

**THE IMPLICATIONS AND CHALLENGES OF BIG DATA IN THE
LODGING INDUSTRY**

by

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TABLE OF CONTENTS

LIST OF TABLES	vii
LIST OF FIGURES	viii
ABSTRACT	ix

Chapter

1	INTRODUCTION	1
1.1	Problem Statement.....	6
1.2	Objectives of the Study	8
1.3	Research Questions	8
1.4	Significance of the Study.....	9
2	LITERATURE REVIEW	10
2.1	Introduction	10
2.1.1	Definition of Data Mining	10
2.1.2	Definition Big Data Analytics	11
2.1.3	Definition of Big Data	12
2.2	Data Mining and Big Data.....	14
2.3	Implications of Big Data	16
2.4	Challenges of Big Data in Other Industries.....	19
2.5	Big Data in the Hospitality Industry.....	20
2.6	Challenges of Big Data in the Hospitality Industry.....	26
3	METHODOLOGY	29
3.1	Introduction	29
3.2	Research Design and Instrument	29
3.3	Population and Sample	30
3.4	Pre-Test.....	30
3.5	Data Collection.....	31
3.6	Data Analysis.....	32
4	FINDINGS AND DISCUSSION	33

4.1	Descriptive Statistics	33
4.2	Big Data Usage.....	35
4.3	Defining Big Data.....	36
4.4	Sources of Data.....	42
4.5	Big Data Platforms	45
4.6	Big Data Analytics	48
4.7	New Opportunities with Big Data	54
4.8	Importance of using data in real-time.....	56
4.9	Challenges with processing of Big Data	59
4.10	The Biggest Challenge	61
4.11	Other Challenges	62
4.12	Why hotel corporations do not use Big Data.....	64
4.13	Description of Big Data Usage.....	66
5	CONCLUSION	68
5.1	Major Findings	69
5.2	Limitations of the Study and Future Studies	71
5.3	Implications of the study	73
5.4	Propositions	73
5.5	Conclusion.....	78
	REFERENCES.....	80
	Appendix	
A	EXEMPTION LETTER	89
B	RESEARCH INSTRUMENT	90

LIST OF TABLES

Table 2.1:	The Three V's of Big Data	13
Table 2.2:	The Difference between traditional models of Data management and Big Data.....	15
Table 2.3:	Summary of Big Data Implications by Industry	17
Table 2.4:	Challenges of Big Data in Different Companies.....	19
Table 4.1:	Categories of Hotel Corporation	34
Table 4.2:	Big Data Usage.....	35
Table 4.3:	Defining Big Data (Publicly Traded Hotel Corporation).....	37
Table 4.4:	Defining Big Data (Independent one - property Hotel Corporations).....	39
Table 4.5:	Duration of Big Data Usage	41
Table 4.6:	Technology used to analyze Big Data	49

LIST OF FIGURES

Figure 4.1: Functional Area of Expertise.....	34
Figure 4.2: Categories of Hotel Corporation	35
Figure 4.3: Big Data Usage.....	36
Figure 4.4: Defining Big Data (Publicly Traded Hotel Corporation	38
Figure 4.5: Defining Big Data (Independent one- property Hotel Corporations).....	39
Figure 4.6: Duration of Big Data Usage	41
Figure 4.7: Sources of Data (Publicly Traded Hotel Corporations)	43
Figure 4.8: Social Media Sites	44
Figure 4.9: Big Data Platforms	46
Figure 4.10: Technology used to analyze Big Data	49
Figure 4.11: Department responsible for Big Data	52
Figure 4.12: Which department Benefits the most?.....	53
Figure 4.13: New Opportunities with Big Data	55
Figure 4.14: Importance of using data in real-time.....	57
Figure 4.15: Areas experiencing significant changes	58
Figure 4.16: Challenges with processing of Big Data	60
Figure 4.17: The Biggest Challenge	62
Figure 4.18: Other Challenges	63
Figure 4.19: Why hotel corporations do not use Big Data	65
Figure 4.20: Description of Big Data Usage.....	66

ABSTRACT

The purpose of this study was to explore the implications and challenges of Big Data in the lodging industry. A total of nine hotel executives participated in this study through an online survey - six from publicly traded hotel corporations and the remaining three from independent (one property) hotel corporations.

The results of the study were that publicly traded hotel corporations are more likely to use Big Data than an independent (one-property) hotel corporation. The challenges the hotels face with Big Data that emerged from this study are: the difficulty in reconciling disparate data sources, the lack of formal process around Big Data management, lack of IT infrastructure, lack of senior management support and requisite skills and the high cost of Big Data Management. However, this study also revealed that Hotel corporations that have embraced Big Data have made significant changes in their entire business and operational processes by using Big Data technologies to predict guest behavior, enhance revenue management and improve strategic decision making and also to answer probing questions that could not have been answered in the past. This implies that hotel corporations that embrace Big Data by defining their areas of application and investing resources into their Big Data initiatives are the ones that will benefit from the enormous opportunities of Big Data.

Chapter 1

INTRODUCTION

In recent years, Big Data has become a major topic of discussion across business industries. Big Data has been defined in many different ways depending on the kind of software tools commonly available and the sizes of datasets common to a particular industry. From a broad standpoint, Big Data is a popular term used to describe the exponential growth, availability and use of information, both structured and unstructured upon which companies are relying to make critical and strategic decisions as well as simple and complex decisions in managing their organizations. One of the most common definitions of Big Data uses three terms, all of which happen to start with the letter V: volume, velocity and variety which define the main characteristics of big data. Many analyst firms, such as International Data Corporation (IDC), a technology research firm, and companies as IBM, seem to coalesce around this definition. Volume means the massive amount of data generated and collected by organizations, velocity refers to the speed at which the data must be analyzed and variety means the vast array of different types of data that is collected, from text, to audio, video, web logs and more. The McKinsey Global Institute also refers to Big Data as gigantic, complex data sets that are beyond the analytical capabilities of the IT tools available to most companies.

This phenomenon has come about as a result of the influx of information from multiple sources, [such as: smart phones and pervasive computing applications, sensors of different kinds (e.g., climate information gathering sensors), social media interaction, pictures and videos, purchase transaction records, cell phone and GPS signals coordinates], cloud based solutions, dramatically lowering the cost of storage and the digitization of virtually “everything”, now creating types of large and real-time data across a broad range of industries. Much of this is unstructured data which does not fit neatly into traditional, structured database warehouses that most businesses have. The explosion of data is not new but the exponential growth in the past two years has been significant. It continues a trend that started in the 1970s. What has changed is the velocity of growth, the diversity of the data and the imperative to make better use of information to transform businesses. As IBM points out, every day, we create 2.5 quintillion bytes of data – so much that 90% of the data in the world today has been created in the last two years alone. (Manyika et al., 2011) suggests that the scale and scope of changes that big data are bringing about are at an inflection point, set to expand greatly, as a series of technology trends accelerate and converge.

According to McKinsey, Big Data is “the next frontier for innovation, competition and productivity”. The impact of Big Data gives not only a huge potential for competition and growth for individual companies, but the right use of Big Data also can increase productivity, innovation, and competitiveness for entire sectors and economies. We are already seeing visible changes in the economic landscape as a result of this convergence. We are already seeing visible changes in the economic landscape as a result of this convergence. Visible changes such as traffic management

and control is witnessing significant data-driven environmental innovation. Governments around the world are establishing electronic toll pricing systems, which set forth differentiated payments based on mobility and congestion charges. Users pay depending on their use of vehicles and roads. These and other uses of data for traffic control enable governments to “potentially cut congestion and the emission of pollutants”. Big Data is also transforming the retail market. Indeed, Wal-Mart’s inventory-management system, called Retail Link, pioneered the age of big data by enabling suppliers to see the exact number of their products on every shelf of every store at each precise moment in time. (Tene & Polonetsky, 2012). Also, Amazon’s “Customers Who Bought This Also Bought” feature, uses an Item-to-item collaborative filtering tool to gather customer shopping history data and use it to create a kind of would-be customer recommendation by associating shoppers who seem to have similar interests and this has provided multiple opportunities for customers to see various products that may interest them when it offers featured items, related components and accessories, and materials that the presumed like-minded shoppers were interested in. (Linden et al., 2003). Big Data inspires new ways to transform processes, organizations, entire industries and even society itself (Schroeck et al., 2012). If Big Data is used effectively, it can be a powerful tool (Giles, 2012). Big Data is all about finding a needle of value in a heap of unstructured information and translate that into business advantage. (Manyika et al., 2011) stated that leading companies are using Big Data to gain competitive advantage. McKinney estimated that a retailer embracing Big Data has the potential to increase its operating margin by more than 60 percent. For example, retailers such as the United Kingdom’s Tesco

(Tesco's loyalty program) use big data to capture market share from its local competitors. Caesars Entertainment Corporation (formerly Harrah's Entertainment from 1995 to 2010) the US hotels and casinos group, compiles detailed holistic profiles of its customers and uses them to tailor marketing in a way that has increased customer loyalty.

The business opportunity that Big Data brings to the conventional business process in the lodging sector of the hospitality industry is huge. Hotels will be able to intelligently decide what data are most valuable and how to source and apply these data to management decisions and processes that are important to financial superiority in a highly competitive environment. Sourcing the right data and understanding the big data concept also brings opportunities for hospitality businesses to streamline their internal processes (Manyika et al., 2011). Today's modern cruise liners are engineering marvels with floating 5-star hotels that offer the best service, accommodation, cuisine, and activities which has increased competition among the different cruise brands. As competition increases, cruise lines still have capacity targets to meet, but outperformers in this find other ways to fill a ship. They turn to their big data to help steer them back to profitable growth. Big Data can predict trends and help them centralize operations across their network, so they can arm their teams with tools they need and begin to create consistencies around key revenue management strategies. Cruise agencies are also another significant way of filling a ship. A company called Vacations To Go, one of America's Largest Cruise Agencies has created an online service which consists of an extensive selection of top-brand cruise vacations, and in-depth information about every cruise line and cruise ship.

Customers can now browse the latest in new promotions and offers, shop by category, and compare prices at a glance and make a decision based of the best offer and all this is possible as a result of the huge amount and variety of information at they have access to.

In an effort to be more competitive, hotels want to offer their customers the lowest room rates but only to customers who are unlikely to make a claim, thereby optimizing their profits. Hotels' approach to this problem is to gather more detailed data about customers' habits, preferences, brands, etc. Each reservation requires and creates a lot of data such as the channel of the reservation, time of booking, location, information of the guests, preferences of the guests etc. Hotel management measures everything from how their property is performing compared to its defined competitive set (RevPAR Index), to how much linen costs per occupied room (CPOR), to employee turnover and repeat- business statistics (Lynn, 2013). Hotels use the data from their loyalty and rewards programs including data from social media to create a better experience for their guests. For example, Intercontinental Hotels is concentrating its social media loyalty program in the form of exclusive customer communities. Three hundred (300)-member groups have been formed, through personal invitation to select members of the hotel's Priority Club program. Members of the social groups are encouraged to respond to questions from company executives, and interact deeply, not only with the company, but with each other. The reactions are used to improve services, evaluate new product ideas, and stimulate continued interest in the brand. (Stevens, 2013)

In spite of the significant opportunities big data presents to the conventional business likes hotels, business leaders in the hospitality industry also face significant challenges with big data. Big data provides the ability to better understand and predict customer behaviors, and by doing so, improve the customer experience (LaValle et al., 2010).

1.1 Problem Statement

The traditional hotel industry has placed great emphasis on the provision of quality service to guests. With the increasing demand for intensive information from customers and hotel practitioners, hotels have adopted computer-based IT facilities to improve operational efficiency, reduce costs, and enhance service quality (Camison, 2000; Cobanoglu et al., 2001; Van Hoof et al., 1996). To efficiently manage the several huge amounts of data, hotel managers need updated management know-how and the latest IT systems. However, prior studies have indicated that hotels typically are not early adopters of new technology (Cho & Olsen, 1998). Such a slow reaction to new technology causes hotels to lag behind other industries in IT applications, preventing them from benefiting fully from the rewards of new technology adoption (Law, 2005). Furthermore, most hotel decision makers did not receive training in IT; for this reason, their technical knowledge is fairly limited (Borsenik, 1993). The low IT knowledge of these hotel managers inevitably causes them to be reluctant or even resistant to accept new technologies because of fear that these technologies might affect their role of providing personalized services to hotel guests (Law, 2005). Since Big Data is an emerging concept that has been misunderstood by many people due to

its definition and changing context, it will be problematic for the hotel Industry to adopt the concept because of the fact that the hospitality industry is known to be late adopters of technology with the leaders not being technologically savvy, it is likely that the benefits of Big Data may take a longer time to be realized in the hotel business as compared to other industries like the pharmaceutical, retail, finance etc. It is therefore beneficial to provide a clear understanding of the concept of Big Data. This research provides clarity for the Big Data concept in the hospitality context so that operators in the lodging industry will have a better understanding of Big Data.

In addition, the lodging industry has disparate systems for each departmental need. In general, the hotel industry can be regarded as information intensive (Law, 2005). Most hotels use today's technology to collect huge amounts of data from a wide range of sources to measure and evaluate all facets of a hotel performance (Lynn, 2013). These sources or systems include Property Management System (PMS), Sales and Catering (S&C) and Point of Sale (POS) solutions, central reservation systems, global distribution systems, reputation management systems, etc. These systems yield valuable information but they grapple to interact or share information with other systems and processes across the enterprise and external sources, this is the problem of interoperability. In addition, today, many hoteliers are recognizing the value of collecting feedback from social media and other online sites, as well as encouraging open-ended comments in their surveys. Compiling and interpreting this unstructured data which comes in different formats like video, audio, text, pictures etc. is beyond the capabilities of the traditional data analysis tools used by hotels. Consequently, it's becoming increasingly more important for companies to manage the hospitality

customer experience, from a variety of channels in order to extract valuable business insights and use those insights to improve the customer experience with their hotels. How can hotels accomplish this? What are the tools, methods, softwares currently available for organizing and managing Big Data?

1.2 Objectives of the Study

The main objective of the study is to examine Big Data and its implications and challenges in the lodging sector of the hospitality industry. The objective of the study is broken into two;

1. First, the study provides an understanding of the implications of Big Data from the hospitality industry context. This includes providing an understanding of the Big Data concept within the hospitality context, the sources of big data and the types of analysis used to evaluate big data.
2. Second, the study provides an understanding of the challenges of Big Data in the lodging industry. As part of this objective, the study examines the types of Big Data platforms, the challenges of Big Data faced by hotel executives and the steps they take to overcome them.

1.3 Research Questions

In order to understand the concept of Big Data and its implications and challenges to hotel management executives, this study answered the following research questions;

1. What is big data?

2. What are the main sources of data to hotels?
3. What types of analysis do hotels use to evaluate and sift through big data?
4. What are the types of big data platforms used by hotels?
5. What are the challenges Big Data poses to hotel Corporations?

1.4 Significance of the Study

The implementation of Big Data can have an impact on many aspects of a hotel's IT infrastructure. Before launching Big Data initiatives, hotel executives need to have a clear understanding of the implications and challenges involved. The results of this study can be useful in helping hotel executives to understand the implications and challenges of Big Data. The insights that will be produced from this study can help hotel executives reach the targets laid down in their business strategies. Understanding the implications and challenges of IT has always been a critical success factor in aligning technology with business strategies and Big Data is no different.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

With Big Data poised to change the lodging sector ecosystem of the hospitality industry, hotel executives need to understand this phenomenon, its implications and challenges. This section of the study provides an understanding of some key concepts such as Data Mining, Big Data and Data Analytics. This section will also provide a review of prior studies about Big Data industries.

2.1.1 Definition of Data Mining

Data Mining according to (Grant, 2003) is the process of discovering meaningful new correlations, patterns and trends by sifting through large amounts of data stored in repositories, using pattern recognition technologies as well as statistical and mathematical techniques. The analogy of “mining” suggests the sifting through of large amounts of low grade ore (data) to find something valuable (Sharma, 2005). Data mining is a multi-step, iterative inductive process. It includes such tasks as problem analysis, data extraction, data preparation and cleaning, data reduction, rule development, output analysis and review (Ha & Park, 1998). The main objective of data mining is to extract valuable information from data with the ultimate objective of knowledge discovery (Sharma, 2005).

