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Chapter

Big Data and Business Intelligence in Hospitality and Tourism

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SUMMARY

The developments in technology in the last 25 years have brought many changes in the tourism and hospitality sector as well as in many other fields. Big data and business intelligence, which are the leading ones among these developments, have caused some changes in the way of doing business in the tourism industry. Explaining the relationship between big data and business intelligence is important for understanding how these changes are reflected in the tourism industry. Business intelligence and big data, which enable many processes to be completed in a shorter time, also bring some ethical problems. In this book chapter, these changes, which are increasingly adopted by both customers and service providers, are discussed and their reflections in the tourism industry are explained with examples.

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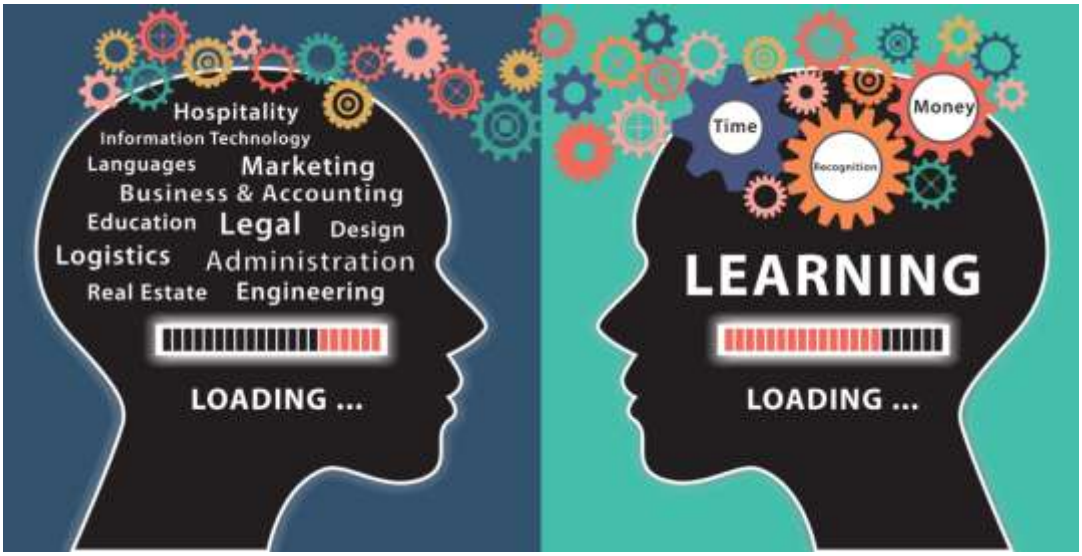

Figure 1. Big data and learning process
Source: Adobe Stock.

Learning Objectives

After completing this chapter, the student will be able to:

- Understand the different types of Big Data and be able to develop a checklist of Big Data use cases relevant to tourist destinations.
- Analyze each Big Data use case and evaluate its fit for a destination based on various factors such as ROI, legal considerations, privacy, and ethics.
- Understand why many Big Data projects fail and manage implementation challenges.
- Understand how Big Data can be used to design and improve the customer experience at a destination.
- Be able to describe the basic elements of Business Intelligence architecture such as a data warehouse, business analytics & decision support system, business process management, and information dashboards.
- Understand processes for designing data warehouses and choosing from analytical tools from vendors.
- Be able to design a rudimentary information dashboard for a business.

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Introduction

Have you heard the story about Dave Carroll and United Airlines? Mr. Carroll is a musician by vocation and early in his career, he had the misfortune to check in his guitar with his bags during a flight. The guitar became damaged during transit and when Mr. Carroll complained, United was very slow to react and fix the situation. Frustrated and dissatisfied with his customer experience, Dave proceeded to create a video aptly titled "United breaks guitars" and posted it on YouTube (still available at the time of this writing). The video went viral much to United's chagrin and it proved very embarrassing for the airline. The hospitality and tourism industry is in many ways similar to the airline industry. Delivering top-notch customer experiences is a key to success and destination managers must keep in mind the learning from the Dave Carroll fable: a single, annoyed customer can ruin a business's reputation by going public on social media.

What can destination managers do to prevent customer service fiasco like United's? Of course, if we manage a restaurant or a hotel, we can make sure that we create business processes that meet and exceed customer expectations, e.g., ensure that the sheets are clean and that the cuisine is both interesting as well as healthy. However, consider a busy hospitality destination like Las Vegas, Nevada. In 2019, Las Vegas had about 150,000 lodging rooms (Lock, 2020), and even assuming a modest occupancy rate (say 200 nights/year), there are over 30 million guests passing through the destination every year and these guests cumulatively create hundreds of millions service experiences between them. In a large-scale service operation such as this, mistakes are bound to happen, however hard we try to minimize them. With every mistake, there is the "potential" for the creation of a new Dave Carroll lurking in the background. As a best practice, destination managers now routinely monitor social media to not only identify dissatisfied customers but also to "amplify their fans". Amplification refers to the process of identifying some highly *satisfied* customers and allowing them to speak positively and advocate on behalf of a destination. Managing customers' social media activity, both positive and negative, is referred to as *peer influence analysis* (Bernoff & Schadler, 2010). While monitoring social media is not difficult today, even for a small-sized destination, keep in mind that the *volume* of social media posts about any destination is usually huge, requiring *Big Data analytics* capabilities.

Another example of the clever exploitation of Big Data is provided by Red Roof Inn. The winter of 2013/2014 was brutal, resulting in bad weather and flight cancellations at several major airports (Marr, 2016). It is noteworthy in this example that Red Roof Inn leveraged several *open-source datasets* for this exercise, obtaining publicly available information about bad weather and flight cancellations. The management team estimated that the flight cancellation rate was approximately 3% and that as many as 90,000 passengers were going to be searching for hotel accommodations every day. Anticipating that business travelers and other customers would use smart phones to look for proximate lodgings, a *targeted marketing* campaign was launched, aimed at mobile device users in the geographical areas most likely to be affected. This big data strategy led to a 10% increase in business for Red Roof Inn.

The ability to leverage Big Data is closely related to the concept of *Business Intelligence*, an umbrella term that encompasses data warehousing, business analytics, and creating visualization dashboards for key performance metrics (KPIs) at a destination. Dashboards summarize the overall performance of a destination and must include information that can answer interesting questions. Some examples of such questions are: how many guests stayed month over month at our hotel? What percentage of our customer complaints pertain to the quality of room service?

Denihan hospitality group is a nationally recognized owner of boutique hotels, including some prime properties in New York City. Denihan recently collaborated with IBM to create a platform for Business Intelligence and Analytics (IBM, 2013). This press release emphasizes the importance of customer service and pricing for a hotel. Pricing and revenue optimization enable a hotel to offer the right product to the right customer at the right time for the right price (Denihan, 2013). IBM collaborated with Denihan to parse large volumes of data obtained from travel-related websites, travel blogs, as well as internal records such as guest profiles, customer complaints, and customer satisfaction surveys to develop a comprehensive *Business Intelligence* platform for Denihan. This project has enabled Denihan to achieve 3 objectives: (a) increase revenue, (b) better manage expenses and, (c) guide Denihan's strategic direction.

To summarize, this chapter reviews the importance of analyzing Big Data, as well as the need to create a comprehensive *Business Intelligence* platform, particularly visualization dashboards for the KPIs at a destination.

Defining Big Data

What is big data? How can it be defined precisely? How can big data be transformed into meaningful information in tourism? It is quite difficult to provide a very general definition of the term "Big Data", which was first introduced in the fields of astronomy and genetics. In the article titled "*Application-Controlled Demand Paging for Out-of-Core Visualization*" (Cox and Ellsworth, 1997a), the storage problem arising from the size of very large data sets is mentioned, and this situation is referred to as the "big data problem". Laney (2001) defined the three basic dimensions (3V's) of big data – *volume, velocity*, and *variety*. Here "variety" refers to the fact that large data sets could contain both structured and unstructured information (e.g., text). Diebold (2013) also refers to the *multidimensional nature* of big data. Today, companies such as Google, Amazon, Facebook, Twitter, and Instagram use big data to analyze customers and also to offer them new products. Besides, with the increasing popularity of smart phones, real-*time* data can be obtained (Ylijoki & Porras, 2016).

