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Big Data as a game changer: How does it shape business intelligence within a tourism and hospitality industry context?

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Abstract

With the advent of web analytics, data mining and predictive modeling, businesses have nowadays a better knowledge in creating more efficient and effective processes for meeting customers' needs, driven by a wealth of available information. The value of big data in influencing business intelligence in the tourism and hospitality industry has also been widely acknowledged, as the synergetic utilization of big data can enhance organizations' decision support systems to reach process optimization. Notwithstanding empirical research on exploring the implications of utilizing big data in the tourism sector has been published in the last few years, there is still need of a framework that would serve as the bedrock of taking the relevant conceptualization one step forward. Therefore, this chapter demonstrates the crucial role of big data in matching organizational objectives with tourist needs through delineating and detailing the analytical frameworks to support an advanced B2C interface, based on various internal databases and external data sources. The role of stakeholders and necessary resources are explained, and the full potential of big data in tourism and hospitality is revealed.

Keywords: Big data; analytical framework; business intelligence; marketing; stakeholders; tourism; hospitality

Introduction

Data and databases are important resources for business units and organizations, including those of the tourism and hospitality sector (Fuchs et al., 2014; Marine-Roig and Clavé, 2015). They are the building blocks for data-driven management, which is of utmost importance currently for informed decision making. This data may refer to tourism organizations' inputs and outputs, as well as key performance indicators (Buhalis and Foerste, 2015; Gretzel, Werthner, Koo and Lamsfus, 2015). Additionally, consumer data regarding personal needs and preferences are collected regularly, as they are stored by users on digital platform profiles, which can greatly contribute in shaping tourism and hospitality product offerings that match individual characteristics. The combined use of data originating from various sources that would cover different aspects of individuals' lives is a reality now, through digital networks offering big opportunities for improved business competitiveness; this is the Big Data evolution.

The value of big data in shaping business intelligence in the tourism industry has been expanding lately with numerous researchers postulating that public and private tourism-related organizations have started moving from conventional database management to Big data (Buhalis and Foerste, 2015; Gretzel, Werthner, Koo and Lamsfus, 2015). The challenge for tourism organizations is to determine how to optimize the use of data available from various sources, stored in different forms and sometimes being inadvertently collected, to improve their decision-making processes (Gretzel, Sigala, Xiang and Koo, 2015; Xiang et al., 2015). To respond effectively to this challenge and leverage any obtainable opportunities, it is important to unravel big data implementation and develop a systematic way for utilizing it. Big data should be developed to support tourism

destinations and hospitality practice. That in turn would also influence the service offering to visitors and hotel guests, which may create new opportunities for evaluating customers' feedback on various aspects of the service delivery (Kunz et al., 2017; Liu et al., 2017; Miah et al., 2017). The premise of big data is to create a smart overarching synergetic framework, where individual data packets would integrate to an optimized system of tourism business intelligence to enhance organizations' decision support system. This is vital for service systems where value co-creation is the product of various resources, such as organizational policies, internal and external systems, proprietary technologies, human resources and, recently, artificial intelligence (Maglio and Spohrer, 2008). In this vein, the main aim of this chapter is to illustrate how Big data formulate new ways for managers to improve tourism and hospitality organizations' capabilities. This would ultimately offer improved tourism and hospitality services and enhanced customer experiences, for the progress of the sector at large. Specifically, this chapter demonstrates the crucial role of big data in matching organizational objectives with customer needs by providing the analytical frameworks to support an advanced B2C interface by combining various internal databases and external data sources.

Business Intelligence in Tourism and Hospitality

Information and communications technology applications in tourism have been increased lately (Buhalis and Foerste, 2015) and Big data is becoming a very promising vehicle to support decision making in tourism marketing and management.

Decisions within the organization are made from an awareness of the utility of data and the clear and deliberate strategy for organizing data within the organization i.e. having a clear

strategy focused on data driven decisions. Improvement in organizational effectiveness requires transforming processes, changing corporate service ecosystems and enabling innovation (Brown et al., 2011; Manyika, 2011). Service science and system innovation is the vehicle to conceptualize, categorize and understand the way service systems interact with each other to achieve value co-creation (Maglio and Spohrer, 2008). Value co-creation offers the critical mass to link the successful implementation of a decision-making system with organizational performance. In line with this idea, the Service-Dominant (S-D) logic (Vargo and Lusch, 2004) has been proposed as the conceptual foundation for building appropriate system theories for a better understanding of contemporary, dynamic service systems.

Various theories have been introduced to conceptualize service ecosystems, such as the complex network theory (Borgatti et al. 2009), social network theory (Goldenberg, Libai, and Muller, 2001), and the multi-attribute value theory (Ferretti and Comino, 2015) to improve decision-making via a dynamic configuration of organizational resources, including the available data flows. Bean (2013) also proffers that the data-driven decision making is a promising trend and that the key factor for successful use of big data flows is the organizations' adoption of it in every aspect within their organization. Accessibility and availability of data is needed to ensure technological innovation is integrated to support organizational decisions. Within the tourism sector currently there are many organizations who are collecting, storing and analyzing data for strategic business decisions providing valuable knowledge. The ability to manage, analyze and act on data ("data-driven decision systems") is crucial to organizations and is seen as a significant asset. The prospects of big data analytics are important and the benefits for data-driven organizations are significant

determinants for competitiveness and innovation performance. However, there are also considerable constraints for organizations to adopt data-driven approaches and gain the benefit of this valuable knowledge through big data.