2.1.2 Definition Big Data Analytics

Big data analytics is the process of analyzing large amounts of data of a variety of types (big data) to uncover hidden patterns, unknown correlations and other useful information. (Rouse, 2012). Big data analytics is the application of advanced analytic techniques to very big data sets. Big Data analytics is simply Big Data plus Big Data Analytics - a collection of different tool and platform types based on predictive analytics, data mining, statistics, data visualization etc. used to analyze diverse data types and handle the velocity of streaming data in real time. Big Data analytics is able to explore granular details of business operations and customer interactions that may be left untapped by a standard report or in a data warehouse. (Russom, 2011). Such information can reveal valuable insights for businesses to predicting customer behavior, effective marketing, increased revenue etc. gain a competitive advantage, however some barriers to Big Data analytics could be the inadequate or the lack of skills, lack of business support and problems with database software which might be left untapped by traditional business intelligence (BI) systems. The business intelligence systems provide reporting capabilities for businesses to gain access to information and summarize data for decision making. These solutions provide a look at various performance aspects of a company that occurred only in past. Today, companies are facing the reality of a rapidly changing data environment where data is being generated in an increasing rate of speed which needs to be mined in real time for more proactive strategic decisions, but the conventional business intelligence systems lack the capability to do that. Companies are investing in Big Data analytics solutions

to be able to mine data in real time and produce more valuable and efficient information for decision making.

2.1.3 Definition of Big Data

There are myriad of definitions of the “Big Data” concept across industries. The concept is fuzzily described as a “huge amount of data” or simply as “a buzz” and sometimes as the “analysis” of data. Strands of the literature define the Big Data concept to mean several aspects by one term, ranging from a technology base to a set of economic models. For instance, “Big Data” is defined as a term encompassing the use of techniques to capture, process, analyze and visualize potentially large data sets in a reasonable timeframe not accessible to standard IT technologies (NESSI, 2012). In this definition, Big Data is viewed beyond the mere size of the data. A similar definition of the Big Data concept was coined by (Oracle 2012) as large datasets that are challenging to store, search, share, visualize, and analyze. These definitions imply that size of the data is important in understanding the Big Data concept as well as the analytics involving the data.

Other strands of Big Data definitions postulate that there are some key characteristics that make a large amount of data “Big Data”. These characteristics include the volume, velocity and variety of the data.

- *Volume*: Volume is described as the most visible aspect of Big Data, referring to the fact that the amount of generated data has increased tremendously the past years (Oracle, 2012; Cognizant, 2012).

- *Variety*: Variety refers to the various sources of Big Data. Big data is an aggregation of many types of data, both structured and unstructured, including multimedia, social media, blogs, web server logs, financial transactions, GPS and RFID tracking information, audio/video streams and Web content (Cognizant, 2012).
- *Velocity*: Big data can be described by its velocity or speed. You may prefer to think of it as the frequency of data generated or the frequency of data delivery (Russom, 2011). In other words, velocity captures the growing data production rates.

Table 2.1: The Three V's of Big Data

Volume	Variety	Velocity
Terabytes	Structured	Batch
Transactions	Unstructured	Near time
Records	Semi-structured	Real time
Tables		Streams
Files		

Source: (Russom, 2011)

The above definition considers the size of data as one of the important criteria that can be used to describe a data set as Big Data. However, (Chui et al., 2012) stated that “we don’t define big data in terms of being larger than a certain number of terabytes (thousands of gigabytes)”. It is assumed that, as technology advances over time, the size of datasets that qualify as big data will also increase. Also note that the

definition can vary by sector, depending on what kinds of software tools are commonly available and what sizes of datasets are common in a particular industry (Manyika et al., 2011). With those caveats, big data in many sectors today will range from a few dozen terabytes to multiple petabytes (thousands of terabytes).

A working definition of Big Data: Big Data is the huge amount of information generated from multiple sources (social media, web data, audio, video, transactions etc.) and in different formats (structured and unstructured) that allows companies to find trends, patterns and connection that previously could not be observed.

2.2 Data Mining and Big Data

Big data management is inherently different from traditional relational models of data management platforms. While that difference is often described in terms of the data, “structured versus unstructured,” this is not quite accurate. The difference is better described this way: Unlike relation-based data, big data manages data in any format and does not require the time and effort to create a model first to capture, process, and analyze data. The table below shows a breakdown of the differences.

Table 2.2: The Difference between traditional models of Data management and Big Data

Application	Relation- Based Data	Big Data
Data processing	Single-computer platform that scales with better CPUs centralized processing	Cluster platforms that scale to thousands of nodes; distributed processing
Data management	Relational databases (SQL); centralized storing	Non-relational databases that manage varied data types and formats (No SQL and HBase* databases); distributed storage
Analytics	Batched; descriptive; centralized	Real time; predictive and prescriptive distributed analytics

(Intel 2012)

During the last decade, data mining has become an integral part of the hospitality business. The application of data mining in the hospitality industry has been extensive but only a few big chains have benefitted from it primarily for customer relationship management and revenue management, however more data is constantly being generated that, the results from a data mining effort will be too late to be of any practical value. (Gaurav, 2012). That's where the concept of big data comes into play. Big data allows for near real-time analysis of data which is far more valuable than mining data in a data warehouse (which may be based on old data). The ever increasing data basically comes from a variety of sources [such as: smart phones and pervasive computing applications, sensors of different kinds (e.g., climate information gathering sensors), social media interaction, pictures and videos, purchase transaction records, cell phone and GPS signals coordinates]. There is a need to have hospitality business applications that can understand and react to changes instantly. This is a call for big data as opposed to data mining. Whereas Big Data allows

business leaders to take immediate action in solving problems, data mining may not have that capability.

Additionally, the ability to analyze big data allows a manager to move beyond mere understanding of relationships between data components. It allows a manager the ability to look for causality in real-time scenario. Within the hospitality industry, managers can have the ability to receive real time monitoring results about what customers are saying online and respond/react in real time. Potentially, a manager could approach an unhappy customer before he/she leaves the restaurant and rectify the issues that caused a customer to be unhappy. There is a great need to develop such resources that harness the relevant data in the social media.

2.3 Implications of Big Data

According to the (Manyika et al., 2011) there are many ways that big data can be used to create value across sectors of the global economy. Indeed, research suggests that we are on the cusp of a tremendous wave of innovation, productivity, and growth, as well as new modes of competition and value capture – all driven by big data as consumers, companies, and economic sectors exploit its potential. The implication of Big Data is shown in another research by (Cognizant, 2012), highlighting the implications of Big Data for patients, providers, researchers, payers and other healthcare constituents. The research by (Manyika et al., 2011) suggests that the value to the US healthcare system could be \$300 billion a year, and US retailers could boost their operating profit margins by 60 percent through effective use of Big Data.

Table 2.3: Summary of Big Data Implications by Industry

Industry	Implications
Financial Services	• Improved risk decisions • “Know your customer” 360° customer insight • Fraud detection • Programmatic trading
Insurance	• Driver behavior analysis (smart box) • Broker document analysis to deepen insight on insured risk to improve risk management
Healthcare	• Medical records analytics to understand why patients are being re-admitted • Disease surveillance Genomics
Manufacturing	• ‘Smart’ product usage and health monitoring • Improved customer service by analyzing service records • Field service optimization

Source: (Owen, 2013)

The past 2012 US presidential elections demonstrated that analytics fueled by big data and advancement in computing technology was an integral part of the presidential campaign process. Joe Rospars, co-founder and CEO of Blue State Digital, the agency behind both of Obama’s campaigns, says “harnessing the power of Big Data is not about simply analyzing antiseptic information, it is about using whatever information is at your disposal to understand the people behind it all”. This was demonstrated on the campaign trail by understanding how Obama’s supporters were connected to people outside of the organization’s reach. Rospars says, “The 2012 campaign upped the data ante through a program dubbed Narwhal--a platform that unified all of the campaign’s data, such as voter, donor, or volunteer information which allowed organizers to get a picture of the person behind the bits”. The campaign realized that they only had phone numbers for 50% of potential supporters. Given how

important phone-based campaigning is, that was a problem. However, the data showed that for the 50% of people they didn't have numbers for, 85% of those people were one degree of separation on Facebook from the people they did have numbers for. The information at hand was used to email supporters and ask them to reach out to their friends.

He further explains five key things marketers should remember when wrestling with big data.

1. Understand there's a person behind the data (understanding that all data generated is fundamentally about a relationship with people).
2. It's not about Big Data but rather Smart data used at scale (Smart use of data has the potential to make all of the rest of your decisions smarter).
3. Tools used must be easy to integrate to build that people-based strategy and actually have meaningful connections.
4. It is not about creativity or data, it is both (the combination is harmonious and result in the best program possible).
5. Data up the organization (data is something that a leader must be comfortable with and be able to hold their internal folks (employees) accountable).

The power of big data is not its size, but what you do with specific segments of that data. While a political campaign is a different beast than a brand marketing operation, there are good lessons that can be learned from politics (Fera, 2013).

2.4 Challenges of Big Data in Other Industries

Big Data presents a number of challenges related to its complexity. A review of the literature reveals that being able to understand and use Big Data when it comes in an unstructured format, such as text or video, is one of the challenges companies face. The table below is a summary of the challenges of Big Data from the research by (Cognizant, 2012, and Manyika et al., 2011).The table below is an outline of specific challenges of Big Data in many Companies.

Table 2.4: Challenges of Big Data in Different Companies

Challenges	Description
1. Technology laggards	Some organizations or industries are notoriously slow to redefine and redesign processes and tend to be laggards in adopting technology that impacts their businesses. E.g. Healthcare industry.
2. Fragmentation	Big data challenges are compounded by the fragmentation and dispersion of data among the various stakeholders, including payers, providers, labs, ancillary vendors, data vendors, standards organizations, financial institutions and regulatory agencies.
3. Security	Significant security and privacy concerns exist, including the Health Insurance Portability and Accountability Act (HIPAA) and Payment Card Industry Data Security Standards (PCIDSS).
4. Standards	Dealing with the myriad of standards (and lack thereof) creates interoperability challenges.
5. Timeliness	Data timeliness is a challenge in various organization settings.
6. Limited Analytical and managerial Talent	Organizational leaders often lack the understanding of the value of big data as well as how to unlock this value.

Sources:(Manyika et al., 2011), (Cognizant , 2012)

(McGuire, 2013) identified three additional challenges that companies face:

1. Deciding which data to use (and where outside your organization to look),
2. Handling analytics (and securing the right capabilities to do so),
3. Using the insights gained to transform operations (business decisions)

Many companies grapple with misconceptions around these tasks. He concludes by saying that companies should not waste their time collecting data if they are not willing to commit to getting the right data, the right modeling capabilities and the right transformational methods to revolutionize their businesses.

2.5 Big Data in the Hospitality Industry

The hospitality industry, like many other industries, is experiencing increases in the volume, velocity and variety of the data they collect and store (Osborn, 2013). Most hotels use today's technology to collect huge amounts of data from a wide range of sources to measure and evaluate all facets of performance (Lynn, 2013). With Big Data, total Revenue Management will study guest behavior at all points of contact – before, during and after their stay – through various channels of engagement, not only the hotel or chain's own channels (Jamieson, 2013). According to InterContinental Hotel Group (IHG) vice president of revenue management, the increased availability of data and the quality of analytics has transformed the revenue management departments in the hotel industry.

Managing an international, multi-brand hotel group involves tracking an enormous number of metrics, providing an opportunity to use Hadoop and big data to

improve both operational and executive-level business performance (Kim, 2013). For example, the InterContinental Hotels Group (IHG), which manages 4,602 hotels worldwide and registers 150 million room night sales a year, moved from a structured dataset with about 50 variables to a big data solution analyzing both unstructured and structured data in real-time. Today IHG uses up to 650 variables from different sources such as information about its hotels, as well as its competitors, guests, and other internal and external data. The use of Big Data with analytics has improved targeted marketing and bottom line results.

Foxwoods Resort & Casino which is one of the largest casinos in the world is a classic example of one of the largest adopters of Big Data in the hospitality industry. In 1986, the Mashantucket Pequot Tribal Nation opened Foxwoods' original high-stakes bingo hall. Foxwoods started expanding in 1993 and created its Wampum card, loyalty program to encourage frequent players to return. Today, Foxwoods is much more than a casino, boasting retail stores, restaurants and bars, a golf course, spa, hotel and the MGM Grand Theater. The casinos offer more than 6,200 slot machines, 380 tables for 17 different types of table games (including 100 for poker), a high-tech race book, and the world's largest bingo hall.

According to an (IBM Case Study, 2011) Foxwoods Resort & Casino had long collected gaming patron (customer) data through their loyalty card system but not data from non-gaming patrons and so non-gaming patrons' preferences were not captured. Also the patron data that was collected was not integrated with patron data from other customer-facing business channels like the hotels, restaurants, retail shops, show venues, spas and salons, nor had it been integrated with patron data with other

business data, such as slot machine or table game data, scheduling data for employees, or data on food and beverage purchases and sales. This was because Foxwoods' analytic infrastructure was not equipped to analyze consumer information beyond the loyalty card data from its casinos. The organization began facing increased demands from Finance, Marketing, executives and other business units to start capturing and analyzing non-gaming patron data and patron preferences in addition to the loyalty card data that was already being gathered. Foxwoods realized that, as more data is gathered from their customers, the organization will be better equipped to understand and satisfy customers, who will ultimately drive repeat business and ongoing success. Foxwood took a 360 approach across all business channels by using the massive amounts of their customer purchase data to analyze their activities and interests in channels such as the theater, shopping, pool bars, hotel and restaurants. Once they were able to develop customer profiles to track what their loyal patrons (customers) valued, they were able to have drastically improved marketing campaigns that offered personalized service to their customers.

According to Michael Kutia, Director of Hospitality Systems at Foxwoods, "The IBM Netezza data warehouse appliance's extreme speed, coupled with SAS Campaign Management, enables Foxwoods to get to know our customers like never before. The insights gained from SAS and provided by our IBM Netezza data warehouse appliance let us alert customers of special offers that they'll care about and make them feel a part of the Foxwoods family."

Big Data is changing the theory and practice of hospitality, travel and tourism businesses. Smart hospitality travel and tourism companies are using these

technologies to anticipate customer needs, rewrite how they meet customer expectations, redefine customer engagement, and achieve new levels of customer satisfaction. In so doing, these firms are creating a new basis for the award of customer loyalty (SOCAP International, 2013).

A recent global study commissioned by Amadeus IT Group has highlighted that the travel industry is at a big data crossroads: large volume, complex and unstructured datasets are beginning to reshape the entire hospitality industry, and so the development of big data initiatives is now a priority for many businesses to truly maximize its benefits and ensure a more intelligent and responsive travel experience in the process. Big data has the potential to transform how travel companies can deliver a more efficient and tailored travel experience with benefits to both travel companies and travelers alike. However, its potential is still confined to early adopters in the travel sector, and it calls for more widespread consideration across the industry about how new approaches to big data can yield significant opportunities. Hotels, travel agencies and other industry players are unlocking the power of big data to dramatically improve products and services, enhancing their competitive position and benefiting customers. Some hotels like InterContinental and Marriott are already embracing big data to enhance their financial performance and a more distinctive experience for their hotel guest.

(Davenport, 2013) found and foresees a great case with Big Data implementations:

- Enhanced revenue management: Hotels recognize that data analytics are helpful in establishing the optimal price for rooms and ensuring that as few as

possible are empty. Hotel chain Marriott takes this approach further, using big data for price optimization in restaurants, catering, and meeting spaces. Air France-KLM also uses Hadoop (Big Data software) as the basis of a group-wide revenue management system.

- Big Data can be the foundation for greater industry-wide innovation: There are examples of how leading travel and hospitality firms are making use of big data today, for example KAYAK's price flight forecasting model, which presents customers with the likely change in a flight's price over a seven-day window. The forecasting tool, launched in 2013, predicts whether a listed airfare will rise or fall within the following seven days with a certain confidence level. This forecasting model depends on data from previous searches of the originating and destination cities, insights from airline sites, data from OTAs and two faring engines. Based on these multiple sources of information and data, Kayak produces a price trend graph with a prediction of whether the fare will rise or fall in the next seven days, with a certain level of confidence, and a suggestion to purchase the ticket or to wait. This is an additional service that the company can provide to its customers while separating itself from its competitors. Kayak averages more than 1 billion searches annually therefore it has the data and the tools to create value from big data. A second example, InterContinental hotels, at its two hotels in San Francisco, is using an energy management system coupled with big data analytics to operate the hotels at a level of energy efficiency far above current industry standards. Stem, a San Mateo California company, has developed an

energy management system that uses real-time energy management software along with a battery capable of storing energy, to allow the hotel to either use energy from the power grid or from its stored energy depending on which is cheaper. The Stem's software gathers data from more than 50 different sources — including weather data, electricity rates and the hotel's energy consumption. Through a cloud-based, predictive analytics algorithm, the software can determine whether power should come from the grid or from the onsite battery module. Current energy cost at the two hotels averages \$50,000 per month and InterContinental's management expects to reduce this cost by 10 to 15%.