Gartner (2001) defines Big Data as follows: *"Big data is data that contains greater variety, arriving in increasing volumes and with ever-higher velocity"*. In this definition, Laney's 3 V's (volume- the amount of data, velocity- the measure of how fast the data is coming in, and variety- the quality or state of being different or diverse kinds of data) is emphasized. Later this definition

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changed to: *"Big data is high-volume, high-velocity and / or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation".*

According to Tech America Foundation's Federal Big Data Commission (2012), *"Big data is a term that describes large volumes of high velocity, complex and variable data that require advanced techniques and technologies to enable the capture, storage, distribution, management, and analysis of the information.*" Later the definitional model was perfected by introducing the additional V's of *Value* and *Veracity* (e.g., data reliability) thus leading to the formulation of a **5V's framework** consisting of volume, velocity, variety, value, and veracity (Bello-Orgaz et al., 2016). These definitional differences are further illustrated in the Fishbone diagram in Figure 2, which contains components for 17 different definitions. Along with volume, velocity, and variety, big data technologies, business components, data distribution, and collaboration concepts (e.g., data privacy and security) are included in the enhanced definitions.

De Mauro, Greco & Grimaldi (2016) further evaluated these definitions and created a "word cloud"

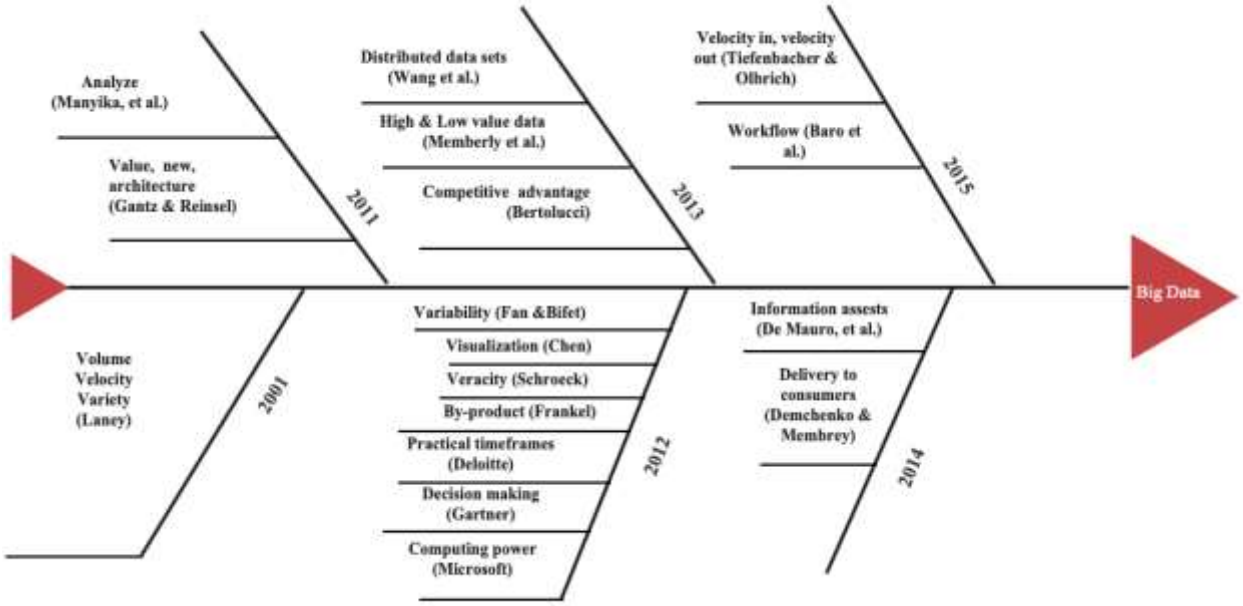

Figure 2. Evolution of the definitions of big data.
Source: Ylijoki & Porras, 2016.

(Figure 3). Four main themes explain the subject: information, technology, methods, and impact. Many other auxiliary topics depend on these "main themes", such as the internet of things, storage capabilities, distributed systems, parallel computing, programming paradigms, machine learning, visualization, emerging skills, decision making, value creation, applications, organizations, society, privacy, overload, diverse and unstructured data.

Figure 3. A formal definition of Big Data based on its "essential features".
Source: De Mauro, Greco and Grimaldi, 2016.

When analyzed from the perspective of both practitioners and academics, big data is more than the integration of technology, software, or different information sources (Gandomi and Haider, 2015). After all, developing and managing big data is an expensive proposition. In related literature it has been pointed out that 80% of businesses cannot fully use data, and 65% of them have poor data management practices. In the same study, it was found that 67% of enterprises participating in the survey do not have well-defined criteria to measure their big data investments (Espinet, 2019).

Business Intelligence (BI)

Hospitality professionals can evaluate the industry's online data to make informed choices about service offerings. Using *hospitality analytics*, hotels can improve revenue, monitor prices, and participate in customized customer conversations. Business Intelligence (BI) helps define marketing strategies, deliver packages tailored to the desires of travelers, and determine which countries to concentrate on for winning customers. So why is business intelligence such an effective element in the tourism sector and how did it develop?

In the 1960s and 70s, the first data management systems and decision support systems (DSS) were developed to store and organize increasing amounts of data. Decision support systems help business management in performance planning. A DSS typically includes computer-aided models for decision making (Sohollo, 2011). In the late 1980s, Decision support systems replaced concepts such as the data warehouse and On-Line Analytical Processing (OLAP). According to Chugh and Grandhi (2013), decision support systems have grown over time and become insufficient for handling increasing information. This has brought about the need for smart systems. At the end of the 1990s, the first applications of business intelligence began to be seen in response to this need (Williams, 2016). Typical functions embrace reporting, OLAP, analytics, data mining, business performance management, benchmarking, text mining, and prescriptive analytics (Rud, 2009; Williams, 2016).

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Luhn (1958), who first used the term business intelligence, defined it as "an automatic system being developed to disseminate information to the various sections of any industrial, scientific or government organization" (Luhn, 1958, 314). Dresner (1989) defined the concept of business intelligence as all methods and concepts within the scope of a data-based support system to improve and support the decision-making process (Chou, et al. 2005). One of the biggest obstacles to success in business intelligence programs is the lack of trust and the difficulty of performing reliable analyses (Dresner, 2014). Various definitions of business intelligence have been made by both academics and industry professionals. Some definitions describe business intelligence as a holistic and complex approach to support organizational decisions, while others define business intelligence from a more technical perspective. Table 1 includes some of these definitions.

Table 1. Definitions of BI

Definition of BI	Author(s)	Focus of definition
A system that takes data and converts it into various information products.	Eckerson (2005)	Technology
Systemic processes for collecting, analyzing, and disseminating the information to support operative and strategic decision making.	Hannula & Pirttimaki (2003)	Technology
It is a set of concepts, methods, and processes that aim not only to improve business decisions but also to support a business strategy.	Olszak & Ziemba (2003)	Organizational
It is an umbrella term for decision support.	Alter (2004)	Organizational
It is a system that combines analytical tools with data collection, data storage, and information management so that decision-makers can transform complex information into a competitive advantage.	Negash (2004)	Organizational
It is a system designed to manage large amounts of data and assist individual users in making decisions regarding organizational processes.	Watson et al. (2002)	Organizational
It is a system that allows inferring comments from structured data.	Seeley & Davenport (2006)	Technology
It is the combination of technology, method, and product used to organize the key information needed by management to increase profits and performance.	Williams & Williams (2003)	Organizational
It is both a process and a product used to develop useful information to help organizations survive in the global economy and predict general business environment behavior.	Jourdan et al. (2008)	Organizational
A term used to describe the set of concepts and methods used to improve business decision making using fact-based support systems.	Dresner (2014)	Technology

BI technologies showed the potential to manage huge volumes of structured and unstructured data to help recognize, improve, or generate new competitive opportunities for business. Accordingly, businesses are using BI to help a wide variety of company operating decisions, such as product positioning or pricing. Besides, BI provides strategic insights into global markets, assists in evaluating consumer appetite and the suitability of goods and services produced for various market segments, or the effects of marketing and advertising strategies (Chugh & Grandhi, 2013). Companies can therefore examine three crucial areas before initiating a BI project (Yeoh & Koronios, 2010):

- The level of commitment and sponsorship of the BI project from senior management;
- The level of business needs for creating a BI implementation;
- The amount and quality of business data available.

In parallel with the increasing transition from traditional databases to big data in the tourism industry, the number of research papers on the impact of business intelligence and big data in tourism is also increasing. (Buhalis & Foerste, 2015; Gretzel et al., 2015; Stylos & Zwiegelaar, 2019). According to some analysts, the challenge of using business intelligence for tourism businesses is to decide how to leverage data from various sources, gathered by different methods, and to clean up non-working data (Xiang et al., 2014). It is accepted that, to improve the quality and satisfaction of visitors, it is essential to concentrate on the needs and wants of visitors and to be customer-oriented (Correia et al., 2013; Prayag et al., 2013). In such scenarios, it is easier for companies to use business intelligence tools and to establish a structured way to take action in a short time (Stylos & Zwieglar, 2019).