Organizations of the tourism sector already engaged in using big data, report great **value** being captured within their structures and also between organizations (Phillips-Wren and Hoskisson, 2015). The power of data is in what they are used to predict or show. The data themselves come to life and begin to have consequences when they are analyzed and when those analyses are integrated into social, governmental and organizational structures (Beer, 2018). Tourism organizations use big data to analyze which variables provide the most interesting correlations and the significant ones are used to find and determine causality with models. Many firms of the sector, mainly large ones, have developed competitive advantage, leading to better **performance**, through the effective use of databases and available analytical capabilities (Gretzel, Werthner, Koo and Lamsfus, 2015). Davenport and Harris (2007) found a positive correlation between higher levels of analytics used and 5-year compound annual growth rate for 32 organizations in their survey. Lavalle et al. (2010) found that organizations using business information and analytics for differentiation within their industry had twice the likelihood of being top performers as lower performers.

The abundant information that flows from various sources to different directions throughout the tourism sector stakeholders' system in the form of data packets encompasses various aspects of tourist activities. This individual-based tourist data apply and are supported by smart technology which equip the organizations with dynamic capabilities to ultimately be part of a smart tourism ecosystem (Gretzel, Sigala, Xiang and

Koo, 2015). A smart tourism ecosystem (STE) is therefore defined as being a tourism system that utilizes smart technology in developing, managing and the intelligent delivery of touristic services/experiences and is constituted by a desire for transparent sharing of information and value co-creation (Gretzel, Werthner, Koo and Lamsfus, 2015). Guo et al. (2014) refer to this phenomenon of data transformation using big data as *informatization* of tourism. Because of smart technology integration, it offers a deeper insight into the evaluation of processes and feedback about tourist experience and organizations' value.

Furthermore, the penetration of big data in the tourism destination research has recently appeared in various publications including the work of Miah et al. (2017), who investigated the capability of big data to provide insights of tourist's behavioral patterns at a destination. The capability of the solution provided by big data was illustrated in a case study of inbound tourists to Melbourne in Australia (Mia et al., 2017). The investigators adopted design science research methods to design and evaluate a 'big data analytics' method to support strategic decision-making in tourism destination management. Tourists used geotagged photos uploaded to the social media site, Flickr. The ability of the method in showcasing destination management organizations to analyze and predict tourist behavioral patterns at specific destinations in Melbourne, Australia was shown as a representative case. The created artefacts provide a method for analyzing unstructured big data to provide deeper strategic decision making within a real problem domain.

Data Mining and Predictive Modeling

Big data is largely driven by Web analytics. This is particularly important for both business via sole online platforms and also physical ones that have an e-shop in parallel to the traditional channel. Web analytics reflect the process of taking customer views and

traffic to facilitated reporting of sales and/or time conversion on digital platforms. The aim is to measure how the customers experience firms' web platforms and produce relevant reports. Thus, with web analytics reports, firms can improve the web platforms to meet consumers' expectations and, overall, better serve the customers shopping needs (Priporas, Stylos, Fotiadis, 2017). Often feedback is required from user testers on the look and feel of websites to ensure that links are working appropriately.

To make predictions based on the immense volumes of data available, tourism and multinational hospitality organizations have started conducting predictive modeling by employing a combination of algorithms and machine learning techniques (Morabito, 2015; Phillips-Wren and Hoskisson, 2015; Xiang et al., 2015). Tourism-related platforms, such as Tripadvisor, Booking.com and Trivago are already providing tourists with recommendations which cover various aspects of their travel experience. These platforms generate more than one-third of their sales by using sophisticated recommender systems to identify, rank and provide suitable product recommendations (Pantano, Priporas and Stylos, 2017; Xiang et al., 2015).

Big data consist of different data forms such as messages, images, geodemographics and updates retrieved from various digital sources and networks. Benefits of the analyses of these sources, e.g. social media tweets from Twitter, may provide enriched information about international tourists' intentions to visit a specific tourism destination, thus predicting relevant trends (Kunz et al., 2017; Zhang, 2012). Consequently, Big data provide the opportunity to collect real-time unstructured and structured data of actual or potential tourists and hospitality guests pertaining to their behavior. That should enhance marketing communications, better segmentation, targeting

and positioning of tourism product. Hence, big data are the medium to faster, more effective and meaningful tourism management and business performance to the benefit of stakeholders and the tourism economy at large (Morabito, 2015).

Creating better knowledge by using efficient processes

The data driven decision-making mindset, according to Davenport and Harris (2007), enables managers to make decisions based on a rationale from evidence taken from the big data. Decisions within the organization are made from awareness of the usefulness of data and the clear and deliberate strategy for organizing data within the organization (Phillips-Wren, and Hoskisson, 2015). The change requires transforming processes, changing corporate ecosystems and enabling innovation (Brown, et al., 2011). Accessibility and availability of data is needed to ensure technological innovation is integrated to support organizational decisions. When there is a clear data driven strategy in place which becomes part of the organization culture, then there is better use of big data and thus more chances of adopting the integrated approach leading to organizational success.

