Big Data empowered Agility for dynamic, volatile, and time-sensitive service industries: The case of Tourism sector

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Abstract

Purpose – Dynamic, volatile, and time-sensitive industries, such as tourism, travel, and hospitality, require agility and market intelligence to create value and achieve competitive advantage. The current study examines the influence of Big Data (BD) on the performance of service organizations, and probes for a deeper understanding of implementing BD, based on available technologies.

Design/methodology/approach – An ethnographic study was conducted following an abductive approach. A primary qualitative research scheme was employed with 35 information technology and database professionals participating in five online focus groups of seven participants each. Analytical themes were developed simultaneously with the literature being revisited throughout the study to ultimately create sets of common themes and dimensions. **Findings** – BD can help organizations build agility, especially within dynamic industries, to better predict customer behavioral patterns and make tailor-made propositions from the BD. An integrated BD-specific framework is proposed to address value according to the dimensions of need, value, time, and utility.

Research limitations/implications – Little research exists on the key drivers of BD use for dynamic, real-time and agile businesses. This research adds to the developing literature on BD applications to support organizational decision-making and business performance in the tourism industry.

Originality/value – The study responds to scholars' recent calls for more empirical research with contextual understanding of the use of BD to add value in marketing intelligence within

business ecosystems. It delineates factors contributing to BD value creation and explores the impacts on the respective service encounters.

Keywords: Big Data; IT-experts; Online focus groups; Tourism organizations; BD-specific framework

Introduction

The dominant role of the temporal dimension in business, and particularly in marketing, has been documented since the 1990s, with Glazer and Weiss (1993) linking conceptually and empirically, information flows, decision making and organizational performance. The importance of information quality and influence of the environmental volatility on decision making was further investigated by Wilson (1999), and reported possible measures for a customer-oriented approach dependent on the availability, quality, quantity of information, and time-to-market analysis. The evolution of Big Data (henceforth, BD) re-introduced the key role of time in decision-making processes (Buhalis and Sinarta, 2019). As BD is a game changer in business intelligence, particularly in volatile, dynamic and time-sensitive industries, a high degree of mobility and collaboration from multiple stakeholders is required (Stylos and Zwiegelaar, 2019).

Tourism is a complex business ecosystem which is based on a variety of operations, i.e., management and marketing offline and online activities (internal/organizational and external). These organizational activities produce corresponding BD transactions, such as webpage visiting data, web search data, online data for bookings, and internal databases on revenue management (Guillet, 2020; Guillet and Mohammed, 2015). They can contribute greatly to a better understanding of tourist decision-making and to improve tourism marketing perspectives (Antonio et al., 2019; Stylos, 2020). BD's usefulness has been

2

acknowledged widely for creating effective customer targeting and service delivery in the tourism sector (e.g. Mariani et al., 2018). However, organizations are challenged in identifying and making better utilizing available data from various sources, to optimize decision-making processes for dynamic applications (Mariani et al., 2018; Wamba et al., 2017). Improved conceptualization, alternative systems design, and effective utilization of BD need to be considered to increase its usefulness for tourism business intelligence.

Due to the interdependence of various actors in the delivery of goods and services, BD flows require an efficient coordination among stakeholders, for tourism organizations to create performance advantages (Li et al., 2018). In both the broader business management literature and particularly the tourism-related literature, less research considers the key drivers and performance implications of BD use for dynamic, real-time and agile businesses.

This study investigates the utility of BD in tourism contexts and the relevant factors that contribute to advancing marketing intelligence of this sector. We explore a deeper and more systematic understanding of BD's contributions to identify elements that influence customer behavior in conjunction with two dimensions, i.e. temporal and spatial, for real-time marketing applications and value co-creation (Buhalis and Sinarta, 2019). This is informed by IT and database experts' input emerging from their previous engagement with BD projects in the tourism sector.

This research has two key objectives. Firstly, it seeks to explore how BD influences the performance of service organizations in dynamic, volatile and time-sensitive industries of the tourism sector. It investigates tourism-related organizations' use of BD engagement with their customer base and differentiates their services to ultimately enhance agility and create dynamic advantages. Secondly, it draws on IT professionals' experiences of BD applications in marketing, to determine how BD can improve organizational capabilities across the tourism ecosystem. Our empirical research extends the Big Data Source Suitability (BDSS,

3

henceforth) framework (Sigala et al., 2019). The lens of the BDSS framework applies to the importance of utilizing BD by concentrating on: a) inputs required for BD innovation, b) spatial processes, c) relevant temporal criteria, and d) contextual factors that shape BD exploitation and practicality. Overall, the research answers calls by Mikalef et al. (2018), and Stylos and Zwiegelaar (2019) who have expressed the need for more empirical research on BD within business ecosystems. The previous research objectives are more crucial in the current, unprecedented pandemic environment, considering the effect of COVID-19 is having on tourism and hospitality organizations. As COVID-19 challenges the traditional ways of doing business (e.g. Donthu and Gustafsson, 2020), this study is timely as it theorizes based on the key factors that should be considered for organizational decision-making in the tourism industry during turbulent times.