Numerous studies have looked at different aspects of business intelligence applications in the tourism industry. Law et al. (2009) include a detailed overview of articles published in tourism and hospitality research journals on the evolution of IT applications, which can be divided into three groups of customers, technology, and suppliers (Law et al., 2009). Pyo et al. (2002) explain how information exploration in databases using data mining techniques can be applied while managing the destinations. The study addresses different aspects of information development, from organizational problems, methods, and techniques to applications involving consumers, markets, goods and services, destination promoters, and tourism professionals. (Pyo et al., 2002). Fuchs et al. (2013) suggest a market intelligence approach based on online analytical processing (OLAP) to demonstrate how information development, sharing, and application processes for Swedish tourism destinations can be enhanced.

Connections Between Big Data and Business Intelligence

Both Big Data (BD) and Business Intelligence (BI) are fast-growing key terms in recent academic study. Although Big Data has recently become popular, Business Intelligence has been proposed much earlier. Luhn (1958) started to use the word Business Intelligence to describe an automated mechanism that disseminates information and facilitates the decision-making process. The theory

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was initially assimilated to the field of the decision - making and information technology. For example, Vitt et al. (2002, p. 13) described business intelligence as a multi-faceted term that encompasses three different perspectives: faster decision-making, the transformation of data into information, and rational management.

The word Big Data was not used until 2011. Berry (2011) first suggested the relevance of "Big Data" to management in a scientific journal. At the same time, Manyika et al. (2011) also argued that Big Data technology and platform have become a key factor in increasing the efficiency and growth of the business. After these two-pioneering works, the publishing of "Big Data" journal articles developed rapidly.

Even though analytics and business intelligence are directly connected, extracting business intelligence from big data may not be as simple forward as it seems. The analysis of many of the issues related to big data analytics follows. It categorizes big data analytics into three categories: BI & A 1.0 (Business Intelligence and Analytics 1.0), BI & A 2.0, and BI & A 3.0. (Chen et al., 2012). In addition, it differentiates between "unstructured" data, which is primarily derived from social media, and other structured forms of big data.

The term big data began to appear in research journals at the end of the 1990s, referring to data sets that are too big to fit into the memory or even local disks (Cox & Ellsworth 1997b; Marr, 2016). The first big data publications applied in the field of scientific computing, but in 2001, Doug Laney, an analyst with the Meta Group, converted the concept to the corporate environment and came up with the term 3Vs to mean volume, velocity, and variety, which rapidly had become the representing components of big data (Laney, 2001). Following Davenport's seminal article "Competing on Analytics" in the mid-2000s, firms became extremely interested in big data and changed their approach from technical issues related to the storage of big data to their analysis. Internet-based companies such as Google, Amazon, Facebook were the first to utilize big data by applying advanced and powerful data mining and machine learning techniques. What separates today's big data analytics applications from traditional business intelligence applications is not only the breadth and complexity of the data being generated but also the questions they answer. Although BI historically focuses on using a standardized collection of metrics to assess past business success (Davenport, 2006), broad data applications concentrate on exploration, discovery, and prediction. As Dhar (2013) mentions, big data makes it possible for a computer to ask and test interesting questions that humans do not understand.

Intelligence is more than big data entities in their storage and analysis processes. It is made up of implicit and explicit inferences based on detailed associations between widely distributed information and knowledge. Therefore, while data, information, and (to a large extent) knowledge can be assumed empirical, intelligence is an intangible human trait. Making decisions in the big data world helps to put together clear empirical expertise and implicit human factors – visible and secret – such as personal experience, belief system, time and place of decision-making, socio-cultural climate, and capacity to make predictions and take risks. Intelligence is measurable knowledge and the basis for the strategic use of big data in a company. Intelligence is the informative use of big data – making use of empirical results and the capacity of individual decision-makers to reliably discern decisions based on their significant, applicable, contextual, and institutional values. Intelligence is not something that could be structured and put in databases and passed to individuals through the kind of preparation. Intelligence, in the top diagram in Figure 4, provides a systematic approach to capacity building.

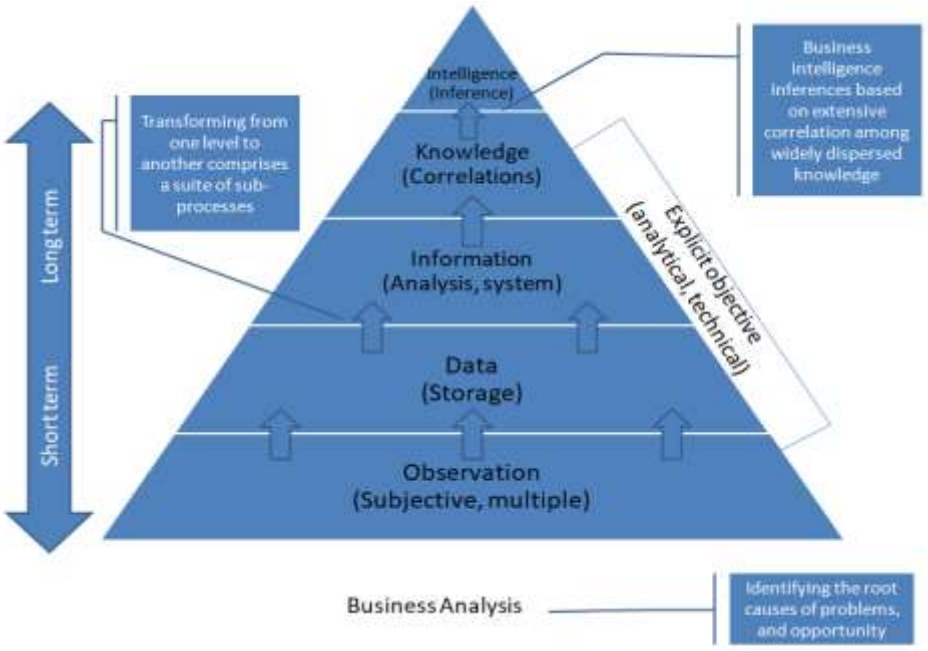

Figure 4. Foundation of big data strategies: short and long-term decision-making based on observations, data, information, knowledge, and insights.
Source: Unhelkarr, 2018.

Business intelligence, analytics, and big data analytics have become highly prevalent in both research and business environments over the past two decades. Studies of industry experts support this issue. For instance, the IBM Tech Trends 2011 report, based on a survey of over 4,000 IT professionals from 93 countries and 25 fields, listed business analysis as being one of the four main technology trends in the 2010s (Chen et al., 2012). In another research report, business intelligence is currently the biggest area of development in information technology in organizations and has been listed as the world's leading technology investment priority for IT

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executives for decades (Arnott et al., 2017). Recently, the principles and careers of data mining and data analytics have become more relevant as a result of the large data size and data warehouses generated. It is critical for firms to provide a database system and to be able to operate this database system in an appropriate architecture. Data science has become more relevant as being able to run a data warehouse in an acceptable environment would bring the business one step ahead of the competition. In this way, data mining techniques are used in huge data warehouses to create a sense of business intelligence data and to support decision-making processes.

Many business intelligence systems are used as part of data warehouse initiatives. Business intelligence processes the data, transfers it to the database system using multiple techniques, transforms this data stack into valuable information with analysis tools, and thus creates strategic, tactical, and operational insights and supports decision-making processes such as all methods, processes, architectures, and technologies. The whole process of data transformation is expressed and thus all cloud service initiatives or all big data projects are expressed as micro-levels of business intelligence initiatives.

Big Data Applications in Hospitality and Tourism

In this section, we outline a managerial framework for thinking about Big Data applications in the hospitality industry. We will refer to this framework as the **PIER** framework which consists of the following steps:

- Portfolio Identification (the **PI** in **PIER**)
- Evaluation of each use case (the **E** in **PIER**)
- Rollout (the **R** in **PIER**)

In other words, destination managers should first create a comprehensive list of how Big Data can be used to improve customer experiences (the portfolio of potential projects); evaluate the fit of each such project for their specific destination (evaluation); anticipate challenges in the implantation of the project and manage the rollout effectively. While the **PIER** process seems simple and linear, we should emphasize that real-life is much more complicated and we may iterate through these steps as circumstances change for the destination manager. For instance, a Big Data project that was previously thought to be infeasible may suddenly become attractive either because new data is available, or because your company has suddenly made more funds available. In this section, we will address **PI** and list a *candidate set* of Big Data applications for you to consider. The candidate set will be discussed under these sub-headers: Mining customer feedback, forecasting demand, geospatial analytics, pricing optimization, social media analytics, and monitoring, online advertising and video analytics, and IoT applications. The next sections in this chapter will address evaluation and rollout. First, here are some candidates for inclusion in your portfolio of Big Data applications.