- Well-informed investment decisions: The hotel sector often employs the 'test and learn' approach to determine what kinds of capital investments are worthwhile, and restaurants and companies in the retail sector have used this approach for product launches and national product roll-outs. Testing investments such as new conference facilities on a small scale, before deciding whether or not to authorize a full rollout, prevents costly mistakes. The objective of the test and learn approach is to test ideas in a small number of locations or on a limited number of customers to predict impact. The test and learn process is intended to answer three questions:
 1. What impact will the idea have on key performance indicators if executed system-wide?
 2. Will the idea have a larger impact on some store units or customers than others?
 3. Which components of the idea are the most successful?

Capital One in the banking industry conducts tens of thousands of such tests annually and the data accumulated is used to customize credit cards for targeted customers. Other companies like Wawa Food Markets, Subway, Pier 1 Imports and Kraft Foods all use the test and learn approach along with a variety of software tools to support a systematic analysis and decision-making.

- Better relationships with hotel guests: When customer data is aggregated, instead of being fragmented across a hotel's various divisions, the analytical insights lead to better marketing and customer service. Marriott uses analytical approaches to understand the likelihood of its frequent guests staying with the hotel chain and then makes offers to them. Also, through predictive analytics, the most favored destinations, lodging and dining preferences, ancillary service needs, and tourism experiences can be identified for each guest. Therefore, big data can provide insights that help deliver a more intelligent travel experience than has ever been possible before.

The research concludes that big data has the potential to dramatically reshape the travel industry. The key now, is to move from potential to reality.

2.6 Challenges of Big Data in the Hospitality Industry

There is scanty or virtually non-existing empirical literature about the challenges of Big Data in the hospitality industry. One of the documented evidence of the challenges Big Data poses to hospitality firms can be found in the book written by Michael Toedt. In this book the author explains the lack of knowledge within the

senior management and the willingness to implement the necessary changes as the biggest hurdles. These challenges to some extent are similar to the challenges Big Data poses to other industries such as the Healthcare, Financial and Insurance Services industries. Below is a summary of the challenges of Big Data in the hospitality industry from Michael Toedt's book.

Some of the challenges were:

1. Lack of managerial knowledge and Leadership
2. Using an operational oriented IT strategy instead of Marketing oriented IT Strategy.
3. Disparate Operational and IT Systems
4. Dispersed Data in different sources and systems
5. Poor Quality of Communication - Uniform Mass Communication on Direct Marketing channels instead of Individualization (time and Content) based on transaction history and individual consumer behavior.

According to (Davenport, 2013), the effective deployment of big data initiatives is not without challenges. He acknowledges that, to access the big data opportunity the travel industry must overcome significant technical and operational challenges associated with big data adoption , including: data fragmentation across multiple systems; co-existence of both big data and traditional data management architectures; finding and recruiting scarce big data science skills (an issue in all industries adopting big data), difficulty of maintaining a sustained competitive advantage from Big Data and managing data responsibly in the interests of all.

This chapter captured the definitions of some key concepts such as Data mining, Big Data and Big Data analytics. The differences between Data mining and Big Data were highlighted. The implications and challenges of Big Data in other industries such as the Banking, retail, and healthcare, manufacturing and insurance were reviewed. Also the implications and challenges of Big Data was explored using examples of hospitality companies that have implemented Big Data.

Chapter 3

METHODOLOGY

3.1 Introduction

This chapter describes the research methodology used for the study. The research design, population and sample were described. The instrument used to collect the data including methods implemented to maintain validity and reliability was also described.

3.2 Research Design and Instrument

A descriptive research design was adopted for purposes of this study. In order to achieve the objectives on this study, an online survey was developed and distributed electronically. One advantage of online survey is that, it takes advantage of the ability of the internet to provide access to groups and individuals who would be difficult, if not impossible, to reach through other channels (Garton et al., 1999). Considering the busy schedule of many hotel executive managers, it was appropriate to use the online survey which allowed them to respond to the survey at their own pace and convenience. In contrast, the use of the traditional survey would have been difficult to reach the participants considering their geographical location and time constraints.

3.3 Population and Sample

The study population consisted of US hotel Corporations. The participants for this study were selected based on the convenience sampling method. This method was adopted because of the flexibility it provides in accessing readily available people or contacts for this particular data collection. Ten (10) publicly traded hotels and ten (10) independent (one property) non- publicly traded hotels was selected. The sample for this study included 20 hotel management executives (Chief Information Officers or Chief Technology Officers). This sample was appropriate due to the participants' technical background and knowledge of the business model and IT architecture of their hotel corporations.

3.4 Pre-Test

Pretesting is critical for identifying survey problems or errors with the data collection instrument and finds possible solutions to improve or minimize these errors. When a survey is used as a data gathering instrument, it is necessary to determine whether questions and directions are clear to participants and whether they understand what is required from them. This is referred to as the pretesting of a survey (Australian Bureau of Statistics, 2001). Before data collection, the researcher pre-tested the survey by seeking assistance from the statistical department at the University of Delaware. A link to the survey was sent to five (5) people (3 with hospitality background and 2 without). The pretest respondents completed the survey, giving their views along the way or afterward. The survey questions were reviewed and analyzed carefully. Based

on the feedback from the respondents of the pretest, some of the questions were revised to improve their clarity and sequence; other questions were eliminated because they were unnecessary. This pretest also estimated the time needed to complete the survey. This pretesting process yielded constructive suggestions which served as the basis for improving the survey.

3.5 Data Collection

Surveys were sent to the participants electronically. Data was collected on the participants' views on the concept definition of Big Data, the types of data and sources, implications and challenges of Big Data using structured and open ended questionnaires respectively. Prior to that, a letter of invitation to participate was sent to each potential participant. In this letter, a brief introduction and the purpose of the study was communicated to all the participants. The survey link was sent finally sent to participants. The participants were offered a comfortable amount of time to answer questions. An instrument valid in content is one that has drawn representative questions from a universal pool (Cronbach, 1971). In order to ensure content validity, the questions were based on information gathered from the literature review to ensure that they were representative of what the subjects should know about Big Data. The data collection was executed over four weeks span between July 25, 2013 and August 26, 2013. Anonymity and confidentiality was maintained by keeping the collected data confidential and not revealing the participants' identities and presenting the results in an aggregate format.

3.6 Data Analysis

After the data was collected, it was organized and analyzed. Data was analyzed using descriptive statistics. The data is presented in frequency tables and graphs.

The next chapter presents the interpretation and the discussion of the findings of the study.

Chapter 4

FINDINGS AND DISCUSSION

The purpose of this study was to explore the implications and challenges of Big Data in the lodging industry. Unlike other research that have examined Big Data in the entire hospitality industry, this research focuses on only the lodging industry in the US. This chapter presents analysis and discussion of the findings from the administered questionnaire of the study. The data were collected and then processed in response to the problems posed in chapter one (1). The data analysis and the findings of the study were presented using tables and graphs.

4.1 Descriptive Statistics

A total of twenty (20) surveys were sent to executives of both publicly traded hotel corporations and independent hotel corporations. Nine (9) out of the total successfully completed the survey.

Functional Area of Respondents

Figure 1 below, shows the main functional areas of expertise of the respondents. Majority indicated Information Technology (3 CIO's) and Finance (3 CFO's) out of nine (9). The remaining were Strategy and Business Development (1) General Management (1) and Revenue Management (1).

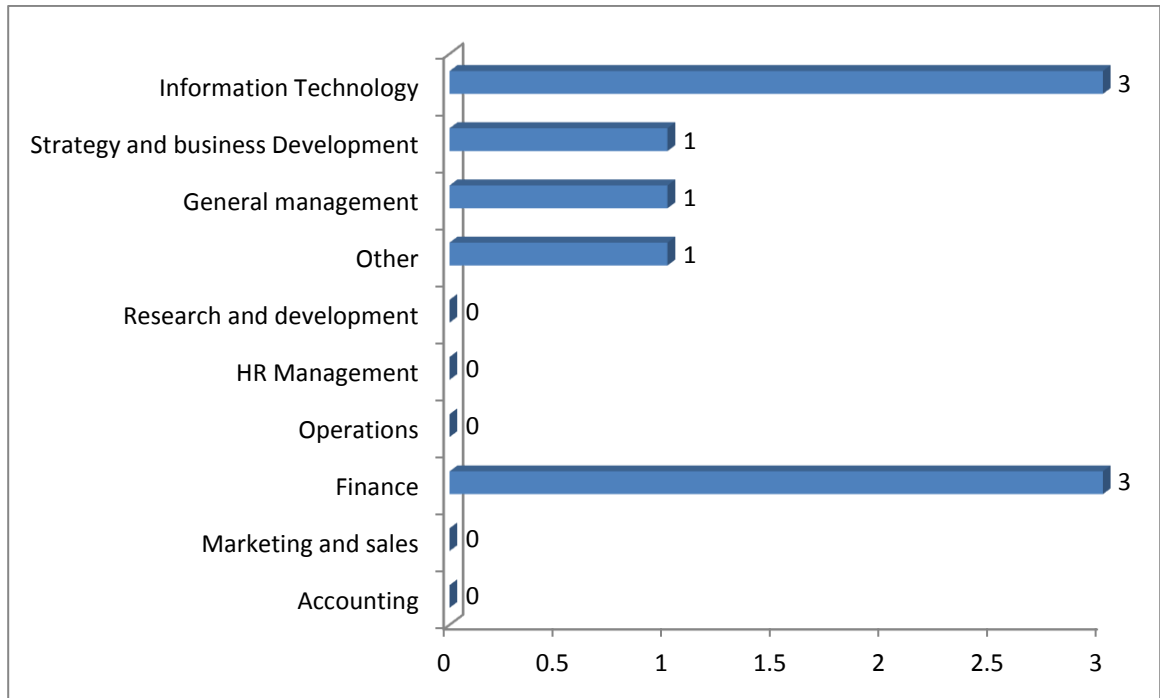


Figure 4.1: Functional Area of Expertise

Categories of Hotel Corporations

Out of the total nine (9) completed responses, six (6) were from the publicly traded hotel corporations and the remaining three (3) from the independent (one property) hotel corporations. This is presented in Table 2 below.

Table 4.1: Categories of Hotel Corporation

	Frequency	Percent
Publicly Traded	6	67
Independent (One Property)	3	33
Total	9	100

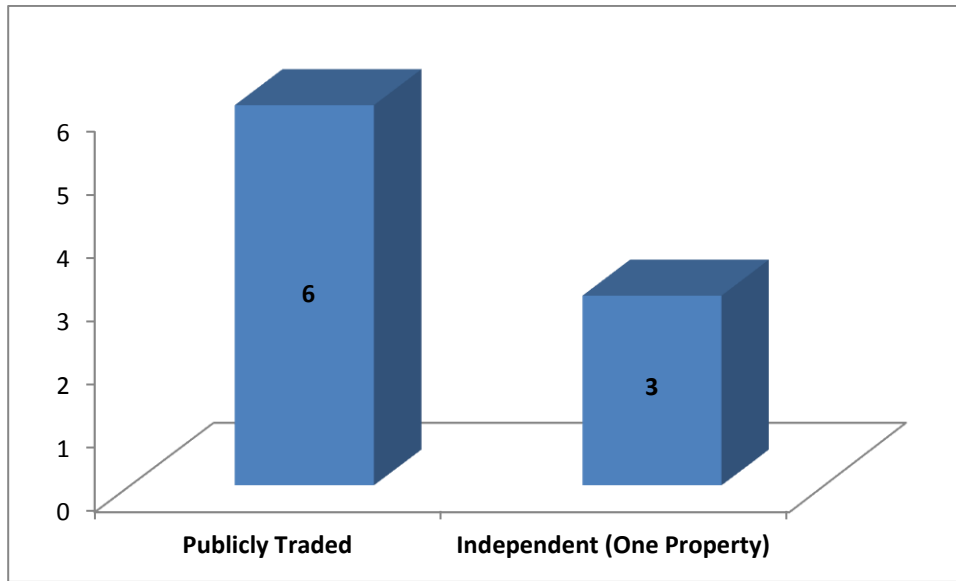


Figure 4.2: Categories of Hotel Corporation

Figure 2, shows the two main categories of hotel corporations that participated in the study. Of a total nine (9) responses, the publicly traded hotels were the highest respondents.

4.2 Big Data Usage

Table 4.2: Big Data Usage

	Publicly Traded	Independent (One Property)	Total
Yes	5	0	5
Plan to Use	0	1	1
No	1	2	3
Grand Total	6	3	9

The data in Table 3 above indicate that, out of the total nine (9) responses, five (5) of them use Big Data meaning that, majority of the respondents used big data in

their hotel corporations and these were the publicly traded hotel corporations, only one of the publicly traded companies did not use Big data in their hotel corporation. The remaining respondents represented the independent (one property) hotel corporations, two (2) of them do not use Big Data and one (1) plans to use Big Data in the future. Even though there were three respondents who did not use Big Data, these respondents were included in the study in order to determine the reasons why they do not use Big Data in their hotel corporation. Figure 3 presents an illustration of the data usage.

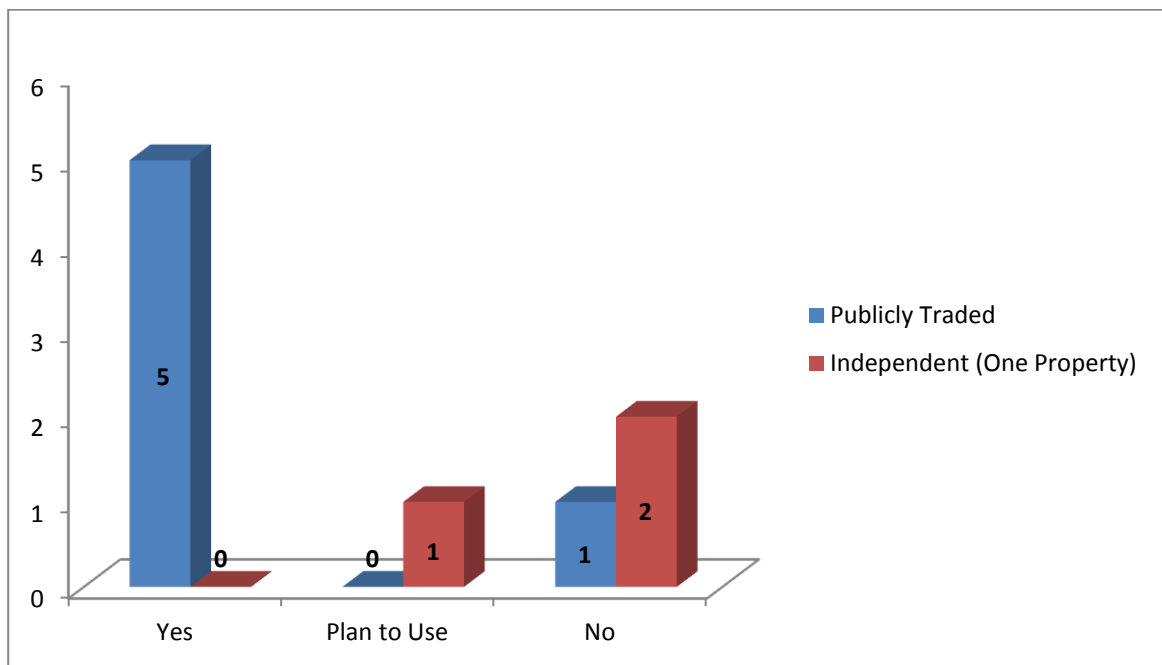


Figure 4.3: Big Data Usage

4.3 Defining Big Data

Table 4 and Figure 4 below describe how those who use Big Data in the publicly traded hotels category viewed Big Data. The respondents had the chance of

choosing more than one option to describe Big Data. All of the five (5) respondents agreed that, Big Data is a greater scope of information. In addition to that, most of them, four (4) indicated that they viewed Big Data as large volumes of new kinds of data that is being generated from multiple sources and its analysis. Three (3) of them viewed Big data as social media data, two (2) viewed Big Data as information generated and distributed in real time and only one respondent described Big Data as the latest buzzword.