Much of the current thinking about big data focuses on the usefulness and the potential that it offers for marketing business products and services. There are concerns about the use of big data within the software industry as to its usefulness when organizations have limited knowledge and skills or capability to exploit the opportunities posed. There are different understandings of the usefulness of big data as a result of varying definitions of the phenomenon. The various definitions often focus on big data as a collection of huge volumes of unstructured data (Amado, Cortez, Rita and Moro, 2018), alternatively it is

considered as a collection of data being taken from different sources and integrated for another use (for example using administrative data). It is not a well-defined tangible object, and the potential of using Big Data to solve problems depend on what the problem is, what sources of Big Data may contribute to the solution, and whether any inherent biases or measurement errors with those sources are significant enough to make them unsuitable for the solution (Tam and Clarke, 2015). Big Data is often defined by its characteristics along four dimensions (Daas and Puts, 2014, Morabito, 2015):

- volume – the number of data records, their attributes and linkages;
- velocity – how fast data are produced and changed, and the speed at which they must be received, processed and understood;
- variety – the diversity of data sources, formats, media and content.
- veracity- quality of the data and trust in the data

Because of these discrepancies with definitions there is a need to investigate how the users of the data view the usefulness, and whether businesses are capable of exploiting these opportunities that big data offers. While plenty of scholars are conducting research on Big Data with respect to Tourism marketing applications, less is found in addressing specifically the benefits that marketers could potentially achieve through Big Data solutions. While Big Data adoption within the industry exists, more research is needed to clearly identify the pros and cons for organizations to invest in Big Data (Amado, Cortez, Rita and Moro, 2018). There are clear foci of organizations to adopt Big Data to extract strategic value but the data-driven decision making is still in its infancy (McAfee and Brynjolfsson, 2012; Russom, 2013). It is better to focus on decisions based on evidence

from sources such as data, than to use intuition alone. Big data can provide better evidence and insights to support the process of decision making.

Tourism marketing and Big data

The enormous growth of powerful digital devices and relevant software create opportunities for collecting and leveraging voluminous data and offer ways for tourism and hospitality firms to innovate and create better offerings and evaluation for better performance (Moro, Rita, and Coelho, 2017).

The effectiveness of a Big data system heavily depends on its set up for the extraction and synthesis of information packets to support business decisions, such as the types of markets and segments to target, what mix of marketing communications to use, and how to shape the characteristics of the offering (Grossman and Siegel, 2014). Also, the rest of tourism/hospitality marketing mix offering, i.e. characteristics, price, and channels of distribution, can be formulated to better match potential tourists' profiles (Hazen, Boone, Ezell, and Jones-Farmer, 2014). Predictive analytics utilizing Big Data drawn specifically for Marketing purposes take the form of Marketing analytics solutions that implement Marketing underpinnings and techniques to solve real-world Marketing problems (Grigsby, 2015).

Among others, Malthouse et al. (2013) proposed that traditional customer relationship management (CRM) can greatly benefit from the Big Data evolution and they proposed specific guidelines accordingly. The predictive methods are useful to provide snapshots of the CRM data to extract models for predicting success of future campaigns

and offer guidance to managers to make informed strategic decision-making about their business (Brynjolfsson, Hitt, and Kim, 2011). Other researchers have also identified the need to incorporate analytics in CRM encompassing widely known concepts in Marketing, such as the evaluation of customer lifetime value (Moro, Cortez, and Rita, 2015). These impacts are seen as creating real value from a marketing perspective because traditional data analyses methods have not been able to provide information on big volumes of data, such as text, pictures and web data.

The focus now is on leveraging the abundant data available from personal smart devices, e.g. smartphones, smartwatches, making this data a source of information reflecting individuals' preferences, lifestyles and habits. Recent studies confirm that while some work has been done to fill this gap, the size of the gap is increasing at the velocity of the inflation of Big Data availability as more individuals engage with smart devices (e.g., Erevelles, Fukawa, and Swayne, 2016). Thus, relevant opportunities for producing tourism marketing applications (tour-apps) based on full scale usage of Big Data will likely grow in the future.

Considering Visitors' Needs

The hotel industry is a highly competitive one in that hotel firms offer essentially homogeneous products and services. The competition, thus, drives the desire of hotels to differentiate themselves among their competitors. Guest satisfaction and approval has become one of the key measures of a hotel's ability to outperform others. Understanding the needs of customers and their experiences is vital for improved sales and overall organization performance. Recent studies have used big data analytics to better understand

important hospitality issues, e.g. the relationship between hotel guest experience and satisfaction. One such study by Xiang et al., (2015) found several dimensions of guest experiences that carried varying weights and, more significantly, meaningful semantic compositions. The association between guest experiences and satisfaction was strong, suggesting that these two domains of consumer behavior are fundamentally associated.