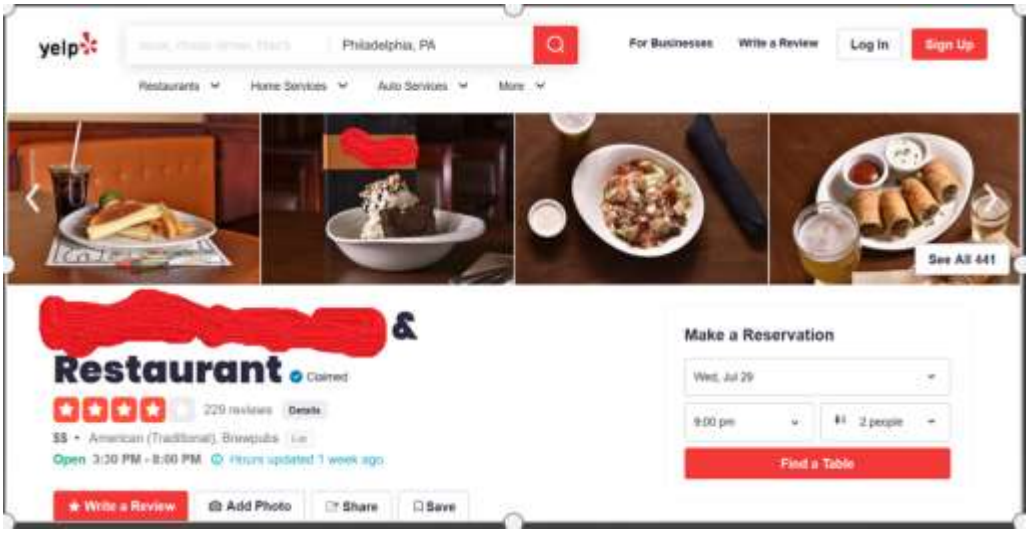

Figure 5. Big Data Voice of Customer can be gathered from sources like Yelp.
Source: Yelp.

Mining Customer Feedback

Remember the Dave Carroll story? Destination managers should pay careful attention to what customers are saying when they speak about your company. Sometimes this process of listening is called gathering VOC, the voice of the customer. Customer feedback can be gathered from several Big Data sources: reviews on Yelp, feedback from customer satisfaction surveys and even observing how customers respond to specific types of marketing promotions. Customer feedback data can be quantitative (e.g., average satisfaction rating on a 5-point Likert scale) or qualitative, such as a free-form complaint written into a survey. Free-form responses are valuable. They can be usually analyzed with a technique called text mining (Berezina et al., 2016). Text mining software can also provide a sentiment score for a body of text (e.g., a review on Yelp) and *classify* the sentiment as either positive or negative. Destination managers must carefully track customer satisfaction indices as well as sentiment scores for their destinations. Moreover, the tracking must be continual and monitor both levels of satisfaction as well as any sudden changes to the levels of satisfaction.

Forecasting Demand

The demand for a service, say a hotel room, is subject to many factors such as seasonality. Destination managers need to be able to forecast demand at their businesses so that they can plan backend operations, e.g., determine the number of staff members on duty on a particular day or even during a particular hour. When only static factors are considered, the standard approach for this problem is to use a technique called *time-series forecasting*. While traditional time-series forecasting can consider factors such as seasonality, today we have plentiful sources of Big Data to enhance forecast accuracy. Pan & Yang (2017) outline a procedure for forecasting travel demand when Big Data is available to do the forecasting. To quote them “Consumers search for

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information on the internet, make purchases on websites, bring various gadgets with them on trips, and comment about their experiences on social media. These interactions leave many types of digital traces that indicate their locations, spending habits, preferences, and satisfaction levels. These data include search engine queries, website traffic, transaction records, social media posts, and geographic locations." In addition to all of the above factors, for many businesses in the hospitality industry, something as simple as the weather can impact travel demand. The best practice today is to use Big Data sources to predict the weather as accurately as possible and then use the weather forecast as yet another input into the forecasting model. Accomplishing all of this requires significant effort and assembling a talented team of Big Data engineers.

Geospatial Analytics

Imagine that you are managing a specific hotel location for a big hotel chain; for instance, you may be managing a destination in San Francisco, California. One simple form of analysis that can be performed is to make *spatial comparisons*. For instance, a destination manager in San Francisco may want to compare her occupancy rates to other similar-sized hotels in an equivalent city, e.g., New York. If you are the CEO of a chain such as the Marriot, you may simply want to compare occupancy rates and profitability of your business by state. Is Nevada more profitable than Illinois? With the rising popularity of Geographical Information Systems (GIS), it is becoming increasingly easy to perform these kinds of analyses, and also to display the results of such analysis using a spatial map. During 2020, the United States and the entire world reeled from the effects of COVID-19. In the United States, the center for disease control started displaying geo-spatial maps of important statistics, such as the number of cases as well as the number of deaths, by state (Figure 6). If you go to the CDC website (CDC, 2020) and hover your cursor over any particular state, the map provides additional information in an interactive manner. As a destination manager, it may be possible to create such colorful spatial visualizations for your own business and track the changes over a period of time. For instance, the COVID-19 visualization can be adapted to also show occupancy rates for your hotel chain by state.

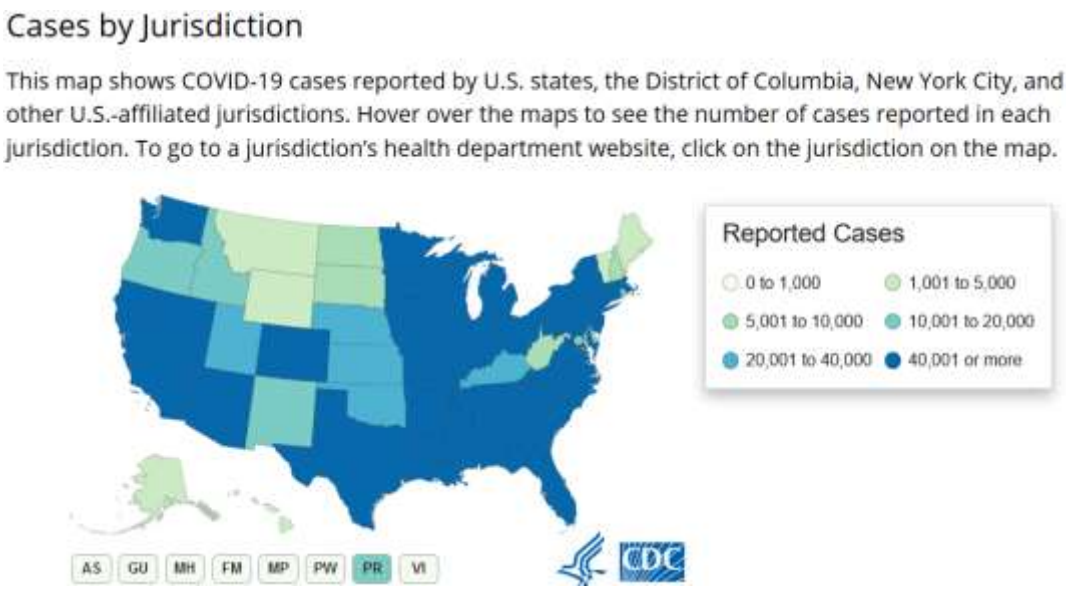

Figure 6. Geospatial representation of the number of COVID-19 cases in the US, by state.
Source: CDC, 2020.

Geospatial analytics can also be performed in other contexts. Supak et al. (2019) describe the use of GIS to improve the customer experience at parks and other protected lands. They collate a data set with over 12 million records that contain visitor data for multiple parks and protected lands. This visitor data enables them to ask and answer interesting questions: for instance, how far away do visitors to a particular park come from? What is the spatial distribution of visitor origins? What is the average length of stay at a park? Which of the park's services experiences the highest demand in a particular month? In a similar vein, Chhetri, P. (2015) describes the use of GIS technologies to improve the hiking experiences at a park in Australia.

Pricing and Revenue Management

Intercontinental Hotels Group (IHG) owns, manages, or franchises 4500 hotels in about 100 countries (Koushik et al., 2012). IHG owns many well-known hospitality brands, including the Crowne Plaza and Holiday Inn chains. Koushik et al. (2012) describe PERFORM, a pricing optimization project for IHG that optimizes room pricing across the entire chain. The PERFORM project determines price levels based upon occupancy rates, price elasticity, and the rates currently being charged by competitors. Netessine & Shumsky (2002) and Van Ryzin & Talluri (2005) provide tutorials on this subject. We reproduce Figure 1 from Netessine and Shumsky (2002) as Figure 7 below.