Table 4.3: Defining Big Data (Publicly Traded Hotel Corporation)

	Frequency	Percent
New kinds of data and analysis	4	80
Real-time information	2	40
The latest buzzword	1	20
Social media data	3	60
Large volumes of data	4	80
Data from multiple sources	4	80
A greater scope of information	5	100

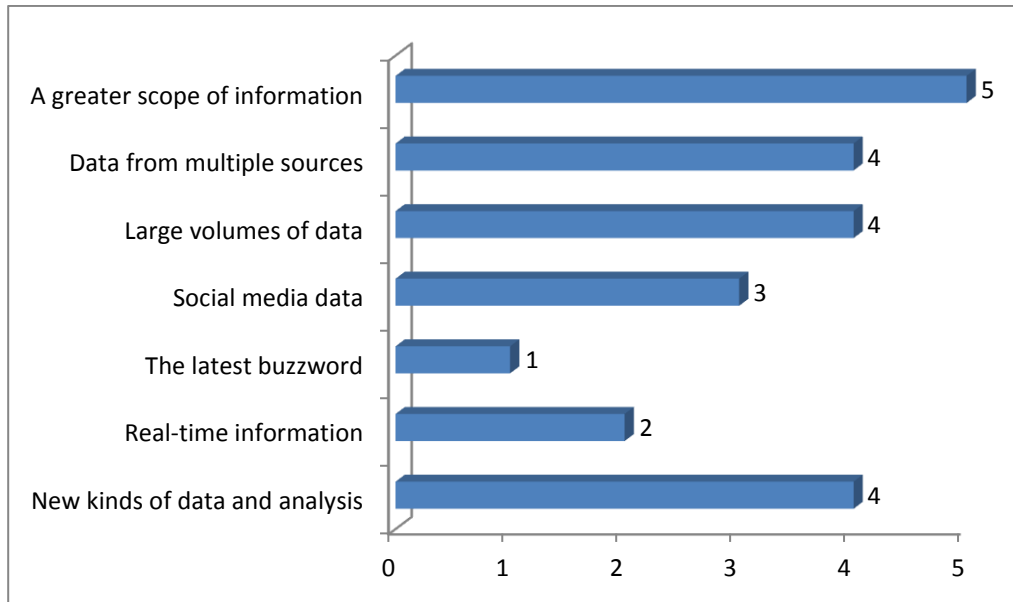


Figure 4.4: Defining Big Data (Publicly Traded Hotel Corporation)

Defining Big Data (Independent one- property Hotel Corporations)

Table 5 and Figure 5 below, show how the Independent one-property hotels category viewed Big Data. The respondents had the chance of choosing more than one option to describe Big Data. Two (2) out of the three (3) respondents defined Big Data as a greater scope of information and large volumes of new kinds of data and its analysis. One (1) out of three (3) defined Big Data as data generated from multiple sources. None of them viewed Big Data as real-time information, the latest buzzword or social media data.

Table 4.4: Defining Big Data (Independent one - property Hotel Corporations)

	Frequency	Percent
New kinds of data and analysis	2	67
Real-time information	0	0
The latest buzzword	0	0
Social media data	0	0
Large volumes of data	2	67
Data from multiple sources	1	33
A greater scope of information	2	67

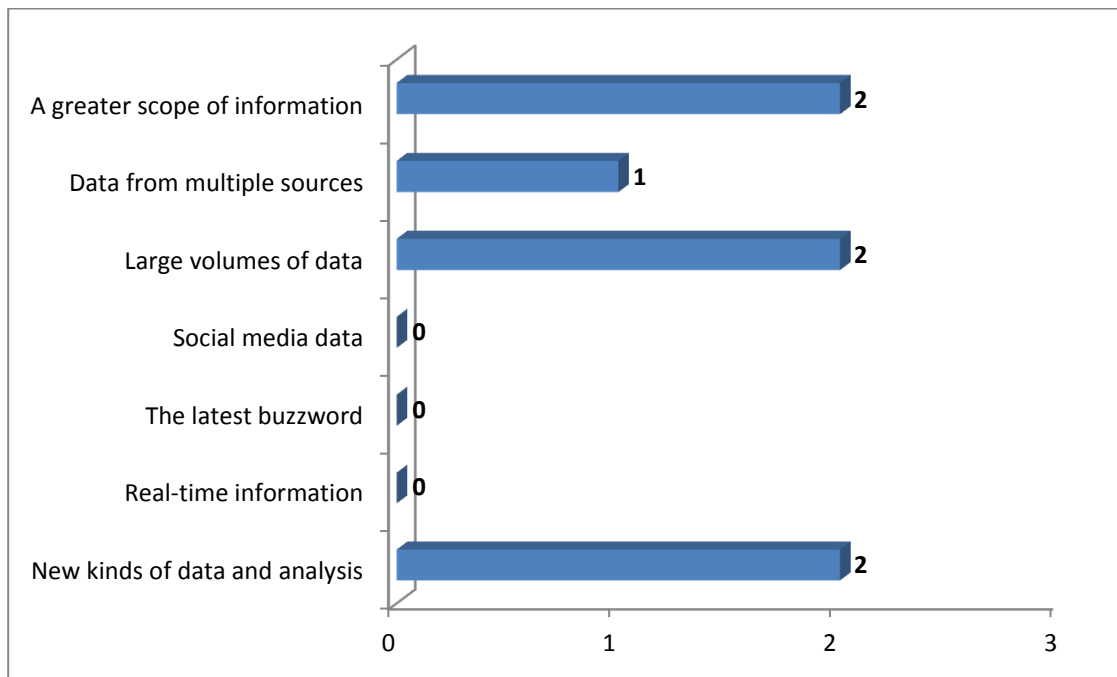


Figure 4.5: Defining Big Data (Independent one- property Hotel Corporations)

Discussion –Big Data in the Lodging Industry

Big Data has been defined in so many ways across different industries and it is usually defined along three main dimensions or characteristics – volume, velocity and

variety (3 V's). According to Gartner, Big Data is "high-volume, high-velocity, and/or high-variety information assets that require new forms of processing to enable enhanced decision making, insight discovery and process optimization." Other IT research firms such as IBM and IDC's definitions are also characterized by the three (3) V's and supports Gartner's definition of Big Data. The findings of this study confirm that, CIO's, CTO's and Senior Business Executives in the lodging industry in both publicly traded hotels and independent one-property hotels define Big Data using the three (3) characteristics. Big Data was defined by hotel executives as a greater scope of information or large volume (Volume) of new kinds of data that is being generated from multiple sources such as social media data (Variety) generated, analyzed and distributed in real time. (Velocity).

Duration of Big Data Usage (Publicly Traded Hotels)

Table 6 and Figure 6 below display the results about how long the respondents have worked with Big Data. Three (3) out of the five (5) respondents have used Big Data from three to four (3-4) years and the remaining two (2) for five (5) years or more. This result shows that, these hotels are well advanced on their Big Data journey since all of them have used Big Data for at least three (3) years. This is consistent with other industries such as the manufacturing, IT and technology, financial services, professional services, healthcare, pharmaceuticals and biotechnology and consumer goods. According to a global survey of 752 executives representing nineteen industries, 57% of them said that they had been working with Big Data for at least three years (Giles, 2012). The independent hotels responded that they do not use Big

Data except one that plans to use Big Data in the future therefore, the duration question was skipped automatically.

Table 4.5: Duration of Big Data Usage

	Frequency	Percent
5 years or more	2	40
3 – 4 years	3	60
1 – 2 years	0	0
Less than 1 year	0	0
Other	0	0
Total	5	100

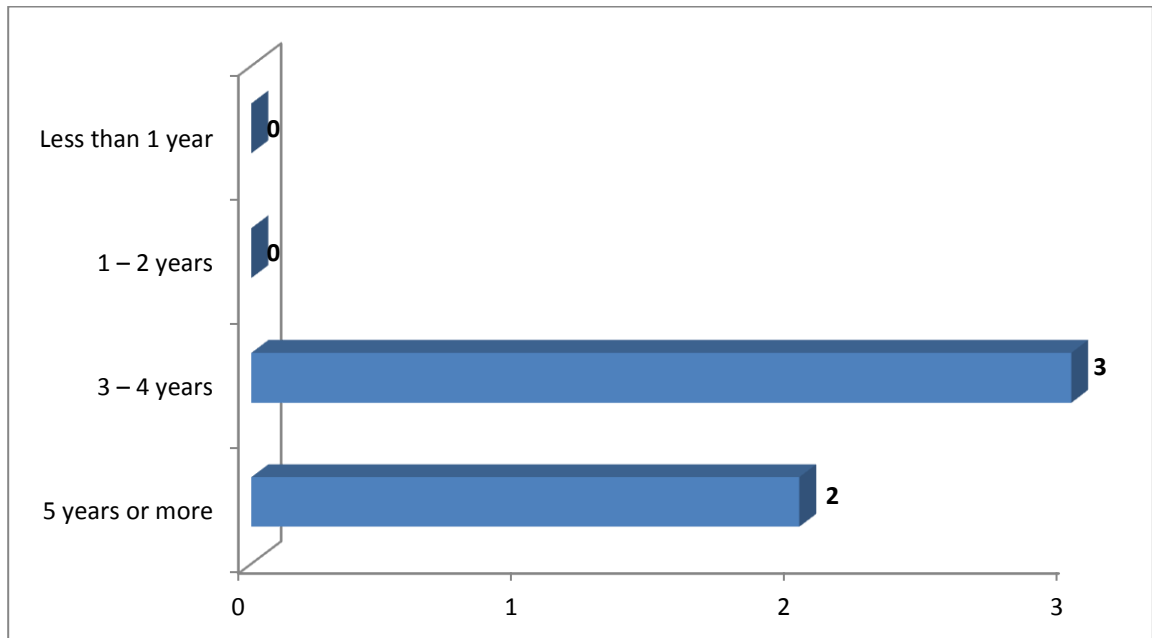


Figure 4.6: Duration of Big Data Usage

4.4 Sources of Data

Sources of Data (Publicly Traded Hotel Corporations)

Figure 7 below, describes the sources of data for the publicly traded hotel corporations. The respondents were allowed to select more than one source. All the respondents, five (5) out of five (5) indicated that they collected data from the web (click stream), three (3) out of five (5) respondents collected data from Mobile usage (Hotel mobile apps and location-based apps) and other sources such as Industry Data, Systems Extracts, Reservation Booking Activity via the Channels of Distribution. Two (2) out of five (5) collect data from RFID Tags and bar codes and emails. Only one (1) out of 5 respondents collected data from audio and video files and energy management systems (smart grid, sensors).

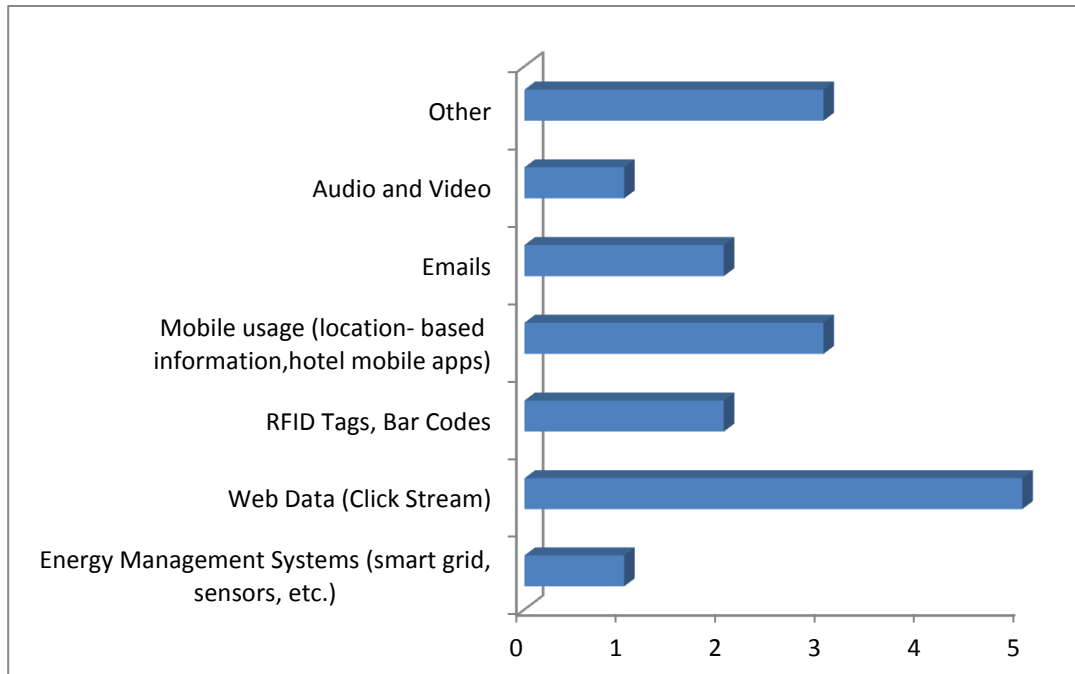


Figure 4.7: Sources of Data (Publicly Traded Hotel Corporations)

Discussion

An IBM report on Big data states, “Every day, we create 2.5 quintillion bytes of data, so much that 90% of the data in the world today has been created in the last two years alone.” This explosion of data is generated from different sources and they vary by type, format, volume and nature. According to a global survey conducted by the (Economist Intelligence Unit, 2011) majority of the respondents indicated that Web data (click stream) and location based information were extremely valuable to their organization. This is consistent with the findings of this study which suggests that the new main sources of data collected by the publicly traded hotels are from the web (click stream) followed by Mobile usage (hotel mobile app and location-based

information). This shows that the hotels that use Big Data collect data from multiple sources and in different formats.

Social Media sites

The respondents were further asked to identify all the social media sites from which they collect data. Figure 9 below shows that two (2) out of five (5) respondents collected data from Facebook, Twitter, Instagram, Tripadvisor, Expedia, Google+, Pinterest and blogs. Two (2) of the respondents selected other, One (1) hotel corporation uses a software called Revinate which is an aggregator of all the social media sites, and interestingly, the other one does not collect data from any of the sources listed or any other social media sites. The one last respondent did not answer the question at all. None of the independent one- property hotels collected data from any of the social media sites.

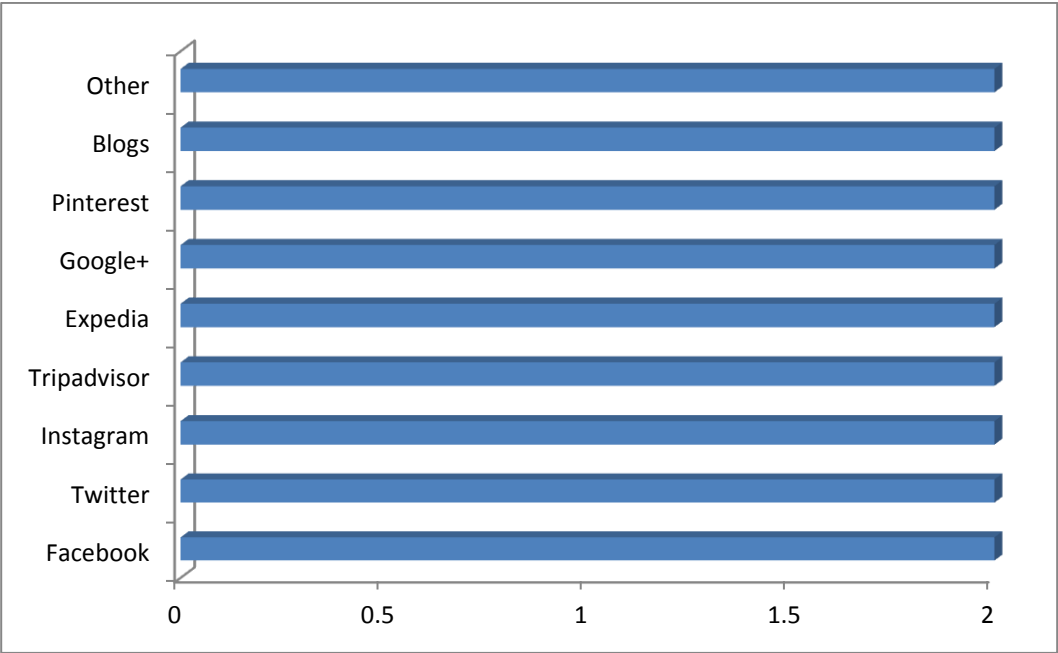


Figure 4.8: Social Media Sites

Discussion

In this study, social media sites were found to be another source of data for the publicly traded hotel corporations. This means that Hotel corporations that use Big Data are now adding data from social media sites to their sources of data. According to a (Hospitality Industry Report ,2011) hotel corporations used to collect only quantitative responses from guests through surveys as their reliable feedback method but today many hotel corporations are recognizing the value of collecting feedback from social media and other online sites, as well as encouraging open-ended comments in their surveys. According to (Chui et al., 2012), majority (72 percent) of companies in other industries surveyed reported using social media technologies (internal collaboration tools and social marketing technologies) in their businesses.