Banerjee and Chua (2016) have collected and analyzed reviews of customers taken from TripAdvisor. They found that travelers' rating patterns differed significantly depending on the chain versus independent hotels. Ye, Law, Gu, and Chen (2011), as well as Lu, Ye, and Law (2014) found a significant impact of user-generated reviews on hotel sales. Liu et al., (2017) investigated a collection of 412,784 user-generated reviews on TripAdvisor for 10,149 hotels from five Chinese cities. They found that overseas tourists, who speak diverse languages (English, German, French, Italian, Portuguese, Spanish, Japanese, and Russian), vary significantly on the roles of various hotel attributes ("Rooms," "Location," "Cleanliness," "Service," and "Value") and in providing their overall satisfaction rating for hotels. Chinese tourists domestically, prefer room-related hotel attributes compared to overseas tourists. From prior studies on the issue, user-generated reviews yield a reliable source of information that can be used to understand the drivers of hotel satisfaction and provide feedback to meet any future customer service demand. The use of these types of feedback require organizational processes for understanding and responding to the customer needs. This might better be considered from internal and external frameworks for tourism and hospitality organizations.

Big Data frameworks for Tourism and Hospitality

Big data flows of a tourism and hospitality organization

For tourism and hospitality organizations to be analytical and use Big data approaches, a specific set of frameworks are needed to enable the organizations to participate in the Big data evolution. As these organizations contribute to the formation of the tourism service ecosystem, and further to the S-D logic introduced by Vargo and Lusch (2004) illustrates the dynamic interactions between various industry stakeholders such as the Viable Systems Approach (VSA) (Golinelli et al. 2012; Barile et al. 2012). The VSA is particularly suitable for building a theoretical framework in this field of study, as it can support the understanding of the organizational and ecosystem change introduced due to the Big data evolution.

In this vein, we have developed two frameworks that support better understanding and potential implementation of Big data processes for tourism-related organizations. The first framework depicted on Figure 1 has the tourism/hospitality organization at the epicenter. It demonstrates the interrelationships and flows of data between the organization and other business or institutional stakeholders.

The cuboid shows the various departments within the organization. Typical examples of departments are included here including the research and development (R&D), marketing, procurement and logistics, sales/reservations, human resources and customer services. The internal flows show the data flowing into the organizations as represented by red arrows. The big data for the outflow are presented with green arrows. An example of an inflow will be suppliers who provide products or services to the organization. A Big data application might focus on the inflow of big data which has been analyzed by applying predictive analytics from volumes of data based on recurring patterns of stock provide

richer information to provide a customized service based on the type of guests or customers in the tourism or hospitality organization. For example, customers/guests fitting a particular profile are presented with offerings that are based on their requirements from previous spending or hotel visits.

On the other hand, outflows of data might focus on the big data collected and processed by public institutions, such as the data required to provide data on customer visits, rooms booked and or payments made to hospitality organizations. This data is made available on an aggregate basis to government organizations such as the Office for National Statistics (ONS) for official statistics on quarterly hotel visits, overnight stays and relevant payments made. These big data outflows provide useful information from the organization to provide global information about data trends and patterns for the benefit of the industry. This type of data provides useful indicators about the health of the whole industry, and thus benefits multiple parties. Subsequently, once these data have been collected and processed by the public institutions, they flow in as feedback (e.g. tables, media release, general reports) to all tourism/hospitality organizations. Similar inflows and outflows can be attributed to; residents, suppliers, information intensive private organizations, governmental bodies and, DMOs and hospitality industry associations and the tourism/hospitality unit.