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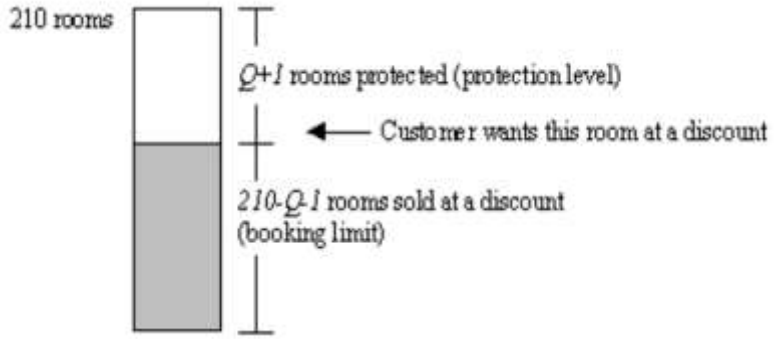

Figure 7. Illustration of Protection Levels and Booking Limits in a Hotel with 210 rooms.
Source: Netessine & Shumsky, 2002.

In Figure 7, a hotel with 210 rooms may "protect" higher price rooms for business travelers by setting a protection level of say 30 rooms. Let us say a hotel can charge $150 a night for leisure travelers and $250 a night for last-minute reservations (usually made by business travelers). The hotel will sell up to 180 rooms (if the protection level is 30 out of 210 rooms) at $150/night but the 181st reservation asking for the $150 price will be denied. The hotel (or rather the pricing optimization system) is "holding out" for last-minute business travelers who may be willing to pay the $250 rate by protecting 30 rooms for them. The protection levels are carefully determined by sophisticated algorithms and a detailed description of these algorithms is beyond the scope of this chapter. However, it behooves destination managers to carefully determine if pricing optimization is appropriate for their particular destination.

Online Advertising & Video Analytics

Many tourists visit a destination from other countries. As such, if they are to "get a feel" for what a destination experience would be like, developing promotional videos and placing these videos strategically in outlets such as YouTube is critical. How can managers measure a viewer's degree of interaction with a video advertisement? Mathôt (2018) provides a review of the science of pupillometry which can be used to measure a viewer's pupil dilations at various portions of a video and thereby infer degree of interest in the content. If budgets permit, a potential video ad must be *tested* with approaches such as pupillometry *before* being deployed over the internet. However, if information about a competitor's videos is to be gathered as well, the problem could grow to a scale that is beyond the scope of manual review, as many millions of videos about a particular destination could be produced in a short period of time. Review and inference about videos at this scale must be delegated to machine learning approaches such as deep learning (Kang et al., 2019). Mookerjee et al. (2016) outline yet another algorithmic approach to optimize performance-based web advertising. Fritz et al. (2005) cite an application of virtual reality technologies to tourism. Ivanov et al. (2019) also provide a review of advanced robotics technologies in the hospitality industry. Moghavvemi et al. (2017) provide a case study of how hospital's websites can be used to promote medical tourism in destinations such as Malaysia. Managing online advertising and related platforms requires considerable insight into hospitality technology on the part of the destination manager.

Social Media Analytics and Social Media Monitoring

As we go through the checklist for Big Data applications, we see that the items in the checklist are not always mutually exclusive. A sophisticated destination manager must constantly mine for customer sentiment in a variety of channels. This process of customer sentiment mining should include social media monitoring, the topic of this subsection. Mousavi et al. (2020) describe an application of mining Twitter data for customer sentiment, in which they state "In recent years, managing customer sentiment-particularly on social media has become crucial as more customers use social media to seek help from firms. Therefore, we strive to determine an optimal strategy to manage customer sentiment on social media sites such as Twitter. We also aim to identify factors and external events that can influence the effectiveness of customer care." Twitter is but one social media platform, but there are many others such as Facebook, Snapchat, and Pinterest. Mining just one of these platforms might be short-sighted, but mining all of them may be prohibitively expensive and infeasible. How should a destination manager perform social media monitoring? Lee (2018) describes a 4-stage methodology for choosing platforms to monitor systematically.

Stage 1: Develop *social media metrics* to monitor, e.g., number of brand mentions/week.

Stage 2: Select platforms to monitor based upon the data they generate and relevance to your destination.

Stage 3: Analyze the data using various tools, e.g., statistical methods.

Stage 4: Develop social media intelligence and an action plan in response to the monitoring.

In another interesting application of social media analytics, Wu et al. (2018) use Flickr data to build a spatially embedded tourism hotspot network for Beijing. They applied complex network analysis to study the network characteristics. As a result, this study was able to suggest interesting new bus routes to be used by tourists. Similarly, Park et al. (2020) study the cell phone trace behaviors of international visitors to South Korea, inferring tourist hotspots in the process.

Exploiting Data from Sensor Devices

Minn et al. (2016) review Big Data sensor applications in urban environments. They summarize the latest developments of big sensor data systems (a term to conceptualize the application of the big data model towards networked sensor systems) in various representative studies for urban environments, including for air pollution monitoring, assistive living, disaster management systems, and intelligent transportation. They also discuss some recent techniques for big data acquisition, cleaning, aggregation, modeling, and interpretation in large scale sensor-based systems.

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Figure 8. Big data applications in tourism and hospitality
Source: Adobe Stock.

Girau et al. (2018) describe an IoT application to detect over-crowdedness at beaches. The Be-Right-Beach (BRB) sensor network consists of control units equipped with a UV sensor, a thermometer, a humidity sensor, and a camera for crowdedness estimation. Data are collected by a cloud platform that provides any user with information about beaches and suggestions as to where to go, based on users' preferences like weather, crowdedness, time of travel, and so on. Girau et al. (2018) is also an application of Big Data for sustainability as beach over-crowdedness is often cited as a cause for coastal erosion.

To summarize, this section of the chapter discussed the **PI** (Portfolio Identification) part of the **PIER** framework for managing Big Data applications at a destination. We discussed a candidate set of Big Data applications under these sub-headers: Mining customer feedback, forecasting demand, geospatial analytics, pricing optimization, social media analytics, and monitoring, online advertising and video analytics and IoT applications. Finally, we must warn the reader that this checklist is merely a starting point and must be viewed fluidly. We encourage you to add new Big Data applications to this checklist over time as technology evolves and also remove those applications that become obsolete. It is important however for you to master the *process*: we will constantly develop a checklist and evaluate each item in the checklist for fit for the destination at hand. This will be the topic discussed in the next section.

Rollout (R in PIER)

Big Data projects are large and complex, and they often fail. In this section, we consider the implementation and *rollout* of Big Data projects. When managing a large and complex project, it is helpful to have a framework for managing the implementation. For instance, there is a framework called CRISP-DM which helps manage data science projects (Provost and Fawcett (2013)). In a similar vein, we could envision creating a framework for managing a Big Data project. One such framework is provided by Dutta & Bose (2015) who developed their management philosophy by studying an implementation at a company called The Ramco Cements.

Dutta & Bose (2015) provide a framework for rolling out Big Data projects that consists of the following steps:

- Perform the strategic groundwork: This phase in turn consists of 4 sub-phases; identifying the business problem, researching the problem, cross-functional team formation, and developing a project roadmap.
- Data analytics phase: This phase again consists of 4 sub-phases; data collection and examination, data analysis and modeling, data visualization, and insight generation.
- Implementation phase: This phase consists of 2 sub-phases; integrating with IT systems and finally training people.

Yet another rollout framework is provided by the company Datameer (2019) which provides some guidelines for optimizing data lakes (data lakes are large data repositories, essentially storehouses for Big Data). To ensure success with Big Data projects, Datameer recommends three vital practices for data management:

- Curate and govern datasets to democratize data (i.e., ensure everyone who needs data can access it).
- Ensure proper security and governance without strangling analytics efforts.
- Consume and use the data to deliver analytics and artificial intelligence.

While the above project management rubrics provide useful guidance, it must be kept in mind that they are only guidelines. Real-life is messy and often project implementations go off the rails and managers must use standardized processes to check their progress towards the final goals of the Big Data project. Alharthi et al. (2017) list several barriers to Big Data implementation.

- Barrier 1: Infrastructure readiness: Big Data projects require considerable savvy with respect to rollout and infrastructure. Even big companies struggle with the level of readiness of their infrastructure.
- Barrier 2: Complexity: Rate of data growth, multiple formats of data as well as multiple sources of data contribute to the complexity of Big Data projects.
- Barrier 3: Lack of trained personnel: It is hard to find good people to implement Big Data projects because these skill-sets are in high demand and people trained in Big Data command very high salaries.
- Barrier 4: Concerns over privacy often hinder the rollout of Big Data projects.
- Barrier 5: Organizational culture: Senior management may not understand the value of analytics and Big Data and may not support these kinds of projects with the appropriate level of funding.

While there are many challenges in the implementation of Big Data projects, we must remember that these challenges also represent opportunities. A skilled project manager who can successfully overcome organizational barriers and implement a Big Data project may also experience rewards in terms of accelerated career growth.