4.5 Big Data Platforms

Figure 10 below, illustrates the type of Big Data platforms used by hotel corporations. One (1) out of the five respondents indicated that they used NoSQL and another one (1) used Information Integration. There were four respondents that indicated that they used other types of technology which are Proprietary, TM1, and SAS software. The respondents were allowed to check all that was applicable.

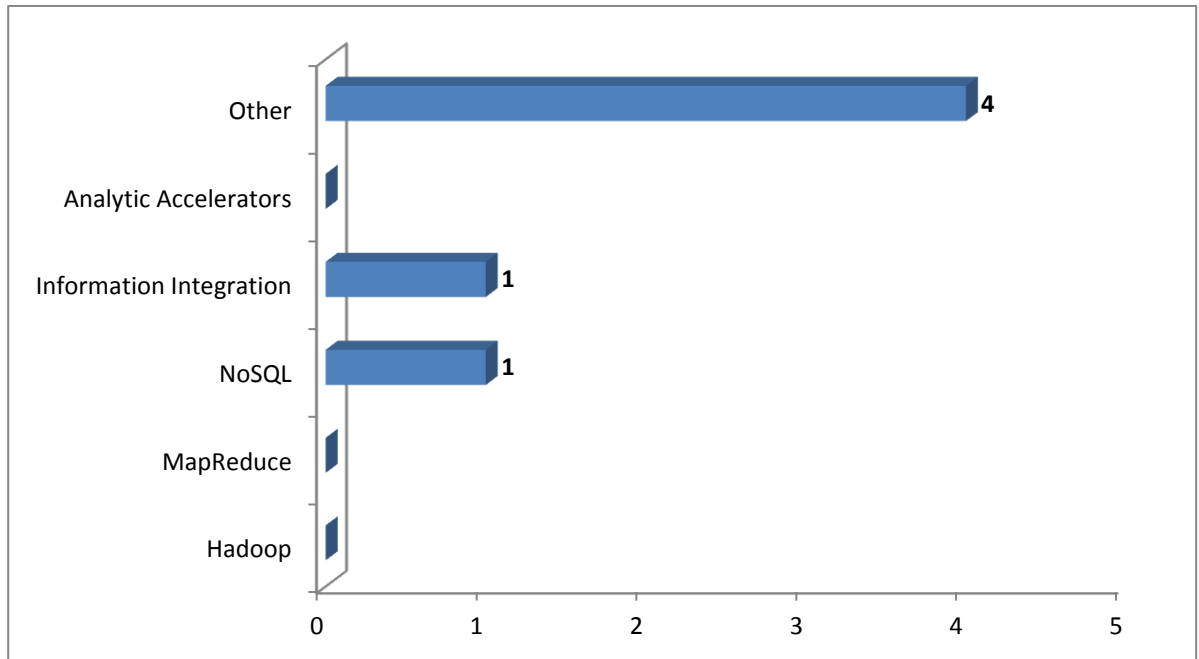


Figure 4.9: Big Data Platforms

Discussion

Companies' ultimate goal when considering components of a big data platform is to easily integrate Big Data with the companies' enterprise data to allow for deep analytics on the combined data set (Dijicks, 2013). There was not a single Big Data platform that stood out to be the most used by the hotel corporations therefore it is suggested from the results of this study that each hotel assess their specific needs and acquire a suitable platform that provides the most benefits to meet the varied needs. Below is a brief description of the Big Data Platforms mentioned above:

- **Hadoop Distributed File System (HDFS)** is a distributed file system designed to run on commodity hardware which provides high throughput access to application data and is suitable for applications that have large data

sets. HDFS is highly fault-tolerant and is designed to be deployed on low-cost hardware (Borthaku, 2007). In a Hadoop-focused interview by travel-business news site Tnooz, with Barney Harford (CEO of Orbitz) discusses how Orbitz Worldwide analyzes every aspect of visitors' sessions on its sites in order to determine the preferences of any given visitor. A classic example was when Orbitz data-crunching found that Mac users spend about \$20 more a night on hotels than do Windows users.

- **MapReduce** is a programming model and an associated implementation for processing and generating large data sets that is amenable to a broad variety of real-world tasks. MapReduce is a flexible data processing tool which is highly effective and efficient for large-scale fault-tolerant data analysis. MapReduce enables easy discovery of common data trends in large unstructured data sets. At Google, MapReduce was used to completely regenerate Google's index of the World Wide Web. (Dean and Ghemawat, 2010).
- **NoSQL** is a term used to refer to a class of database systems that differ from the traditional relational database management systems (RDBMS) in many ways. It emerged as companies, such as Amazon, Google, LinkedIn and Twitter struggled to deal with unprecedented data and operation volumes under tight latency constraints. It is used in analyzing high-volume, real time data, such as web-site click stream which provides significant business advantage by harnessing unstructured and semi-structured data sources to create more business value.(Khangaonkar, 2011).

- **Information Integration** (also called information fusion) is the merging of information from disparate sources with differing conceptual, contextual and typographical representations. It is used in data mining and consolidation of data from unstructured or semi-structured resources. Typically, information integration refers to textual representation of knowledge but sometimes applied to rich-media content. (Turban 2012).
- **Analytic Accelerators** is a workload optimized appliance add-on that enables the integration of business insights into operational processes to drive winning strategies. It accelerates select queries, with unprecedented response times. (Peschke, 2011).

4.6 Big Data Analytics

Technology used to analyze Big Data

The responses regarding the types of analysis they use to evaluate and sift through Big Data are summarized in Table 11 and Figure 11 below. Respondents were allowed to choose more than one answer option. Four respondents indicated they analyzed their Big Data using Query and Reporting and Optimization. Three (3) used Predictive Modeling, Two (2) used Data Visualization and only one selected Other and indicated that they used an Oracle software in analyzing their Big Data.

Table 4.6: Technology used to analyze Big Data

	Frequency	Percent
Other	1	20
Query and Reporting	4	80
Data Visualization	2	40
Predictive Modeling	3	60
Optimization	4	80

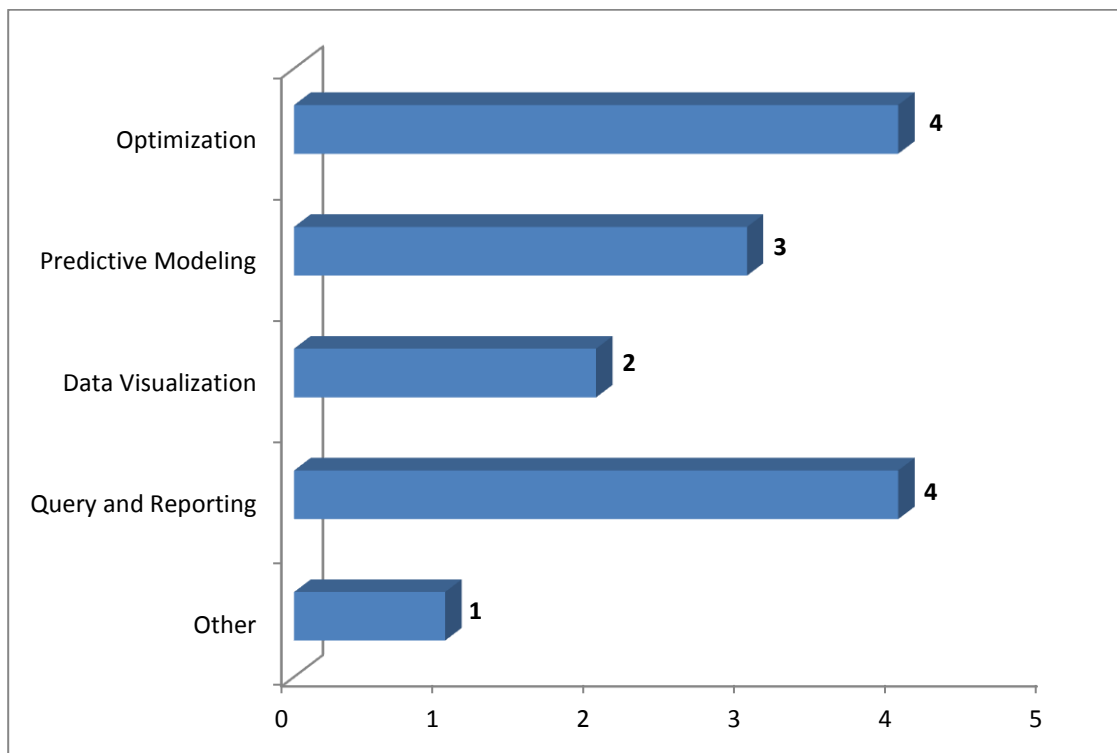


Figure 4.10: Technology used to analyze Big Data

Discussion

The findings of the current study are consistent with those of (Schroeck et al., 2012) which found that, today the majority of organizations engaged in Big Data activities start with analyzing structured data using core analytics capabilities, such as

query and reporting (91 percent) and data mining (77 percent). Two-thirds (67 percent) reported using predictive modeling skills. This is consistent with the findings of this study. Majority of the respondents indicated that they used Query and Reporting and also information optimization to analyze their Big Data.

Below is a description of the Big Data Analytics capabilities:

- **Information Optimization** is a complete enterprise solution that turns disparate data into dynamic reports for easy analysis and visualization. The information optimization platform allows end users to easily access, extract and incorporate data from any combination of existing reports already published inside or outside the enterprise, and then to create, distribute and publish dynamic, interactive reports – without requiring the time, expense or expertise of IT resources. (Datawatch Corporation, 2012)
- **Predictive Modeling** is defined by Gartner as a commonly used statistical technique to predict future behavior. Predictive modeling solutions are a form of data-mining technology that works by analyzing historical and current data and generating a model to help predict future outcomes. In predictive modeling, data is collected, a statistical model is formulated, predictions are made, and the model is validated (or revised) as additional data becomes available. For example predictive modeling can be used extensively in analytical customer relationship management and data mining to produce customer-level models that describe the likelihood that a customer will take a particular action.
- **Data visualization** is the science of the visual representation of data, meaning "information that has been abstracted in some schematic form, including attributes or variables for the units of information" in other words the term

means a graphical representation of data that can make understanding it easier. Data visualization helps with the analysis of information and presents it in a way that allows viewers to discover patterns that might otherwise be hard to uncover before. (Friendly, 2001).

- **Querying and Reporting:** Query is a request for information from a database. Query tools enable users to identify trends and find root causes in data from relational and OLAP data sources. A report is a formatted and organized presentation of data. Most database management systems include a report writer that enables the designing and generating of reports. (SAP Business Objects)

Department responsible for Big Data

Figure 12 below, is a graph that shows the different departments responsible for Big Data in hotel corporations. The results showed that majority (3) of the respondents selected the Strategic and Decision Making department. Two (2) selected Sales and Marketing department and another two (2) selected the Revenue Management department. Two (2) respondents selected other and indicated the Business Intelligence Group and Finance & Asset Management department. Only one (1) respondent chose the Customer Service department

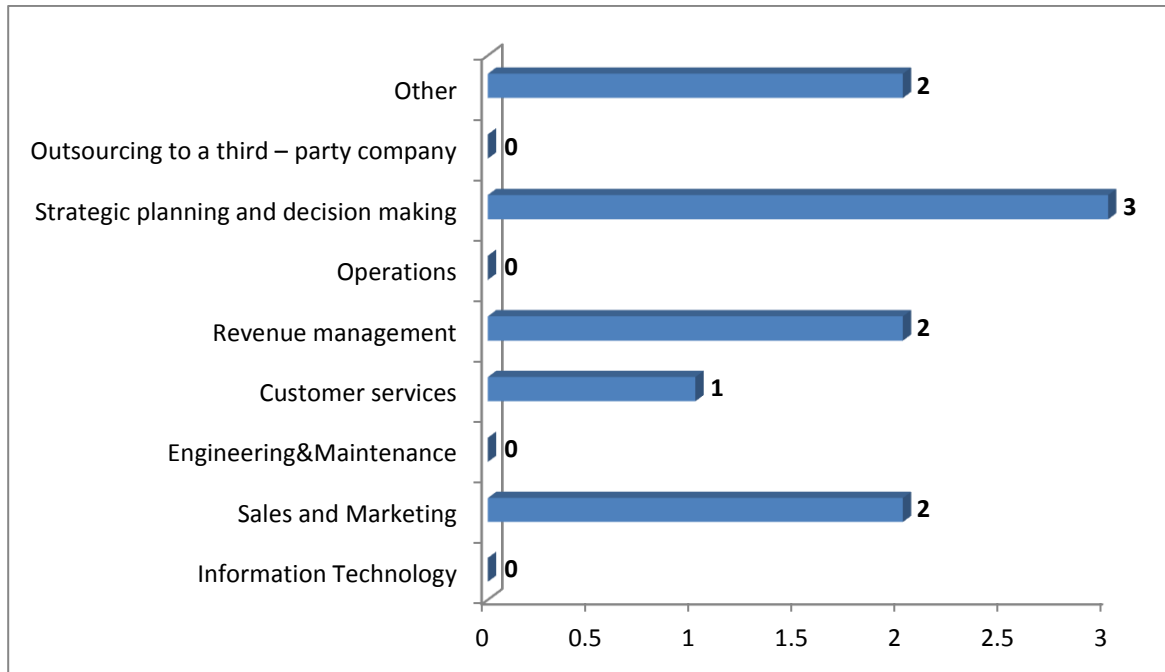


Figure 4.11: Department responsible for Big Data

Discussion

Surprisingly, none of the respondents chose the IT department as responsible for Big Data in their hotel corporations. (Redman, 2012) supports the idea that companies should remove the responsibility for data from the IT departments. In drawing inferences from the results of the study, the revenue management and sales & marketing department could be another functional area where Big Data appears to be housed considering that revenue management is a marketing function that involves the manipulation of pricing to fit demand and supply conditions.

Also, the findings of the survey results and case study of the Economist Intelligent Unit report by (Giles, 2012) revealed that, many companies will thrive if they place Big Data at the heart of their businesses, giving it the strategic attention it

deserves. This is consistent with the findings of this study which revealed that, majority of hotel corporations have their strategic planning and decision making department in charge of Big Data management.

Which department Benefits the most?

Figure 13 below, illustrates the importance of Big Data for the different departments in hotel corporations. Majority of the respondents indicated the Strategic Decision Making department (4), Revenue Management (4) and Marketing and Communications department (4). The remaining (3) indicated the Customer Service department and the Information Technology department (1).

