Benefits □ Started and no Benefits □ Not Started

7. With the integration of Big Data the company is able to transform its business for the future.
   □ Started and Benefits □ Started and no Benefits □ Not Started

8. The company has established a data driven culture.
   □ Started and Benefits □ Started and no Benefits □ Not Started

9. What are your overall assessment of the business results of investing in Big Data?
   □ Highly Successful □ To be determined □ Moderately Successful □ A failure

10. In 3 years, what tangible benefits do you hope to achieve through your Big Data initiatives?
    □ Improved customer experience □ New product innovations □ Better, fact-based decision making
    □ Increased sales □ More efficient operations □ Reduced risk

11. Since the Big Data initiatives implemented, what tangible benefits have been achieved in the company?
    □ Improved customer experience □ New product innovations □ Better, fact-based decision making
    □ Increased sales □ More efficient operations □ Reduced risk

12. What are the tangible benefits the company is aiming to achieve using Big Data initiatives?
    □ Reduced risk □ New product innovations □ Improving customer service
    □ Better, fact-based decision-making □ High quality products and services
    □ Greater efficiency in operations □ Increased sales

13. What business functions in the company are fueling Big Data initiatives?
    □ Risk Management □ Customer Service □ Direct and online Marketing
    □ Information Technology □ Operations □ eCommerce, eBusiness, Online operations
    □ Product Development/Management □ Fraud Management □ Customer and Market Analysis

14. What data domains is the company most focused on in Big Data initiatives?
    □ Customer transactions □ Fraud Detection □ Channel Data
    □ Supply Chain Data □ Production Data □ Automotive industry specific data
15. Where will Big Data have the biggest impact on the company in the next five years?
- Impacting customer relationships
- Redefining product development
- Changing the way we organize operations
- Making the business more data-focused
- Optimising the supply chain
- Fundamentally changing the way business is done

16. Where has Big Data have the biggest impact on the company since its implementation?
- Impacting customer relationships
- Redefining product development
- Changing the way we organize operations
- Making the business more data-focused
- Optimising the supply chain
- Fundamentally changing the way business is done

17. Big Data has revolutionized the way that business is done to a degree similar to the advent of the internet in the 1990s
- Yes
- No

18. Big Data will dramatically change the way business is done in the company’s future.
- Yes
- No

19. Companies that don’t embrace Big Data will lose their competitive position and may even face extinction.
- Yes
- No

20. The company feels they are ahead of their peers in using Big Data and it creates a competitive advantage for the company.
- Yes
- No
# APPENDIX B - Raw Data

Table 9-1: Raw Data, Survey Responses

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>C</th>
<th>Q</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>S</td>
<td>A</td>
<td>Q</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>A</td>
<td>Q</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>A</td>
<td>Q</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>A</td>
<td>Q</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>Q</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>Q</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>Q</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>Q</td>
<td>5</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>Q</td>
<td>6</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>G</td>
<td>9</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>G</td>
<td>9</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>B</td>
<td>Q</td>
<td>10</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>B</td>
<td>Q</td>
<td>11</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>B</td>
<td>Q</td>
<td>12</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>B</td>
<td>Q</td>
<td>13</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>C</td>
<td>Q</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>C</td>
<td>Q</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>C</td>
<td>Q</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>C</td>
<td>Q</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>C</td>
<td>Q</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>C</td>
<td>Q</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>C</td>
<td>Q</td>
<td>7</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>C</td>
<td>Q</td>
<td>8</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>C</td>
<td>Q</td>
<td>9</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>C</td>
<td>Q</td>
<td>10</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>C</td>
<td>Q</td>
<td>11</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>C</td>
<td>Q</td>
<td>12</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>C</td>
<td>Q</td>
<td>13</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>C</td>
<td>Q</td>
<td>14</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: The table contains raw data from survey responses, organized in a tabular format with columns for different categories and rows for individual responses.
## APPENDIX C - Responses Job Title x Organization Size

<table>
<thead>
<tr>
<th>Organization Size</th>
<th>Operations Manager</th>
<th>Quality Control, Safety, Environmental Manager</th>
<th>Accountant, Bookkeeper, Controller</th>
<th>Office Manager</th>
<th>Foreperson, Supervisor, Lead Person</th>
<th>Marketing Manager</th>
<th>Purchasing Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 10 employees</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>10-15 employees</td>
<td>47.8%</td>
<td>17.4%</td>
<td>0.0%</td>
<td>13.0%</td>
<td>0.0%</td>
<td>17.4%</td>
<td>4.3%</td>
</tr>
<tr>
<td>50-250 employees</td>
<td>5.2%</td>
<td>8.1%</td>
<td>8.1%</td>
<td>14.5%</td>
<td>19.4%</td>
<td>4.8%</td>
<td>9.7%</td>
</tr>
<tr>
<td>More than 250 employees</td>
<td>10.6%</td>
<td>10.6%</td>
<td>10.6%</td>
<td>0.0%</td>
<td>10.6%</td>
<td>6.4%</td>
<td>6.4%</td>
</tr>
</tbody>
</table>
## APPENDIX D - Responses Question 2, 5, & 6

<table>
<thead>
<tr>
<th>Analytical Abilities</th>
<th>World Class</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adequate</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td>Less than Adequate</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Minimal</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Access to BD</th>
<th>Minimal</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Less than Adequate</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Adequate</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>More than adequate</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>world class</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ability to use BD</th>
<th>Minimal</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Less than Adequate</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Adequate</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>More than adequate</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>world class</td>
<td>33</td>
</tr>
</tbody>
</table>
## APPENDIX E - Company’s Big Data Usage

<table>
<thead>
<tr>
<th>Access to BD</th>
<th>Minimal</th>
<th>Less than Adequate</th>
<th>Adequate</th>
<th>More than adequate</th>
<th>World class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>55</td>
<td>69</td>
<td>8</td>
</tr>
<tr>
<td>Ability to use BD</td>
<td>0</td>
<td>0</td>
<td>42</td>
<td>57</td>
<td>33</td>
</tr>
</tbody>
</table>

### Analytical Staff to Business

<table>
<thead>
<tr>
<th>Staff to BD Analytics Ratio</th>
<th>Only B2C</th>
<th>Mostly B2C</th>
<th>Both, about evenly</th>
<th>Mostly B2B</th>
<th>Only B2B</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 or fewer</td>
<td>4</td>
<td>12</td>
<td>4</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>50-100</td>
<td>0</td>
<td>0</td>
<td>18</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>101-250</td>
<td>2</td>
<td>4</td>
<td>12</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>251-500</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>501-1000</td>
<td>0</td>
<td>0</td>
<td>19</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1,001-2,000</td>
<td>0</td>
<td>3</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>More than 2,000</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Decrease in Expenses

<table>
<thead>
<tr>
<th>Started and Benefits</th>
<th>63.6%</th>
<th>63.6%</th>
<th>64.4%</th>
<th>75.6%</th>
<th>58.1%</th>
<th>62.9%</th>
<th>42.4%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Started and no Benefits</td>
<td>27.3%</td>
<td>27.3%</td>
<td>6.8%</td>
<td>14.4%</td>
<td>27.3%</td>
<td>0.0%</td>
<td>12.1%</td>
</tr>
<tr>
<td>Not Started</td>
<td>9.1%</td>
<td>9.1%</td>
<td>28.8%</td>
<td>9.8%</td>
<td>13.5%</td>
<td>37.1%</td>
<td>45.5%</td>
</tr>
</tbody>
</table>