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How to Select Big Data Applications for Your Business?

One of the most critical questions regarding big data is about how to choose applications. Although it makes many different evaluations, there are some basic criteria. First of all, it is recommended to understand the goals, to start with small initiatives, to provide a holistic approach, to involve the whole team in the work. After that, an evaluation should be made according to some criteria as; integration with legacy technology, performance, scalability, usability, visualization, flexibility, security, support, ecosystem, self-service capabilities, the total cost of ownership, estimated time to value, and artificial intelligence and machine learning (Harwey, 2018). The following questions may help to make the right choice for the data (Millman, 2014);

- Does the organization currently have a big data platform?
- What are the data platform drivers? Storage or advanced analytics?
- Is low latency, real-time application access needed?
- What are the availability and consistency requirements for the platform?
- How will your data be accessed by users and applications?
- What is the shape of the data?
- What is the workload profile required of the solution?

While answering the above questions, big data applications are much more complicated than in the past. This complexity stems from platform capabilities, operational requirements, governance needs, and targeted user personas (Sacolic, 2020).

A disciplined business process can be used in the selection of big data applications. In short, this process gives an idea for technology selection. As shown in Figure 9; strategy, time, analytics, data, and technology are included in this system, and layer and technology selection are made. The strategy consists of storage, processing, and analytics stages as a tactical plan. All transactions are carried out in a certain period. In the analysis process, the required analysis type, the expected data volume, and the required machine learning methods are used. In the data section, the selection, obtaining, and protection of the most suitable data are mentioned. Technology is the final stage of this process. Similarly, it plays a vital role among all layers in the selection of this technology.

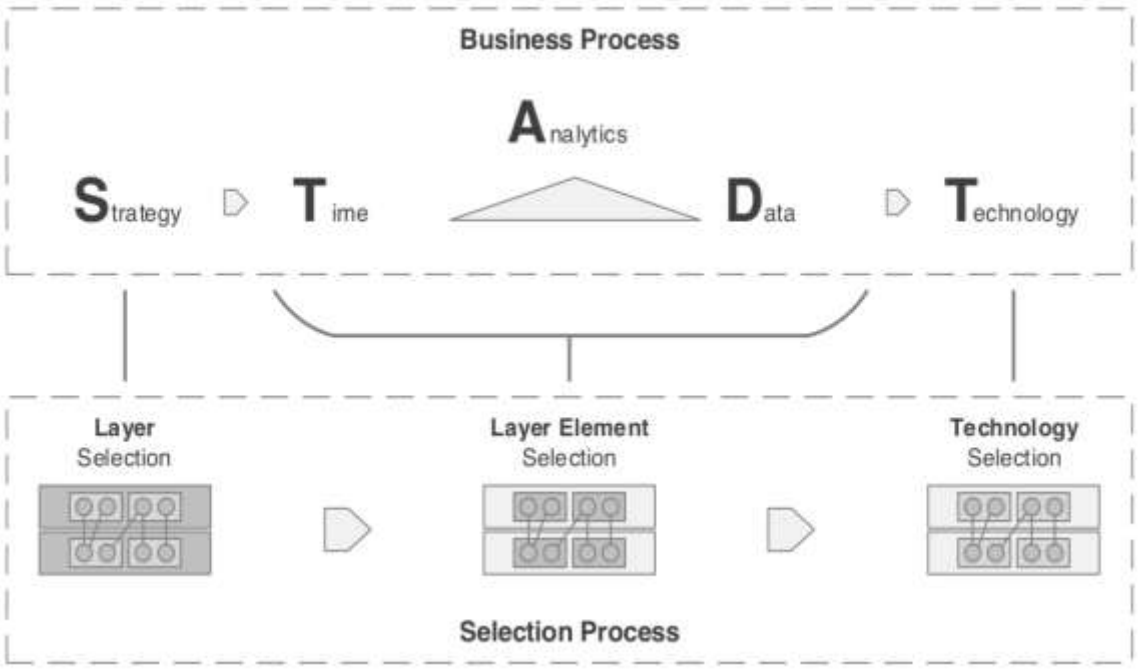

Figure 9. Big Data Selection Process.
Source: Lehmann, Fekete & Vossen, 2016.

Ev

Firms that utilize big data generally focus on application rather than measurement. In this case, some problems come to the fore regarding implementation. It is seen that most of the projects that are not compatible with the needs of the enterprises, which are made only to provide a competitive advantage and whose measurement criteria are not clear, have failed. A framework for measuring ROI for big data is given in Figure 10. According to the figure, it is expected that the costs (hardware, software, support, skills, facilities, etc.) incurred for the enterprise will be returned at the end of the process (business execution, operational improvements, increase business, decrease costs, etc.).

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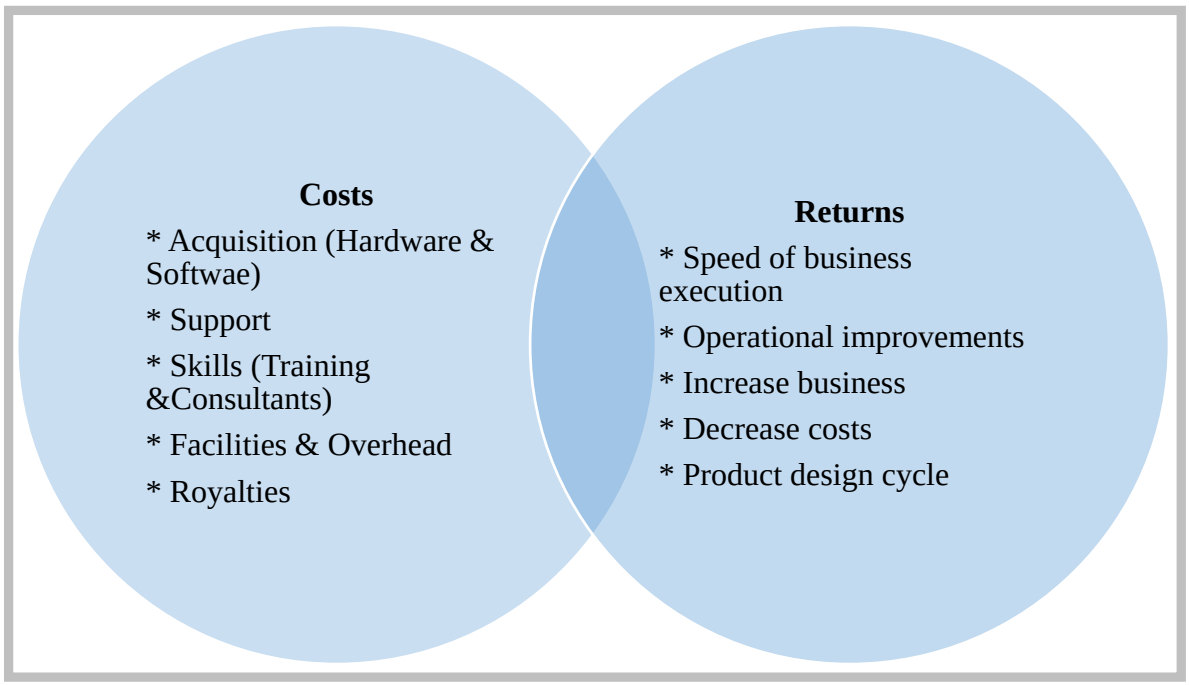


Figure 10. Big Data Return on Investment
Source: Jablonski, 2014.

To make an accurate plan on this subject, decision-makers should pay attention to four issues. These are skill, measurement, technology, and use profile. Since big data is an application area related to new technologies and methods, a staff that can achieve this is needed (skill). On the other hand, all projects should have basic metrics in line with the needs of the business. Especially key performance indicators (KPIs) should be determined (measurement). With the technology existing in big data projects, the integration of new technology should be provided. And innovations in this field should be followed constantly (technology). For all works to be successful and to ensure the return of investment, a system that will meet all needs, such as system administrators, system architects, program managers, and business analysts should be planned (use profile) (Shim et. al., 2015).