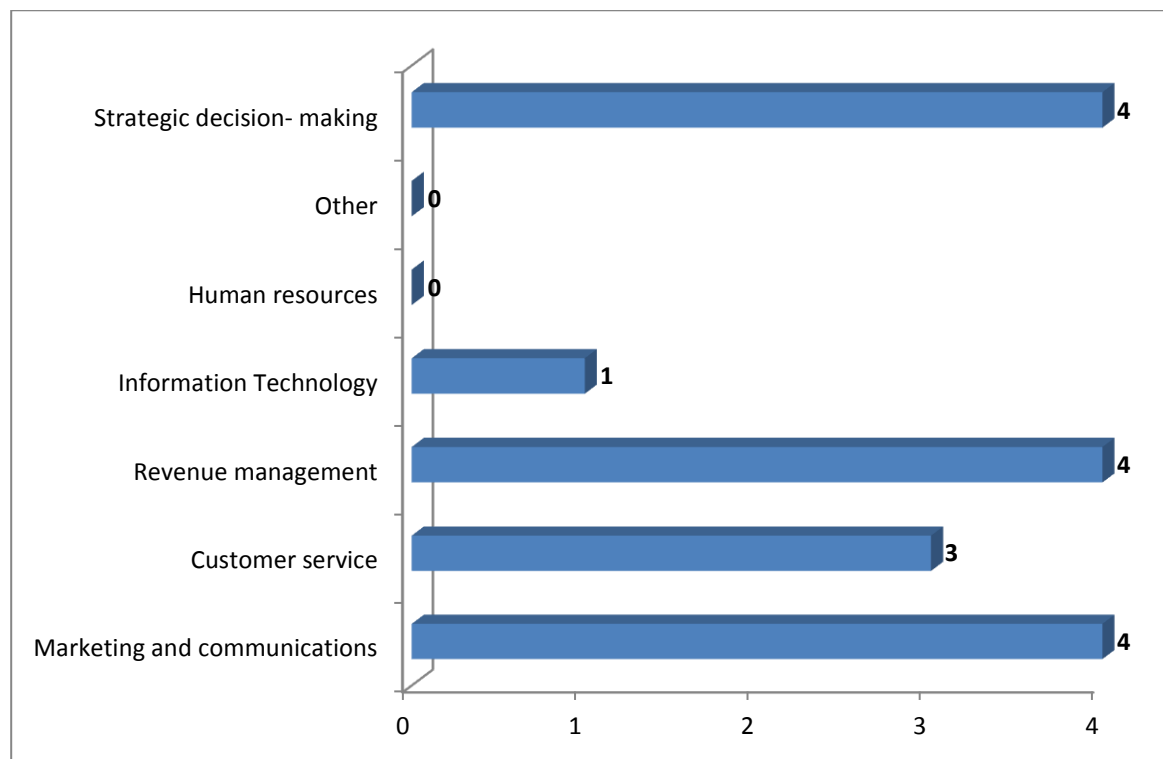


Figure 4.12: Which department Benefits the most?

Discussion

According to the survey respondents of the Economist Intelligence Unit survey (Giles, 2012), Big Data is improving company performance in other industries, across many areas beyond marketing departments. The most frequently highlighted areas were strategic decision - making and operational efficiency. This is consistent with the findings of this study which identified majority of the respondents indicating that the Strategic Decision Making department (4), Revenue Management (4) and Marketing and Communications departments are the departments that benefit the most from Big Data. None of the respondents selected the Human Resource department as a beneficiary of Big Data however the Human Resource department in hotels can also benefit from Big Data through the integration of relevant employee data and presenting it to the business in a timely manner. This valuable data when used creatively can boost recruitment and selection, employee retention, employee engagement, and talent management. According to the Aberdeen Group, Human Resource can become a hub of strategic insights for organizations by shedding its image as a tactical order-taker, and striving to be relevant and meaningful to organizational leaders in providing insight to the entire business.

4.7 New Opportunities with Big Data

Figure 14 shows the new opportunities that Big Data presents to hotel corporations. The respondents were allowed to choose all that were applicable. All the respondents (5) agreed that Big Data has improved their strategic decision making,

followed by Big Data enhancing Revenue Management (4). The remaining respondents confirmed that Big Data has increased their operational efficiency (2) and personalized the guest experience in their hotels.

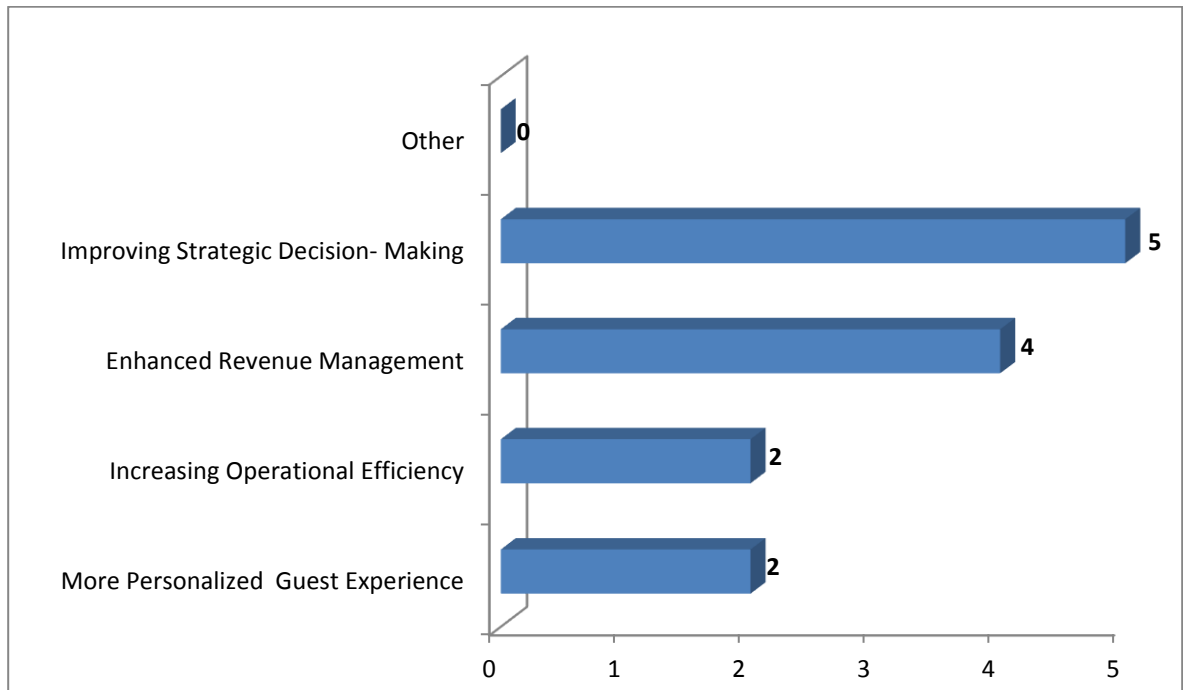


Figure 4.13: New Opportunities with Big Data

Discussion

The findings of this study suggest that hotel corporations that use Big Data creatively and effectively will see new opportunities in their businesses. Majority of the respondents indicated that their strategic decisions have improved as a result of the use of Big Data. This finding corroborates the ideas of (Manyika et al., 2011) which found that, leading companies are using data collection and analysis to conduct controlled experiments to make better management and strategic decisions. Today,

smart hospitality companies are using Big Data technologies to collect huge amount of data from both internal and external sources and analyzing such valuable data to anticipate customer needs, redefine customer engagement and to achieve new levels of customer loyalty (SOCAP International, 2013). For example, when guests stay at hotels, they leave vital information from the time of booking, check in, through their entire stay, at the point of check out and feedback through surveys or on social media. Using all this information from multiple sources, in different formats, the data can be analyzed by using Big Data analytics which can provide valuable insights into the guests' behaviors and preferences. This allows the hotel to tailor products and services to better meet the true needs of individual guest. This will ultimately optimize the guests experience and result in greater long - term customer loyalty. According to the (Deloitte Debates ,2012), it was highlighted that leaders who harness Big Data insights can maintain the strategic direction of their businesses, while using deeper insights on customers and operations to gain a jump on their competition in tactical plans.

4.8 Importance of using data in real-time

When asked how important the ability to process and act on data in real-time was to hotel corporations, majority three (3) out of five (5) rated it as somewhat important and the remaining (2) rated it as very important. This is presented in Figure 15.

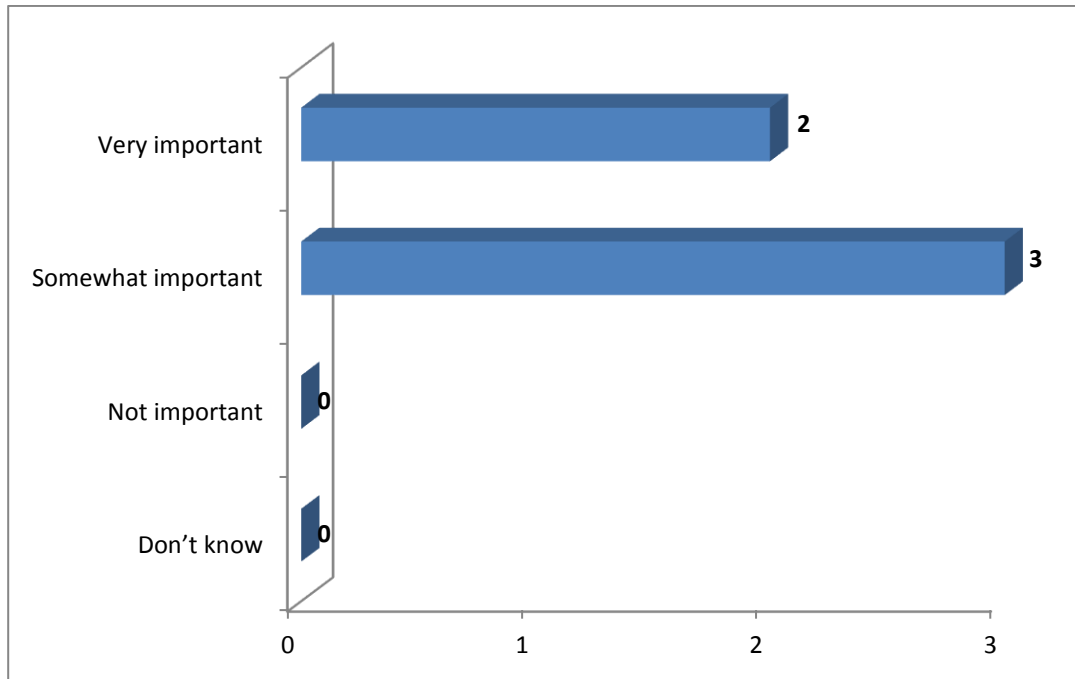


Figure 4.14: Importance of using data in real-time

Discussion

According to a survey conducted by (GigaSpaces Technologies, 2012) spanning various industries, it was revealed that, Big Data is now a mission-critical need for enterprises and the need for real-time processing of that data is significant and growing. The finding of this study equally deems data processed and acted upon in real time very important to enable business leader to make decisions almost instantaneously based on analysis of the Big Data.

Areas experiencing significant changes

Figure 16, illustrates the areas in hotel corporations that have experienced significant changes as a result of the implementation of Big Data. The respondents were allowed to check all that were applicable. Majority of the respondents indicated

that decision making at all levels (4) and the business and operational processes (4) have experienced the most significant changes. The remaining respondents indicated employee skill development (1) and corporate culture (1). The last respondent selected other and stated Revenue Management.

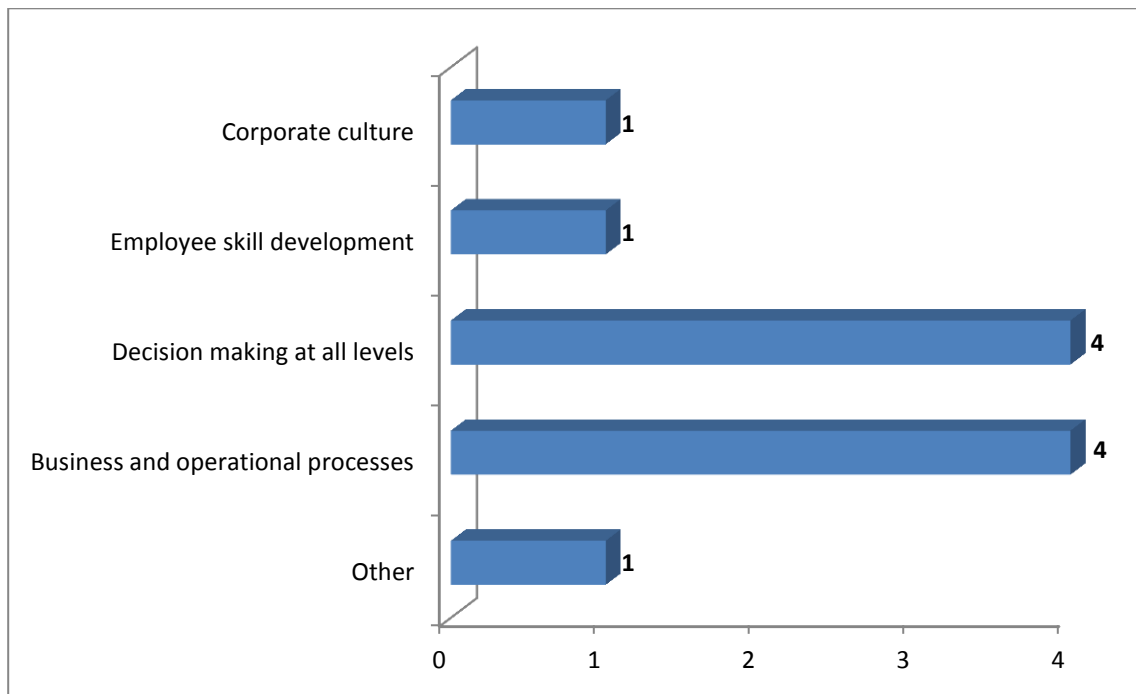


Figure 4.15: Areas experiencing significant changes

Discussion

The findings of the study reveals that the areas in hotel corporations that are experiencing the most significant changes as a result of the implementation of Big Data are the entire business and operational processes as well as employee skill development and corporate culture. An example of Big Data application in hotels such as InterContinental Hotel Group uses the “Test and Learn” focused software from

Applied Predictive Technologies to test investments such as remodels, conference facilities, new restaurant formats on a small scale before making a decision to authorize a full rollout. This assists in identifying the types of capital investments that will be beneficial as well as reducing cost risk. The advent of Big Data means analyzing large unstructured, managers and business analyst will be expected to interpret data and create innovative data- based products and services and to do that, employees require special skills. According to (Davenport, 2013), finding and recruiting Big Data skills is a significant challenge in the hospitality industry. Hotels will need to invest in data- driven training and development courses to update their existing employees or recruit from external sources.

4.9 Challenges with processing of Big Data

Figure 17 below, depicts the challenges that hotel corporations face with the processing of Big Data. Most of the respondents did not have a formal process for Big Data Management (3), two (2) indicated they lack the necessary IT infrastructure and one (1) said they do not have the right skills to process Big Data.

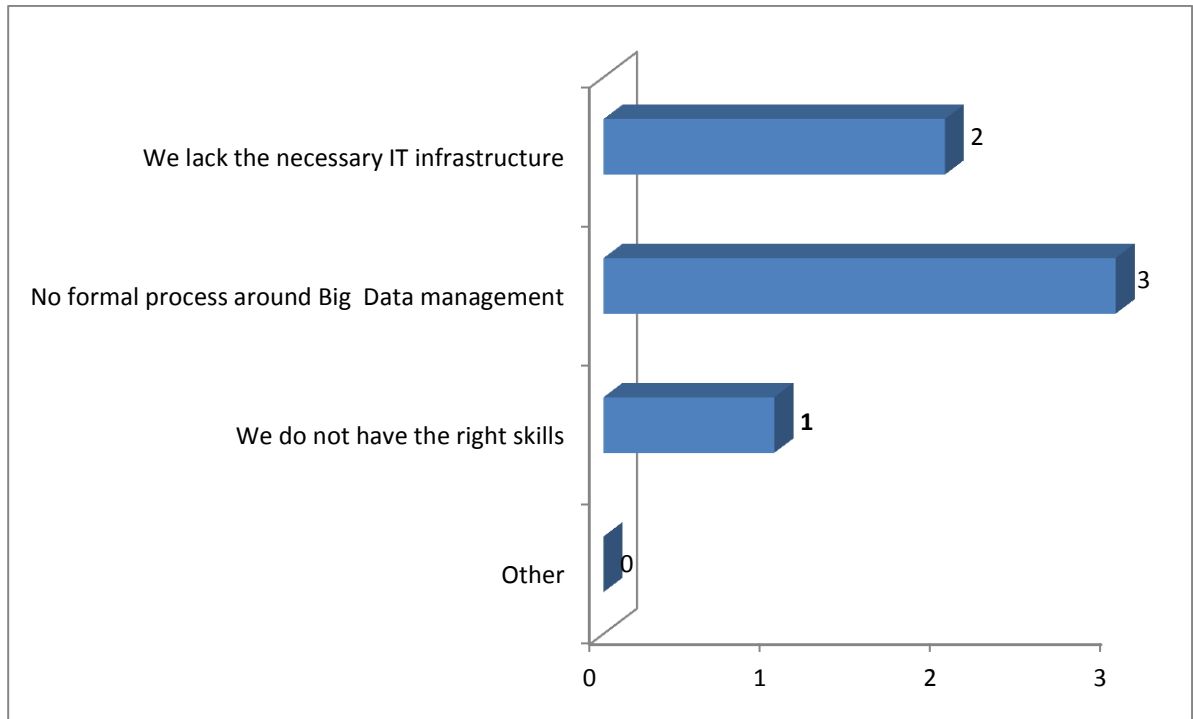


Figure 4.16: Challenges with processing of Big Data

Discussion

Many companies are aware of the power of big data but there is still some confusion on how to turn this data into a useful asset. Gartner predicts that through 2015, about eight in 10 Fortune 500 companies will fail to exploit big data opportunities for a competitive advantage. This study found that the dominate challenge hotel corporations face with processing of Big Data is that, there is no formal process around Big Data management. This is consistent with the findings from the Outsourcing Center and Wipro survey, which revealed that only just more than two in 10 (21.7%) firms currently have a formal strategy in place to deal with and leverage big data. Hotel companies are still discovering how they can extract value from the data they gather. Data and this may suggest why most of the respondents did

not have a formal process around Big Data management. Hotel corporations will need to define the goal of their Big Data effort, in other words, recognizing the problem they want to solve using Big Data rather than collecting huge volumes of data to identify problems. Identifying a specific area of interest and setting business priorities will facilitate a well-defined strategy based on key business priorities. (Schroeck, et al.,2012) confirms that companies become successful at exploiting data by focusing on business priorities.