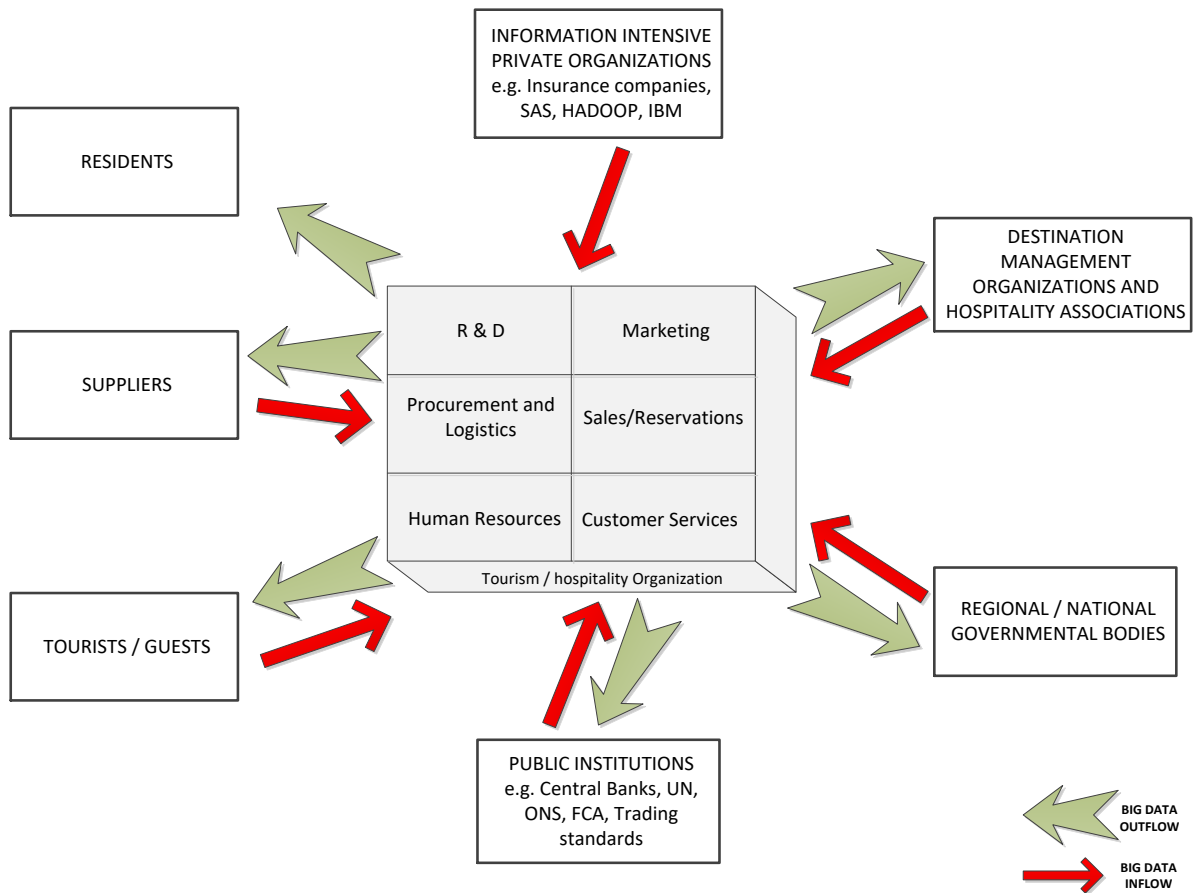


Figure 1: Big data flows of a tourism and hospitality organization (BDF) (source: the authors).

Table 1 below has been developed to show how these inflows and outflows work in practice between the tourism/ hospitality organization and external organizations, guests, tourists and residents. It illustrates various types of data inflows then outflows into tourism/ hospitality organizations, examples of the typical data flows, resources that are required to action these transfers/ informatization. Lastly, it considers whether the necessary enterprise-wide organizational processes, individual skills and expertise, and interrelationships between stakeholders are emerging or established capabilities in the tourism ecosystem.

Table 1. Big Data Flows of Tourism and Hospitality Organisations.

Business or Institutional Stakeholders	Specific examples of Organisations and related activities	Big data process resources	Established/emergent capabilities
Information intensive private organisations to the tourism organisation	Insurance companies' data for determining liability for the destination management events	Data analysts/ database administrators	Emergent - in respect of the use of Big data (Brown et al., 2011; Manyika, 2011)
Destination management organisations	Data about sales and marketing are exchanged with the DMOs and/ hospitality associations and aggregated to provide a view of the industry and the hospitality organisation	Databases, software to share data	Established based on the industry view according to Kunz et al., (2017); Zhang, (2012)
Regional/ national governmental bodies	Municipalities and counties providing reports, research, strategic data on regional or national industry aspects and sharing with the hospitality organisation.	Expertise of Insights analysts, reports, research on regional or national outcomes/goals. Databases, software for updates etc.	Emergent - in the sense of using data to create value (Beer, 2018; Gretzel, Werthner, Koo & Lamsfus, 2015).
Public institutions	Sharing of data between the Office of National Statistics (ONS) and the DMO about customer visits, sales transaction data. Could be based on compliance for tax or for official statistics.	Database or CRM capturing and sharing interval data on visitors, sales transactions.	Established- this practice is well established according to Beer, (2018) who explains the value of these partnerships.
Tourists/ Guests	Reviews of previous guest/tourist experiences of DMOs based on feedback on sites such as Tripadvisor,	Online reviewing uses Big data and ranks feedback from Reviews posted about guests/tourists' experiences. DMOs	Emergent - based on research (see Buhalis and Foerste, 2015; Gretzel, Werthner, Koo and Lamsfus,

	Booking.com, Trivago etc.	need to engage with feedback.	2015; Xiang et al., 2015)
Suppliers	RFID tags are used to track and trace products such as towels for monitoring their location, frequency of cleaning and or whether they have been stolen.	RFID tags, software for data analytics, track and trace geotags, databases etc.	Emergent- there are new ways of working with suppliers based on reporting and data tracking etc. (Golinelli et al. 2012; Barile et al. 2012; Priporas, Stylos, and Fotiadis, 2017)
Residents	People living locally are provided information about the operations, processes of the organisation that affects them. For example, unstructured data from surveillance, security etc. to ensure safety and security is monitored	Camera footage and monitors are used for surveillance and data is stored etc.	Established- the practice is not new but the technology and dynamic data integration with websites and other device is developing (e.g., Erevelles, Fukawa, and Swayne, 2016).