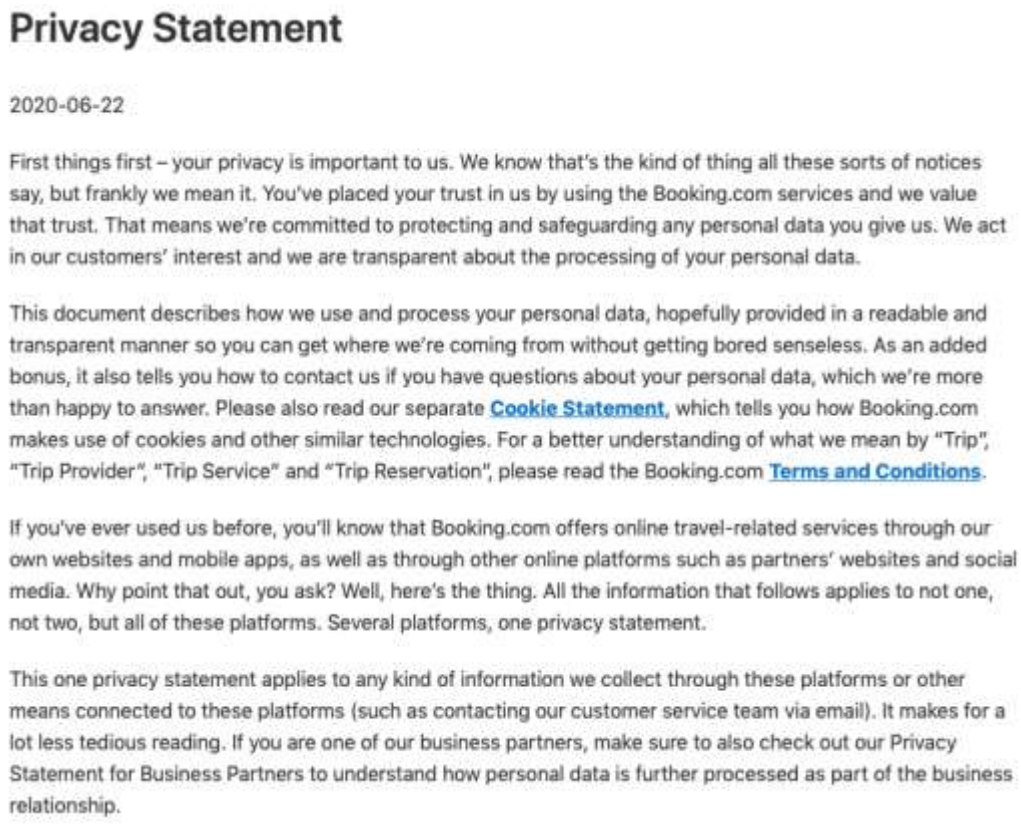
Privacy & Ethics Concerns

"Big data can be seen as a troubling manifestation of Big Brother by potentially enabling invasions of privacy, invasive marketing, decreased civil freedoms, and increase state and corporate control" (Boyd & Crawford, 2012).

One of the most critical issues in terms of big data is privacy. Having control over how personal information is collected and how this data is used is called "privacy". The misgivings about the distribution of information about individuals or groups by the persons or businesses they give information to require both corporate, customer privacy and legal work to be done on this issue (Jain, et. al., 2015).

According to Craig & Ludloff (2011); privacy can be categorized into three basic types. These are; *physical* (freedom of intrusion into a physical person, possessions, or space), *informational* (expectation of privacy when personal information is collected, stored, and shared in digital), and organizational privacy (government agencies, organizations, and businesses expect to be able to keep activities or secrets from being revealed to others).

What does privacy mean? How is privacy issues raised? When is it discussed? What essential features of big data do these concerns relate to? At what stage is the issue of privacy discussed more? Collection, storage, analysis, processing, reuse, or sharing? What is the real reason for the work to be done on this subject? The answers to these questions provide ideas about future studies. The enormous amount of stored data contains the most confidential information of individuals and requires strong management to determine which data is used by whom and for what purposes. As an example; all players in the tourism industry, especially accommodation businesses, transportation businesses, food and beverage businesses, travel businesses, should make an effort on the issue of privacy with the above questions in mind. Businesses make clear statements about their privacy standards, for example, on their websites to explain their sensitivities and talk about data policies (Figure 11).



Privacy Statement

2020-06-22

First things first – your privacy is important to us. We know that's the kind of thing all these sorts of notices say, but frankly we mean it. You've placed your trust in us by using the Booking.com services and we value that trust. That means we're committed to protecting and safeguarding any personal data you give us. We act in our customers' interest and we are transparent about the processing of your personal data.

This document describes how we use and process your personal data, hopefully provided in a readable and transparent manner so you can get where we're coming from without getting bored senseless. As an added bonus, it also tells you how to contact us if you have questions about your personal data, which we're more than happy to answer. Please also read our separate **Cookie Statement**, which tells you how Booking.com makes use of cookies and other similar technologies. For a better understanding of what we mean by "Trip", "Trip Provider", "Trip Service" and "Trip Reservation", please read the Booking.com **Terms and Conditions**.

If you've ever used us before, you'll know that Booking.com offers online travel-related services through our own websites and mobile apps, as well as through other online platforms such as partners' websites and social media. Why point that out, you ask? Well, here's the thing. All the information that follows applies to not one, not two, but all of these platforms. Several platforms, one privacy statement.

This one privacy statement applies to any kind of information we collect through these platforms or other means connected to these platforms (such as contacting our customer service team via email). It makes for a lot less tedious reading. If you are one of our business partners, make sure to also check out our Privacy Statement for Business Partners to understand how personal data is further processed as part of the business relationship.

Figure 11. Booking.com Privacy Policy.
Source: Booking, 2020.

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Discussions continue about the purposes for which a large number of data obtained from computers, increasing numbers of new technologies and social media are used. Using the personal data of many companies operating in the market, entering the privacy of others causes important ethical problems. On the other hand, according to Berry (2011), people increasingly voluntarily share data regarding their activities, locations, what they feel or what they talk about. How should ethical issues be addressed for these data?

Figure 12. Ethical issues of big data in daily life
Source: Adobe Stock.

As in all areas of life, in big data, there is no general acceptance of what is right, what is wrong, or what is bad. With the value systems of individuals and companies, an understanding of the issue can be developed by asking the right questions. This process is linked to the concepts of identity, privacy, ownership, and reputation (Davis & Patterson, 2012).

Ethical issues can be evaluated from different approaches in big data. Apart from the Privacy (described at the beginning of this chapter), Awareness, Control, Trust, Ownership, Surveillance and Security, Digital Identity, Tailored Reality, De-Anonymization, and Digital divide constitute the topics of ethical issues.

It is important to recognize the importance of awareness by both the company *and* individuals. It is primarily a human rights requirement to know for what purpose the detailed and personal data shared while subscribing to any system are used. On the other hand, when users want their shared information to be deleted, they have taken the risk of selling this data to companies. In other words, control at the individual level is limited. Another problematic issue explored in today's big data

context is trust. It is necessary to develop hardware and software architectures that will help establish trust bonds not only between people but also between people and things (e.g., Internet of Things-IoT). Another issue under discussion is who owns the data? Users? Is it the company collecting the data? Is it the company doing the analysis? Data ownership poses an ethical problem in this respect. With the control or restriction of access to websites; bottom-up, top-down, horizontal, or self-surveillance is considered "security". Some discrimination may occur through digital identity, which can create and manage the online identity and reputation of a person, can also cause ethical problems. Issues such as excessive personalization, other arising issues with the re-analysis of data, difficulties arising with the use of new technologies, disappointments, social withdrawal are brought to the agenda by presenting personalized information with shared data (Swan, 2015; EESC, 2017).

Critical Incidents (Black Swan events)

Contrary to the fact that all swans in Australia are known to be white, in 1697, a black swan was discovered. Although millions of swans that people have encountered throughout history are white, the discovery of black swans has changed the reality that is thought to be. In an academic sense, the concept is developed by Finance Professor Dr. Nassim Nicholas Taleb. The 'Black Swan' is a theory that deals with events that are seen as unlikely to happen, but whose impact is enormous when it happens, and requires new explanations once it happens, which ultimately turns out to be simple. The most important distinction in Black Swan Events is that the event can lead to positive or negative consequences. Such events are often ignored, considering that the incident may not occur or is not so likely to happen.

The extraordinary effects caused by unpredicted and unforeseen events make businesses increasingly vulnerable to the current metaphor, which is described as a black swan (Poonawala, 2016). It is stated that Black Swan Events are almost impossible to predict, but they have far-reaching consequences, so they should always be taken into consideration. The achievements of Google, Apple, and Microsoft are associated with this concept. The Asian Financial Crisis, The Dot-Com Crash, Crash of 9/1, 2008: Global Financial Meltdown, BREXIT, first space tourist, and Coronavirus are other examples of crucial Black Swan Events in the world.

Black Swan Events are evaluated in big data in many different ways. Often within seconds, outlier events that occur with other data sources affect business strategies. While an appropriate approach provides essential opportunities for businesses, not making use of or misinterpreting the data causes serious problems.

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Figure 13. Big data and hospitality industry
Source: Adobe Stock.