4.10 The Biggest Challenge

The biggest challenge for hotel corporations is shown in the graph below (Figure 18). The results show that the biggest challenge was the variety characteristic of Big Data (4), followed by the velocity. Interestingly, none of the respondents indicated volume as a challenge.

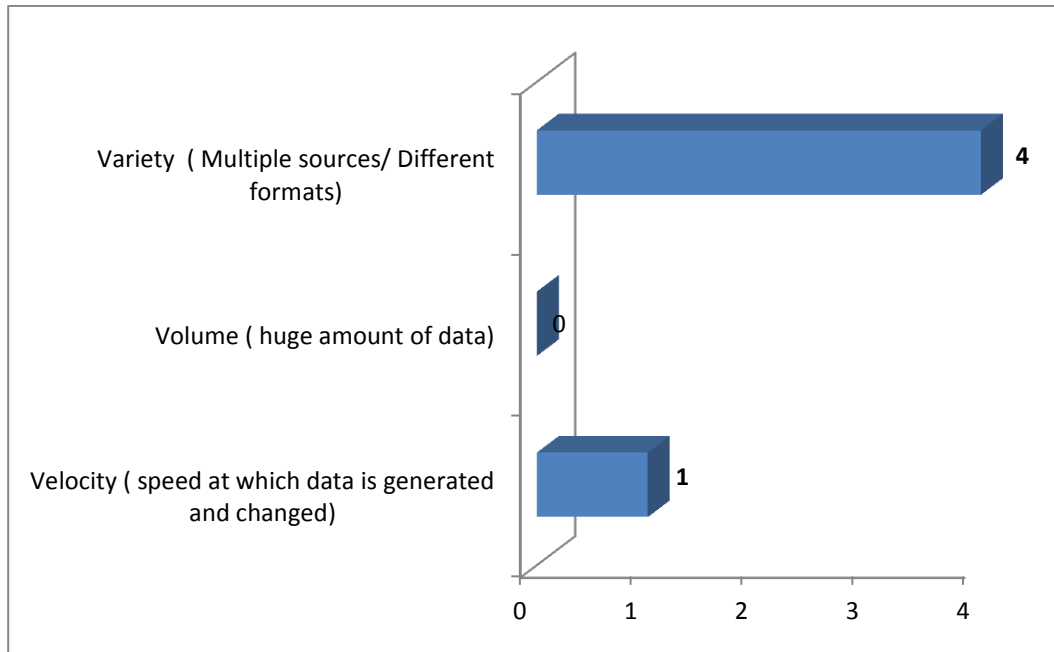


Figure 4.17: The Biggest Challenge

4.11 Other Challenges

The respondents were further asked to identify other challenges they face with management of Big Data and Figure 19 below shows the results. Majority of the respondents (4) rated reconciling disparate data sources and the lack of top management interest in Big Data as very problematic, followed by data quality and accuracy (2), privacy and security issues (1), increased cost of data management (1) and Data security. However, other respondents rated risk of data leaks and abuse (3) storage capacity (2), data security (1), increased cost of data (1), lack of organizational view into Big Data (1), privacy and security issues and limited analytical and management talent as not problematic at all.

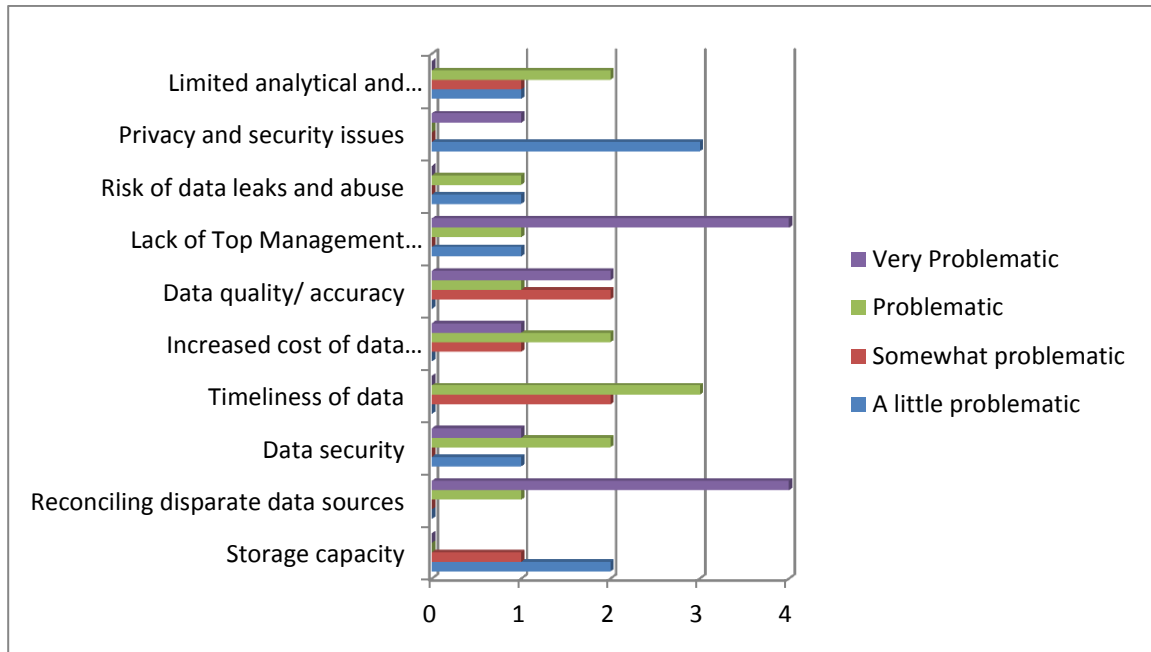


Figure 4.18: Other Challenges

Discussion

This study's results reveal that the biggest challenge of Big Data for hotel corporations is reconciling disparate data sources. This study supports (Sherman, 2012) which points out that only 27 percent of companies integrate data from different data sources. A lot of data that exist today did not exist before. Unstructured and voluminous new sources of data such as blogs, social media, email, sensors, photographs, video footage, etc. have emerged generating a tremendous wealth of information from multiple sources that companies are struggling to integrate and ultimately to find deeper insights to enhance decision making. For hotel corporations to address the variety and velocity challenge of Big Data, it will require advanced analytics and technologies to integrate and analyze data from disparate systems of

both structured and unstructured information sources from internal and external sources and also the need to incorporate streaming data into business processes and decision making.

4.12 Why hotel corporations do not use Big Data

Out of a total of nine (9) respondents who participated in this study, two(2) of them do not use Big Data and one (1) plans to use Big Data in the future. Figure 20 below, shows the reasons why hotel corporations in this category do not use Big Data. One (1) of the respondents strongly agreed that the difficulty in creating an integrated data source was the reason why they do not use Big Data, one (1) agreed to an extent and the remaining one (1) disagreed. Majority of the respondents (2) agreed that the reason was the high cost of data management but one (1) respondent disagreed. Two (2) respondents agreed it was because of the difficulty in recruiting Data Analytical personnel and being confused about Big Data. Two (2) respondents strongly disagreed that the reason for not using Big Data was maintaining a competitive advantage and being confused about Big Data.



Figure 4.19: Why hotel corporations do not use Big Data

Discussion

Most CIOs, according to a recent survey, responded that their budget was not sufficient to cover the cost of a Big Data deployment .Sixty five (65) percent of the 369 companies surveyed by CIO magazine have deployed or plan to deploy Big Data technology to boost the speed and quality of business decisions. The number-one hurdle was getting the funds to pay for it (Brousell, 2012). This is consistent with the findings of this study which suggest that hotel corporations that do not use Big Data cited the high cost involved in data management and the difficulty in creating an integrated data source as the main reasons for not investing in Big Data. Big Data Management can be very expensive, however hotel corporations could invest in the Big Data technologies that will allow them to extract value from their key business priorities instead of focusing on investing in technologies for extreme use cases.

Also, if more Big Data solution vendors penetrated the market, the cost will fall significantly. Hotels enjoy the benefits of making more informed decisions, offering tailored quality products and service and improved customer relationships as a result of using Big Data therefore it is clear that the benefits of Big Data may outweigh the cost when leveraging the information learned from Big Data

4.13 Description of Big Data Usage

Figure 21, shows how hotel corporations described their use of Big Data. Majority (3) of the respondents indicated that they probably leverage about half of their valuable data and the remaining two (2) indicated that a huge amount of their useful data go untapped.

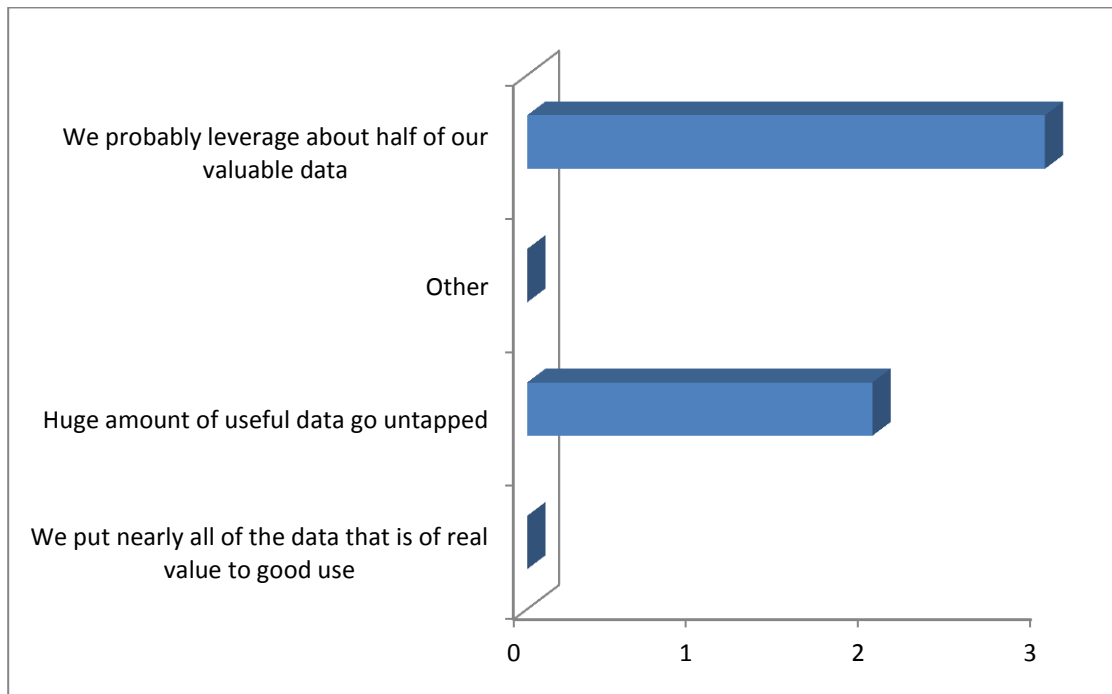


Figure 4.20: Description of Big Data Usage

Discussion

Today, most companies collect a large amount of data but do not consistently maximize their value. According to the survey results conducted by the Economist Intelligence Unit, nearly one in four survey respondents said the vast majority of its company's data are untapped. Another 53 percent said they only use half of their valuable data. This is consistent with the findings of this study which confirms that hotel corporations also leverage about half of their valuable data, leaving huge amount of useful data to go untapped. This means hotel corporations are still learning how to manage Big Data and also hotels without a formal structure around Big Data management may not be able to harness the power of the valuable data they collect.

This chapter summarized the data analysis and a discussion of the findings in the forms of tables and graphs. The details of what was presented were the functional background of the respondents, the main categories of hotels that participated in the study, the definition of Big Data in the lodging industry, the hotels main sources of data, the technology and platform they use to mine Big Data, the departments responsible for Big Data Management and the ones that benefits the most as a result of the application of Big and the new opportunities presented and challenges that hotel corporation faces using Big Data,

Chapter 5

CONCLUSION

This chapter presents summary of all the chapters, major findings and limitations of the study. The implications of the study, some propositions and a conclusion were also discussed.

Chapter one presented an introduction to the concept of Big Data, the definition and characteristics of Big Data across different industries, how the phenomenon of Big Data has evolved, the enormous benefits and opportunities Big Data presents and its challenges. The problem statement, objectives of the study, research questions and the significance of the study were discussed as well.

Chapter two reviewed the related literature on Big Data across different industries and provided a clear understanding of the concept of Big Data and examined the application of Big Data in different industries. Some key concepts such as Data Mining, Big Data and Data Analytics were explored. Examples of the practical application of Big Data in the hospitality industry were examined.

Chapter three discussed the research methodology adopted. A descriptive research design was adopted for purposes of this study. An online survey was developed and administered to collect data from the respondents. The study population consisted of US hotel Corporations and the participants for this study were selected using the convenience sampling method. Ten (10) publicly traded hotels and five (5)

independent (one property) non- publicly traded hotels were selected. A pre-test was conducted to test the survey before it was launched.

Chapter four summarized the data analysis and a discussion of the findings. The data were collected and then processed in response to the problems posed in chapter one (1). The data analysis and the findings of the study were presented using tables and graphs.

5.1 Major Findings

Specifically, this study endeavored to answer the following:

1. What is Big Data?

The results of the study align with a useful way of characterizing the three dimensions of Big Data – volume, variety and velocity. Big Data was defined by hospitality executives as a greater scope of information or large volume of new kinds of data (Volume) that is being generated from multiple sources such as social media data (Variety) generated, analyzed and distributed in real time to find deeper insights to make strategic decisions. (Velocity).

2. What are the main sources of data to hotels?

For many years, hotel corporations have collected and had access to tremendous transactional data stored in relational databases and sourced from Property Management System (PMS), Sales and Catering (S&C) and Point of Sale (POS) solutions, central reservation systems, global distribution systems, reputation management systems, etc. to make business decisions. Today, hotel corporations collect more data from non- traditional (unstructured and semi structured) new sources

such as web data (click stream), mobile usage (hotel mobile apps and location based apps), RFID tags, bar codes, audio and video files, energy management systems (smart grid sensors) Industry Data, Systems Extracts, social media sites such as Facebook, Twitter, Instagram, Tripadvisor, Expedia, Google+, Pinterest and blogs that can be mined for useful information. As a result, hotel corporations are now adding these new sources of data to their existing data to extract new insights and understanding that could not be seen previously from their data.

3. What types of analysis do hotels use to evaluate and sift through Big Data?

Hotel corporations engaged in Big Data activities start with analyzing structured data using core analytics capabilities, such as query and reporting. Majority of the respondents reported that they used Query and Reporting and also Information Optimization to analyze their Big Data and this is consistent with the findings of (Schroeck et al 2012) which also found that, majority of organizations engaged in Big Data activities analyze structured data using core analytics capabilities, such as query and reporting (91 percent) and data mining (77 percent). Two-thirds (67 percent) reported using predictive modeling.