The Big Data Tourism Analytical (BDTA) Framework

The BDF framework that is depicted as a satellite system of information carriers that orbit around a tourism/hospitality organization, shows the data that flows in and out of the organizational boundaries. Nevertheless, it does not illustrate the integration of the context and the wider interactions that are pertinent within a Big data analytical environment. Since, data storage is only one part of big data analytics, we should consider the wider interactions of how intelligence is accessed by various stakeholders in the tourism ecosystem. This is where Big data emerges, i.e. to facilitate the multiple exchanges and processes at various layers of data infrastructure.

Figure 2 below provides an overview of the big data flows that cross over and processed by the tourism analytical hub on a real-time basis. The framework extends across four layers of data flows from a series of access points into the analytical hub. The analytical hub is where the Big data is transformed and pumped throughout the ecosystem. These layers include, firstly, the access points serving as data satellites; secondly, types of data used by the access point; thirdly, analytical professionals required for analyzing the big data; and lastly, in the center is the tourism analytical hub.

The **first layer** presented in the framework spans nine key access points. These are commercial banks, insurance organizations, governmental institutions, social networking platforms, tourism services vendors, tourists/guests, destination management organizations, tourism/hospitality organizations, and the supply chain for both goods and services. The data from these organizations provide big data to hospitality and tourist organizations to deliver better touristic services. For example, *commercial banks* (access point 1) offer data on transactions and electronic payments, thus providing financial intelligence which is processed and analyzed in the tourism analytical hub in real-time. The big data that flows from the commercial banks are transformed by processes such as predictive analytics to provide scoring reports, profiling of customers and credit history to provide better tailored services and better insights about tourists.

Access point 4 focuses on the social networking platforms and the big data that provides information about the feedback of customers and guests. The Big data provide information about the customer satisfaction and information about their experiences in hotels and tourist organizations. It is important to have a way to analyze the data and information presented on social media. With the plethora of data provided from these social

media platforms it is in the best interests of the hospitality and tourist organizations to consider the feedback and reviews from customers on the platforms. The ability to analyze the Big data is possible with the advent of key data consultants able to react to feedback swiftly and also detect when there are anomalies in the feedback patterns on social platforms. When data is received, text analytics software can decipher when feedback is being fabricated. This gives the whole process higher credibility, authenticity and makes the reviews and other information shared via the tourism platforms more trustworthy (e.g. Tripadvisor, Booking.com). Furthermore, the social media feedback and reviews are useful to capture how employees and the organization is performing. Within the tourist analytical hub there are now ways to integrate Big data and provide feedback across multiple social media sites.

Access point 7 focuses on the Big data flows of *destination management organizations (DMOs)*. The Big data flows show that reporting, forecasting and insights are some of the important advantages of the data for these organizations. External data from the weather are modelled and insights are provided about the potential weather system that might impact on the destination management organizations performance. Diving organizations are able to get updates on weather models, sea conditions and global positioning systems for key information affecting their organizations. Updates on storms, tides, hurricanes and other weather systems can have a significant impact on these organizations ability to deliver positive customer experiences such as the ability to experience diving at key destinations. It would not be pleasurable with murky, choppy seas and, potentially, safety could be compromised. With the advent of Big data, integrated

solutions benefit these organizations, especially since they are dependent on external data, as well as internal business intelligence to thrive and prosper.

The tourism / hospitality organization represents access point 8 which shows the flow of big data into the tourism analytical hub. For example, ticketing information for events or hotel visits are able to be processed in real-time from external as well as internal data. The data flow from the computer terminal interfacing with the website for ticketing big data will access the tourism analytical hub. The CRM in the hub is connected to the Big data and the Cloud and provide feedback on the availability of tickets or rooms in the hotel. For tourism and hospitality organizations, the advantages are that with the Big data efficiency and effectiveness of service offerings.

Figure 2 provides additional details about the rest of access data points/stakeholders contributing to the function of the tourism ecosystem from an intelligence point of view.

The **second layer** from the analytical hub focuses on professionals who have expertise in providing analytical services for transforming the data into key business intelligence. Data analysts, such as the software developers, web developers, data architects and data analysts, use business intelligence by transforming the data. They provide the key analytics capability to convert data into useful – and potentially optimum – decisions within organizations and, thus, they are paramount to shaping strategies and the future performance of organizations. For the analytics environment to thrive, transformed big data is needed to provide better decisions to the ecosystem.

The **third layer** represents the spokes which illustrate the specific types of data between the access points of data and the analytical hub. Without the oil of data provided

both internally and externally to the organizations, the tourism and hospitality ecosystem is limited in their ability to be effective and efficient. Big Data opportunities transform into long-lasting success only for organizations focused on managing synergy between a firm's execution of engagement efforts and the customers' experience, motivation, preferences and expectations (Kunz, et al. 2017).