In the tourism industry, it is possible to come across case studies that can be predicted about big data. For example, a cyber-attack was made in 2017 to obtain data from 500 million customers of the Marriott chain, and credit card information was accessed. Thanks to data security, payment information could not be accessed, but this situation caused a decrease in company revenues (Dallemand, 2019). Similarly, the MGM Resort Hotel chain was hacked, and various information of approximately 11 million customers who had previously stayed was reached. The company stated that a database containing the only name, address, and passport numbers, and there was no financial data (BBC, 2020). Another example to be given in this regard is accessing customer data via Wi-Fi. In a hotel pool, a hacker can access customers' smart phones over Wi-Fi and be able to see everything they do (including shopping). Hackers do this by copying the same Wi-Fi name and broadcasting the existing SSID (Orsi, 2018).

Conclusion

This chapter addressed the topics of big data and Business Intelligence (BI) in hospitality and tourism. Some key highlights of the chapter include:

- Identifying the 5 V's of big data: volume, velocity, variety, value, and veracity.
- Stressing the importance of BI platforms and dashboards to get an updated, dynamic view of the business and form marketing strategies.
- A project management framework PIER for managing big data projects. PIER stands for Portfolio Identification (PI), Evaluation (E,) and Rollout (R).
- The importance of measuring ROI for big data projects. Throwing advanced technology into a tourism business is insufficient and indeed many big data projects fail due to the lack of technical skills and also because the project was not carefully screened for ROI.
- Big data raises many privacy concerns. In particular, there is the potential for "black swan" events such as a large-scale loss of customer information due to breaches.
- Big data also raises concerns about fairness. In particular, advanced analytics and machine learning algorithms cannot discriminate between customers or treat anyone customer segment differently.

Despite the risks in execution, big data and BI tools offer tremendous opportunities for the tourism industry as a whole. Destination managers that master these capabilities will gain a competitive advantage and be able to build a significant lead in their territories.

Expert Box

Menka Uttamchandani is a proven analytics and strategy leader, with a track record of using data & insights to maximize sales and profits, achieve key business objectives, and drive customer satisfaction. She has accumulated over twenty years of senior leadership experience with hospitality companies such as the Denihan group and Hyatt.

When you devise Business Intelligence strategies for a hospitality company, you have to ask yourself the question: **Where do I start?** Frame the Insights and Analytics thought process with considerations like:

- First, understand the business: how does the organization make its revenue and profit? What are the pain points to get there?
- What data does the company have, from internal CRM data to external data that can be bought?
- Ask the 'So what' question. If I knew this information, would it change what we do, how we react, how we plan to be proactive? Distinguish 'need to know' versus 'nice to know'.
- Use the 'So what' results to identify KPIs, and prioritize related data to assess, remedy, and structure for use.
- Repeat the above process as the use of data and analytics expands in the organization, from sporadic or intra-departmental efforts to inter-disciplinary efforts with multiple divisions using data and connecting the dots.
- As the frequency of wins from the use of insights become a continuous stream, it fosters an "analytics culture", a 'habit' where a majority of decisions are made based on information combined with business judgment

Tools for effective enterprise reporting get better and more inexpensive each year.

Visualization is a quick way to absorb data, spot trends, and make predictions. But nothing is worse than chic dashboards that prove to have unreliable data. Data is one of the least cool, highly tedious but most critical elements in the successful application of BI and Analytics. Hospitality companies have a bonanza of data just from the reservation and check-in information provided by the customer. Competitors' data can sometimes be purchased, which when combined with internal transactional and profile data in a timely manner, can be very powerful.

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Some areas to apply analytics:

Revenue Management (RM): Use internal transactional data along with competitive performance metrics. When possible, add in 3rd party data such as airline load factors, special events calendars and design actionable reports with trends that layout opportunities and risks. RM is one of the most effective uses of data and BI: monitor on-books data sliced by key dimensions: what segments tend to book through what channels, day of the week, lead time, length of stay (LOS) patterns. Similarly, examine real-time pick up compared to a previous custom period. All these elements contribute to the process of predicting demand and making pricing decisions. Once RM for rooms is stable, consider revenue from F&B, and other ancillary sources to implement total revenue management. Recognize that the profitability ratios of each division can be vastly different.

Customer Satisfaction and Marketing Analytics: Use booking, guest history, and survey data to enhance customer satisfaction. Understand the profile of your (happy & profitable) customers, why they choose to stay with you, and their wants and desires. Figure out how and where to find new customers like them. Demographic and psychographic data strengthen messaging to be more relevant and personal. Use this to shape strategy on future offerings and renovations, to tactics for designing 'experiential' packages. Combining transactional data with customer metrics facilitates understanding the satisfaction drivers of your most impactful guests. Source this customer feedback from online reviews, surveys, and focus groups. Well-designed surveys with a good response rate are a low-expense way to gain direct insight into what matters to our customers, what we should focus on, what we should spend money on, rather than making those assumptions on behalf of guests. Surveys or 'floater' questions in e-communications allow for asking and tracking the **Net Promoter Score** (a single question on whether the customer will recommend your firm) over time. A company with a consistently high NPS is more likely to be financially successful.

Competitive Performance: The other side of the performance coin. How do your channel and segmentation compare to that of your competitive set (Demand 360)? Which channel is your strongest and where are the best opportunities? If you are lagging in budgets and forecasts but consistently outperforming your competitors, that is different from meeting budgets and forecasts, but consistently lagging your competitors. Where are you placed on Gross Operating Profit per Available Room (GOPAR) in Competitive Ratios?

Sales Optimization: Help the Sales team understand their clients and provide concise information that shows if their clients are producing the right business at the time it is needed. Highlight top performers, those declining, and the ability to distinguish between high revenue and high-profit clients. Dashboards can consistently gauge performance metrics to identify clients that require a retention strategy, versus a development strategy versus a reacquisition strategy. Analytics can also help answer what pieces of group business are worth taking at what rate and when?

Digital Analytics: A whole world in itself. In brief, this is one of the most effective and measurable methods of marketing today. The essential foundation of Search Engine Optimization (SEO) for an optimized website makes it more discoverable for organic search results. Different goals lend

themselves to the different mix of digital channels. Increasing brand awareness may be better suited to social media marketing than a Pay per Click (PPC) campaign. Conversion for a direct business promotion may be more effective with PPC, a part of paid search (SEM). While Click-Through Rates (CTR) and conversion rates are measurable, much more so than non-digital marketing, attribution to specific campaigns is still a challenge. Tagging and tracing of events such as Press Releases, e-Mailers, and Posts is a key to track site visits and transactions to better measure channel and campaign effectiveness. Whatever the application, look beyond just the metrics to maximize the marketing dollar. For e.g., if conversion metrics show that the Length-of-Stay (LOS) of Sweden is twice that of Japan, anything more than half the conversion rate of potential customers in Sweden still makes for a more positive ROI. Factor in the Average Daily Rate (ADR) expected from each for a more informed decision.

Mobile analytics, one of the fast-growing channels of digital analytics, enables you to message the guest when on/in the vicinity of the property, using relevant messages that are of value to them. The Geo targeting permits the 'here and now' for at the moment messaging. Device centric targeting, while controversial, may impact pricing and marketing.

Human Capital or People Operations: from understanding your employee base, their skillets and future role possibilities, and retaining the best talent, to optimizing the labor costs.

Financial Services: analyzing below the top-line revenues, what are the fixed and variable expenses? How do they change based on the segment and channels booked? What are the true costs of each distribution channel? What expenses are aligned with which revenue departments, and how does the expense to revenue ratio compare?

Once the basic effort to build an enterprise analytics portal and the culture to use it is achieved, consider Artificial Intelligence (AI). While AI adds more cost and complexity, it may add enough value for some organizations. Huge strides have been made in adapting AI enabling technologies like Machine Learning (e.g. self-learning on data to recommend pricing, auto turn off ACs in vacant rooms) and Natural Language Processing (e.g. powering chat bots, Google Translate).

Implementation of BI Tools to use Big Data: Success often comes down to will it be *used*? Will it make a difference in both strategic and tactical decisions? Will those on the front line use it in day to day decisions?

Keeping in mind the initial steps outlined, design Big Picture dashboards with drill down to detailed reporting that illustrate identified and agreed upon KPIs and the changes that impact them. Build for 'self-serve' ability, using powerful filters and drill troughs that allow a user to see distinct specifics based on the business issue in the mind of the user.

Involve likely power users in the thought process to test proofs of concept. Test, test, and test thoroughly before launching any tool in the organization. A small credibility issue can derail an entire project.

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Ensure training is provided during and post-launch. Track and share usage. Embed 'cheat sheet' notes on how to use each dashboard.

In summary, harness the power of data to frame decisions. Ensure the analytics are aligned with what the business needs. Use those insights blended with business rationale, for Descriptive, Predictive, and Prescriptive Analytics that will reshape an organization's strategy. Expertise in analyzing the data will give rise to opportunities but culture will play a key role in success.

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