4. What are the types of Big Data platforms used by hotels?

There was not a single Big Data platform that stood out to be the most used by the hotel corporations therefore it is suggested from the results of this study that each hotel assess their specific needs and acquire a suitable platform that provides the most benefits to meet the varied needs. For hotel corporations to be able to derive real business value from Big Data, it is necessary to have the right tools to capture and

organize a wide variety of data types from different sources and have the ability to easily analyze it within the context of all enterprise data.

5. What are the challenges Big Data poses to hotel Corporations?

Today, most companies collect a large amount of data but do not consistently maximize their value. The findings of this study confirm that hotel corporations also leverage about only half of their valuable data, leaving huge amount of useful data to go untapped.

The challenges that hotel corporations face with the application of Big Data are:

- Reconciling disparate data sources
- Lack of formal process around Big Data management
- Lack of IT infrastructure
- Lack of Senior Management support and requisite skills
- High cost of Big Data Management

5.2 Limitations of the Study and Future Studies

This study offers several important findings yet, there are some limitations to the study. First, the sampling method adopted was the convenience sampling approach instead of a random sampling method. The random sampling methods allows every member an equal chance of being selected in a study whereas convenience sampling method makes no pretense of identifying a representative subset of a population. Convenience sampling is a way of sampling only the people that are readily available, meaning that the sample may not necessarily represent the entire population.

Another limitation to this study was the sample size. The sample size was small due to time constraints and low participation of potential respondents, consequently it limited the study from generalizing the results to the entire Lodging industry population.

Further research needs to be conducted using a random sampling approach and including a larger sample size. Since this study is exploratory, future researchers could use this study as a foundation to explore deeper how hotel corporations benefit from Big Data what new challenges they face in the future as compared to other industries.

Another area where research could be conducted is to find out if hotel corporations perform better operationally and or financially when they have top management support in the adoption and implementation of Big Data than hotels that do not have top management support.

A third area that could be researched is to find out if having a Chief Digital Officer will improve a hotel Big Data Management processes?

And finally, future research could be conducted to find out how much it will **cost** for small and independent hotels to invest in Big Data Management. At what threshold of dollars (Cost) would be reasonable for small and independent hotels to engage in Big Data?

5.3 Implications of the study

The results of this study will be useful in assisting both Hotel Executives in the Lodging industry and the research community in the hospitality industry in the following ways:

Hotel Executives

The finding of this study provides a base line for understanding the concept of Big Data in the Lodging industry. It also identifies new insights to help hotel executives to understand what hotel corporations are doing with Big Data, the benefits and challenges of Big Data. This will improve Hotel Executives' decision making and improve operational efficiency and drive innovation in the Lodging industry.

Research Community

In reviewing the literature for this study, there was no evidence of research on the implications and challenges of Big Data in the lodging industry. Therefore, this research serves as a foundation to future research and adds to the body of knowledge.

5.4 Propositions

The following are propositions made as a result of the findings of this study.

- To ensure the success of Big Data usage and implementation in the Lodging Industry, senior management, especially the CEO, should be educated about the efficacy and usefulness of Big Data in order to avoid the financing/funding challenges that companies will face.

One of the challenges that have plagued corporations as they evolve in the path of technology adoption and innovation is the lack of senior management interest. The lack of senior management support for Big Data Management was one of the challenges highlighted in the findings of this study. Michael Toedt also stated in his book that the biggest hurdle for a successful Big Data integration seems to be the existing lack of managerial knowledge and leadership. The ability for senior management to understand the Big Data concept is very important as this will encourage them to support the initiative and provide the relevant resources for the successful implementation and usage. Mooney et al., (2008) confirm that for a strategic technology project to be successful, it must have the support of top management.

- The results of the study suggest that publicly traded hotel corporations are more likely to use Big Data than an independent (one-property) hotel corporation. Although some independent hotel companies have invested in different ways of managing their unstructured data by using online reputation management, social media monitoring and guest satisfaction surveys solutions, there is the need for the integration of their structured and unstructured data to capture the real value and insight of Big data hence the need for investing an entire Big Data Management solution. So

for the hotels in the independent category that cannot afford a strategic planning department or a team of analysts to perform the analytics required for Big Data, this function can be outsourced in the short-term just as currently some individual hotels outsource the revenue management task to independent contractors.

- According to the results of the study, hotel corporations confirmed that their Revenue Management has improved as a result of the use of Big Data analytics, and this represented one of the top benefits to the hotel corporations of using Big Data. In contrast, the McKinsey Global CEO Survey of 2013 (Brown et al., 2013) revealed that Dynamic Pricing Strategies was at the bottom of the list of applications for which companies used Big Data, thus signifying a lower-level priority for pricing.. This contrast is to be expected because of the different business priorities in the lodging industry versus other industries. The hospitality business is considered a perishable product therefore effective Revenue Management is very crucial to optimize product availability and maximize revenue growth through dynamic hotel room pricing.

Below are propositions that are not directly from the results of the study but are based on the content of the literature review and the best practices from companies that are using Big Data:

- Big Data analytics may be applied to employee management and development in order to maximize productivity and enhance the customer-employee experience in the Lodging industry.

Whereas most corporations have focused on adoption of customer-engagement technologies, in the hospitality industry where the role of the employee in service delivery is paramount, Big Data analytics could be used to determine effective ways to draw out employees more and to involve them in the affairs of the company. For example, advanced analytics can be used for segmentation analysis to break down large populations into "groups" of employees in order to hone in on their needs and how each group might behave in certain circumstances. The following variables could be used for grouping: demographics, attitudes, employee characteristics or behaviors and employee need or preference etc. Segmentation helps organizations gain perceptive insights from employee data and to understand the different needs of an increasingly diverse employee population in order to satisfy these needs. Using such analysis ensures that employees know that their input matters and that they are contributing to the hotel's success in a meaningful way (Evans, 2013). Happy employees lead to happy guest and happy guest leads to repeat business. This could be the competitive advantage hospitality companies are seeking and Big Data can deliver. Bob Kelleher (CEO, The Employee Engagement Group) states that one common trait successful businesses share is that, the firm's leaders understand that employee engagement is intricately linked to customer satisfaction.

- The hospitality industry could benefit from embracing the new corporate role of Chief Digital Officer (CDO). According to (Arthur, 2013) CDOs are digital-savvy, business-driven leaders whose focus is on transforming traditional businesses into data-driven companies.

Today, Big Data has become a priority for all businesses across industries. The opportunities that Big Data offers to businesses in this digital age are enormous and for companies to keep up with the pace and changing technology, a new corporate role, Chief Digital Officer, has been created in several large corporations to oversee the full range of digital strategies and drive change across the organizations. For many companies, especially those in the retail and leisure sectors, digital is the fastest- growing revenue stream, and a Chief Digital Officer (or, sometimes, SVP Online) is extremely important in driving growth and keeping their customers' experience at the front of mind. Gartner predicts that by 2015, 25% of organizations will have a CDO.

- Ensuring that Big Data creates big value for corporations requires a reskilling effort and a shift in corporate culture. Therefore, hospitality graduate programs in the country may consider modifying their curriculum by incorporating courses such as business analytics, data mining and

analysis, decision support systems and quantitative skills to prepare students to assume middle management roles related to business analysis.

5.5 Conclusion

Big Data and Big Data analytics play a very critical role in the lodging industry and is changing the practices of businesses from traditional data mining to the rapidly changing analytics of Big Data. Today hotel corporations are experiencing significant changes in their entire business and operational processes by using Big Data technologies to predict guest behavior which helps deliver a more exceptional guest experience and also to answer probing questions that could not have been answered before.

Davenport, (2013) highlights that the hospitality industry is at a Big Data crossroads: large volume, complex and unstructured datasets are beginning to reshape the industry, and so the development of big data initiatives is now a priority for many. In the lodging industry, hotel corporations are still discovering how they can extract value from the data they gather. As much opportunities that Big Data presents, so are the challenges. The challenges that emerged from this study are the difficulty in reconciling disparate data sources, the lack of formal process around Big Data management, lack of IT infrastructure, lack of senior management support and requisite skills and the high cost of Big Data Management.

In order for hotel corporations to tap into the power of Big Data, those responsible for Big Data management will need to define a specific area of interest to reach the goal of their Big Data effort and set priorities to facilitate a well-defined

strategy based on key business priorities. The relevant analytical tools and technology must be adopted to capture and organize a wide variety of new data types from different sources, and to be able to easily analyze it within the context of old (traditional) data. New insight comes not just from analyzing new data, but from analyzing it within the context of the old to provide new perspectives on old problems (Dijcks, 2013).

In conclusion, hotel corporations that embrace Big Data by defining their areas of application and investing resources into their Big Data initiatives are the ones that will benefit from the enormous opportunities of Big Data.

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Appendix A
EXEMPTION LETTER



RESEARCH OFFICE 210 Hullihen Hall University of
Delaware Newark, Delaware
19716-1551
Ph: 302/831-2136
Fax: 302/831-2828

DATE: July 10, 2013

TO: Clarissa Frimpong, MSc
FROM: University of Delaware IRB

STUDY TITLE: [489144-1] The Implications and Challenges of Big Data in the
Lodging Industry.

SUBMISSION TYPE: New Project

ACTION: DETERMINATION OF EXEMPT STATUS
DECISION DATE: July 10, 2013

REVIEW CATEGORY: Exemption category # 2

Thank you for your submission of New Project materials for this research study. The University of Delaware IRB has determined this project is EXEMPT FROM IRB REVIEW according to federal regulations.

We will put a copy of this correspondence on file in our office. Please remember to notify us if you make any substantial changes to the project.

If you have any questions, please contact Jody-Lynn Berg at (302) 831-1119 or jlberg@udel.edu. Please include your study title and reference number in all correspondence with this office.

Appendix B

RESEARCH INSTRUMENT

1. What is your main functional area of Expertise?

- a. Information Technology
- b. General Management
- c. Strategy and Business Development
- d. Accounting
- e. Marketing
- f. Finance
- g. Operations
- h. HR Management
- i. Marketing and Sales
- j. Research and Development
- k. Other

2. Which of the following category does your hotel corporation fit?

- a. Publicly Traded
- b. Independent (One property)
- c. Other

3. Does your hotel corporation use Big Data?

- a. Yes
- b. Plan to Use
- c. No

- 4. Big Data has been defined in so many different ways across industries, how does your corporation view Big Data?**
- a. A greater scope of information
 - b. New kinds of data and analysis
 - c. Real-time information
 - d. The Latest buzzword
 - e. Social medial data
 - f. Large volumes of data
 - g. Data from multiple sources
 - h. Other
- 5. Big Data has been defined in so many different ways across industries, even though your hotel corporation does not use Big Data, What is your view of Big Data?**
- a. A greater scope of information
 - b. New kinds of data and analysis
 - c. Real-time information
 - d. The Latest buzzword
 - e. Social medial data
 - f. Large volumes of data
 - g. Data from multiple sources
 - h. Other
- 6. How long has your Corporation been working with Big Data?**
- a. 5 years or more
 - b. 3 – 4 years
 - c. 1 – 2years
 - d. Less than 1 year
 - e. Other
- 7. Which of the following sources of Big Data other than social media does your hotel corporation collect?**
- a. Energy Management Systems (smart grid, sensors, etc.)
 - b. Web Data (Click Stream)
 - c. RFID Tags, Bar Codes
 - d. Mobile Usage (Location based information, hotel mobile apps)
 - e. Emails
 - f. Audio and Video
 - g. Other(s)

8. Which of the following sources of data does your Corporation PLAN to collect?

- a. Energy Management Systems (smart grid, sensors, etc.)
- b. Web Data (Click Stream)
- c. RFID Tags, Bar Codes
- d. Mobile Usage (Location based information, hotel mobile apps)
- e. Emails
- f. Audio and Video
- g. Other(s)

9. Which social media sites does your hotel corporation collect data from?

- a. Facebook
- b. Twitter
- c. Instagram
- d. Tripadvisor
- e. Expedia
- f. Google+
- g. Pinterest
- h. Blogs
- i. Other

10. Which software or platform, if any, does your hotel corporation use in analyzing Big Data?

- a. Hadoop
- b. MapReduce
- c. NoSQL
- d. Information Integration
- e. Analytic Accelerators
- f. Other

11. Which of the following analytical capabilities does the platform or software used provide

- a. Query and Reporting
- b. Data Visualization
- c. Predictive Modeling
- d. Optimization
- e. Other

12. Which department is primarily responsible for analyzing Big Data in your Corporation?

- a. Strategic planning and decision making
- b. Sales and Marketing
- c. Engineering and Maintenance
- d. Customer services
- e. Revenue Management
- f. Operations
- g. Strategic Planning
- h. Outsourcing to a third – party company
- i. Other

13. Which departments benefit?

Please indicate the importance of Big Data for the following parts of your organization

Departments	Not Important at all (1)	A little important (2)	Somewhat important (3)	Important (4)	Extremely important (5)
Marketing and communications	[]	[]	[]	[]	[]
Strategic decision- making	[]	[]	[]	[]	[]
Information Technology	[]	[]	[]	[]	[]
Customer service	[]	[]	[]	[]	[]
Revenue management	[]	[]	[]	[]	[]
Human resources	[]	[]	[]	[]	[]
Other	[]	[]	[]	[]	[]

14. Who is primarily responsible for your Corporation's Data Management Strategy?

- a. Chief Information Officer/ Chief Technology Officer
- b. SVP/VP/ Director of IT Strategy
- c. Chief Financial Controller
- d. IT Manager
- e. Strategic Planner/ Decision maker
- f. Senior Business Executives
- g. Business Analyst
- h. Marketing Manager
- i. Controller
- j. Other

15. What new opportunities do you see for your hotel corporation as a result of the increased utilization of Big Data?

- a. More personalized Guest Experience
- b. Increasing Operational Efficiency
- c. Enhanced Revenue Management
- d. Improving Strategic Decision- Making
- e. Other

16. Which of the following areas has experienced significant changes as a result of the implementation of Big Data in your corporation?

- a. Business and operational processes
- b. Decision making at all levels
- c. Employee skill development
- d. Corporate culture
- e. Other

17. How important is the ability to act on data in real time to your Corporation?

- a. Very important
- b. Somewhat important
- c. Not important
- d. Don't know

18. Which of the following statements most accurately describes your Corporation's use of data it collects?

- a. We put nearly all of the data that is of real value to good use
- b. We probably leverage about half of our valuable data
- c. Huge quantities of useful data go untapped
- d. Other

19. What challenges, if any does your Corporation face when attempting to process data more rapidly?

- a. We do not have the right skills in the Hotel
- b. No formal process around Data management
- c. We lack the necessary technology/software
- d. Other

20. Which Big Data characteristic is the biggest issue for your Corporation?

- a. Volume (huge amount of data)
- b. Variety (Multiple sources/ Different formats)
- c. Velocity (speed at which data is generated)

21. Please indicate how problematic each of the following is in the management of data in your organization. (Rate on a scale of 1 to 5 . Where 1= Very Problematic and 5 = Not at all problematic).

	Very Problematic (1)	(2)	(3)	(4)	Not at all Problematic (5)
Storage capacity	[]	[]	[]	[]	[]
Reconciling different data sources	[]	[]	[]	[]	[]
Data security	[]	[]	[]	[]	[]
Timeliness of data	[]	[]	[]	[]	[]
Increased cost of data management	[]	[]	[]	[]	[]
Data quality/ accuracy	[]	[]	[]	[]	[]
Lack of organizational view into Big Data	[]	[]	[]	[]	[]
Risk of data leaks and abuse	[]	[]	[]	[]	[]
Privacy and security issues	[]	[]	[]	[]	[]
Limited analytical and managerial talent	[]	[]	[]	[]	[]

22. Which of the following explains why your hotel corporation does not use Big Data?

	Strongly Disagree (1)	Disagree (2)	Somewhat Agree (3)	Agree (4)	Strongly Agree (5)
High Cost of Data Management	[]	[]	[]	[]	[]
Difficulty in recruiting Data Analytical personnel	[]	[]	[]	[]	[]
Difficulty in creating an integrated data source	[]	[]	[]	[]	[]
Maintaining Competitive advantage	[]	[]	[]	[]	[]
Confused about Big Data	[]	[]	[]	[]	[]
Other	[]	[]	[]	[]	[]