The **fourth layer** is the tourism analytical hub which provides the infrastructure for doing the analytics. The tourism analytical hub is a part of the Cloud (Buhalis and Amaranggana, 2013) and the 'heart' of the wider analytical ecosystem. The tourism analytical hub includes *the big data service*, which provides the data which could be collected from internally or externally to the organizations; the *big data platform*, such as Integration Platform as a Service (iPaaS) and Blockchain or other proprietary software to support Big data processing and accessing without installing any hardware devices or middleware; and *big data storage*, such as the data marts, and servers. *Big data infrastructure* provides the interfaces between the CRM or proprietary software and software which communicates with the servers such SQL server and the Database Management System (DBMS). The tourism analytical hub provides the engine for the ecosystem to survive and thrive. Ultimately, data is needed to service the engine and provide smooth performance for the hospitality and tourism organizations. Without the hub the ability for the analytics is limited, as Big data and the predictive and forecasting techniques, will be stifled. Much as the engine needs oil to ensure that the engine is lubricated, similarly the tourism analytical hub needs volumes of Big data to create supportive information for decision making. These decisions can now be made real-time via analyzing feedback provided by various stakeholders. Thus, the tourism analytical hub

is needed to provide infrastructure for predicting how to improve services and feedback on performance. It is the networking power it carries that fights silo-ed intelligence practices and solves problems holistically. Big data is a major game changer now in optimizing change and better managing future events.

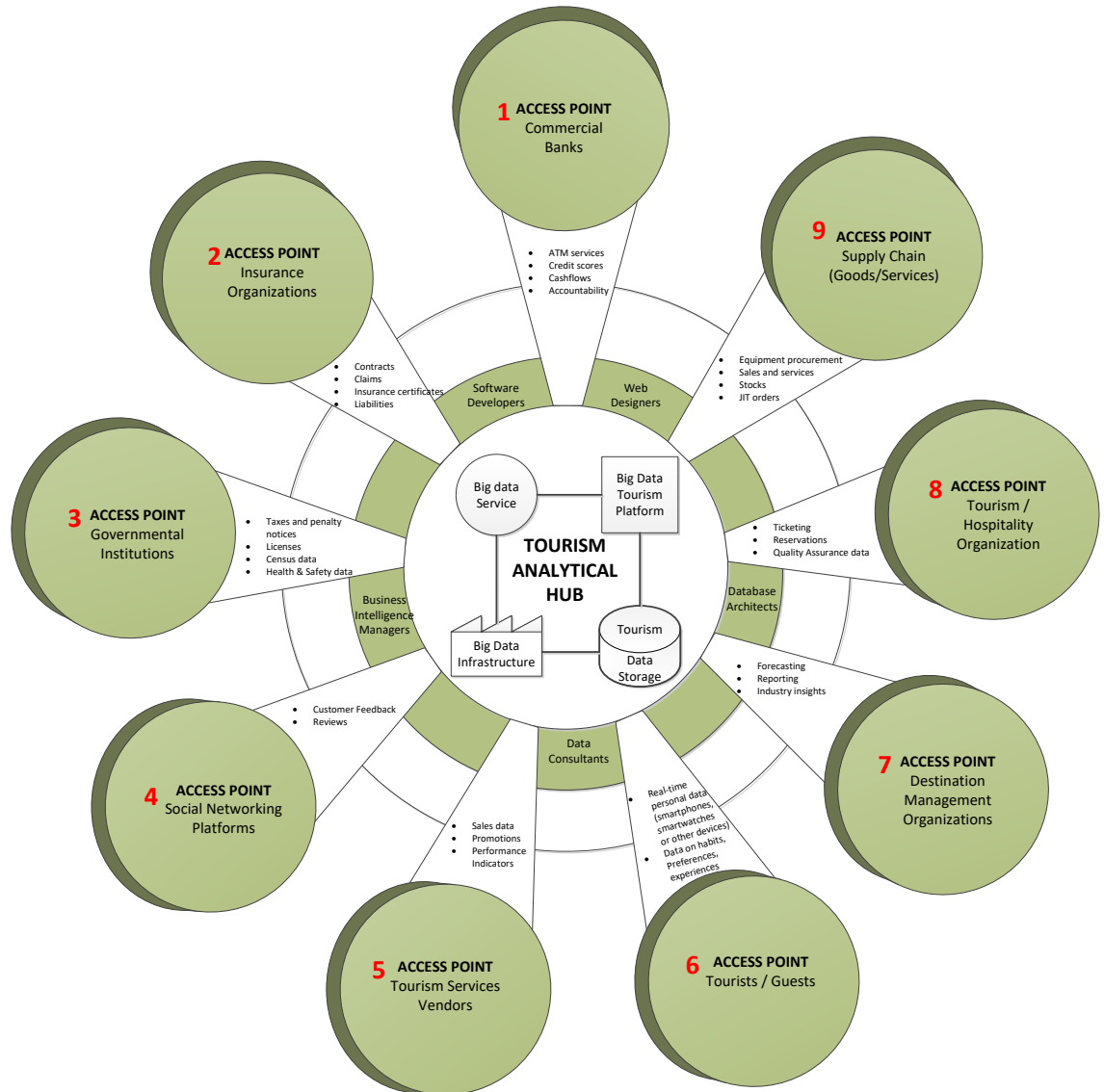


Figure 2: The Big Data Tourism Analytical (BDTA) framework (source: the authors).

Table 2 focuses on the roles, key skills required, level of competencies required, uses of big data and the extent to which the industry is ready to embrace the challenges and opportunities afforded by big data for better business intelligence within the tourism sector.

Table 2 Key Skills, Competencies, and uses of Big data

Actor/Stakeholder	Key Skills required	Level of competency required	How big data used	Resource availability
Software developers	Programming skills Analytical skills Business intelligence Analytics product knowledge e.g. Hadoop, Java, SQL, Machine learning frameworks, team work skills	Highly competent in programming languages and software such as Hadoop and Java	Developers code programmes that communicate between different databases and websites. For example, they create software for dataflows between the booking system and the payment system.	Currently, there is a shortage of key skilled developers with this set of skills, especially with AI and Hadoop skills.
Web designers	Programming skills Analytical skills Business intelligence Analytics product knowledge e.g. Hadoop, Java, SQL, team work skills	Competent at developing websites that work with data integration in CRM, reporting tools etc.	Web designers create and code the website details used for systems such as the CRM, organisation websites	There are shortages of web designers with experience of dealing with Big data web applications/ analytics.
Database architects	Programming skills Analytical skills Business intelligence	Highly competent at providing the infrastructure to support	They are designers of the overarching architecture for hardware and software	There is a shortage of database architects with skills in developing key infrastructure to support an enterprise wide Big data strategy. With the increase in demand for these skills the

	<p>Database Infrastructure knowledge,</p> <p>Analytics product knowledge e.g. Hadoop, Java, SQL, team work skills</p> <p>Conceptual understanding of the enterprise data, products, applications and infrastructure.</p>	<p>existing and enterprise-wide hardware and software for application in the organisation.</p>	<p>data flows with the organisation.</p>	<p>market is not able to keep pace with the demand.</p>
Data consultants/analysts	<p>Analytical skills</p> <p>Business intelligence,</p> <p>Advanced data analyses skills</p> <p>Analytics product knowledge eg. Hadoop, SQL, SAS</p>	<p>Specialised knowledge is required to analyse the data for reporting, analyses and maintaining the integrity of the data.</p>	<p>Data consultants and analysts are key in providing meaningful transformation of data for practical decision-making and evidence. They provide the data for making meaningful business insights, cleaning, preparing, analysing and ongoing reporting of key metrics.</p>	<p>These are key roles in organisations to make sense of the data. They are in high demand for their expertise and they are definitely needed to ensure the meaning is created from the volumes of data.</p>
Business Intelligence Managers	<p>Key knowledge of business needs- business subject matter expertise,</p> <p>Business intelligence, analytics,</p> <p>Decisions based on data,</p>	<p>High levels of competence is required to understand how to make the best use of the data and business</p>	<p>They take the Big data and use their subject matter expertise to make better decisions using the data. For example, they are able to use reservation information for strategic planning and predictions</p>	<p>Making decisions based on data, requires specialised knowledge and expertise in this area. There are shortages of the personnel to manage analysts and provide business intelligence to the organisation.</p>

	Management expertise	models for business intelligence.	of reservations for customer visits etc.	
Business Analysts	<p>Analytical skills</p> <p>Reporting skills</p> <p>Documenting user requirements,</p> <p>Developing process flow diagrams</p> <p>Business intelligence,</p> <p>team work skills</p>	<p>Business analysts need to be competent in their understanding of requirements of business and IT professionals.</p>	<p>They provide the detailed documentation and communication about the processes involved between the subject matter experts and the IT personnel.</p>	<p>Bridging the difference between IT and business areas, the Business analysts are important to provide the communication of user requirements and mapping the processes for IT to develop.</p>

Conclusion

This chapter highlighted the active role Big data take in shaping the contemporary tourism and hospitality industry intelligence. To further understand this, approaches to implementing Big data were explored within a tourism and hospitality context. Two frameworks were developed, providing a blue print showing the various stages of Big data, thus demonstrating the relevant flows and implementation processes. Marketing analytic solutions utilizing Big data may benefit tourism organizations in achieving real-time deep insights into tourists' preferences (Moro, Cortez, and Rita, 2014), constructing interactive reports and dashboards for managers or even unveiling interesting trends from what is being said about the tourism destination or hospitality organization on social media (Miah et al. 2017; Morabito, 2015). Furthermore, big data-driven marketing practices, such as recommendations, geo-fencing, search engine marketing, CRM, market segmentation, customization and marketing mix optimization, play a key role in creating new forms of data-driven strategies and enabling business innovation (Priporas, Stylos, and Fotiadis, 2017).

There is excitement and keen anticipation that future Big data applications will provide optimized services for organizations in tourism and hospitality sector when they leverage the opportunities arising from technological advances. The game change is about the integration of business intelligence using Big data occurring throughout the tourism ecosystem. Decision making capabilities may be much improved to the benefit of the whole performance (or micro) environment of a tourism/hospitality organization. Future research could investigate empirically the Big data flows across the tourism industry by utilizing the proposed BDTA framework. This would offer insights into how Big data influences operations of each organization involved, as well as the performance of the tourism service ecosystem as a whole. In this regard, researchers would be able to suggest improvements for the way access points

are efficient and effective; consequently, tourism and hospitality managers could draw on this research and inform their practice.

Big data calls for collaborative action. Therefore, we suggest: *“Think holistically; think Big data for more intelligent decision-making, supreme guest experiences and enhanced business performance. The Big data era is here. The game has changed indeed.”*

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