From a theoretical viewpoint, this study focuses on how BD offers an all-round enhancement of time-sensitive, agile service environments. The tourism sector is used as a representative case for this investigation. Previous research has identified the opportunities BD offer to tourism and hospitality (e.g. Centobelli and Ndou, 2019). This paper systematically demonstrates the technical and managerial requirements for leveraging the practical value of BD and explores the contributing factors to value creation across the tourism ecosystem. It enhances the efforts to respond to the recent challenges, emerging from the COVID-19 impact to the economic viability and sustainability of the global tourism industry. This can be fulfilled in relation to the research call of Jiang and Wen (2020), Amankwah-Amoah (2020), and the prompts of Zeng et al. (2020) on enhancing individuals' tourism experience via wider implementation of Artificial Intelligence (AI) in the tourism sector.

Previous research on agility in tourism suggest potential ways of implementing Davenport and Harris' (2017) conceptualization, but mainly from a consumers' perspective

4

(Alaei et al., 2019; Li et al., 2018) and recently, BD using social media (Del Vecchio et al., 2018). This paper takes a holistic approach and demonstrates how to transform the power of BD into value created by various tourism stakeholders including tourists, entrepreneurs, and managers, as per Centobelli and Ndou's (2019) study. Hence, a systematic way of implementing BD in the tourism industry is offered. A state-of-the-art conceptual underpinning has initially been adopted; then, it was adapted to situate and theorize the relationships among BD flows within the tourism services context, combined with the empirical data collected from IT experts using an ethnographic approach. The proposed framework can be useful to scholars who investigate the triggers and dimensions of BD value creation and assimilation across business ecosystems. Practical implications demonstrate how marketing practitioners can exploit BD to design and implement effective marketing strategies to improve consumer engagement and enhance the competitiveness of the entire tourism business ecosystem.

Literature Review

BD analytics and its recent evolution

Recent technological progress in hardware sensors and platforms, as well as advances in social media, virtual communities and networks facilitate data sharing, which contribute to the era of large-scale data variability (Sigala et al., 2019; Williams et al., 2015s). Organizations use metadata from mobile phones which is sensor-equipped and other electronic devices, thus offering organizational structures, a new approach to serving their needs with better quality intelligence and value creation for their customers. They use BD scalable techniques, such as text analytics and web analytics, which allow organizations to process and examine tracking data (Buhalis and Sinarta, 2019). BD analytics are data-processing techniques used to obtain useful information from the data (Mariani et al., 2018) through users' activities whilst online

5

(e.g. browsing and purchasing) and relevant interactions (feedback, perceptions and sentiments about a goods and services) (Alaei et al., 2019; Chareyron et al. 2014).

BD are becoming instrumental in their contribution to decision-making, when it is used for mining information for business' decisions (Mariani et al., 2018; Moro et al., 2020). Predictive analytics solutions explore BD through advanced machine learning, which provide organizations with grounded marketing insights and better options in creating competitive advantage and advanced customer offerings (Köseoglu et al., 2020). Extant debates have concentrated on the effectiveness of BD and the possibilities it affords in marketing goods and services (Mariani et al. 2018). The use of BD to solve the organizations' problems depend on the issues to be addressed, what BD intelligence may be applied to the proposed answers, and whether there are any intrinsic biases or systematic errors of measurement for which causes are deemed unsuitable for the solution (Sigala et al. 2019).

From an internal marketing perspective, tourism organizations may harness BD from intranet reviews to enhance organizational intelligence and determine job satisfaction and employee turnover (Wamba et al., 2017). Notwithstanding the different options for decision-making tools that analyze business intelligence assets, there are, however, certain issues with the implementation of BD in organizations. Managers are unwilling to implement investigative models that are dependent on the unbiased evidence as assessed by experimental tests. They are often dependent purely on their own analyses of data, blind-siding them about key decisions based on intent that is strategic and/or competitor behaviors (Köseoglu *et al.*, 2020). As Benoit et al. (2020; p. 239) posit, 'People, especially managers, won't use what they don't understand'. The greatest barrier to the implementation of BDA relates to cultural challenges: *organizational orientation* (enterprise-wide strategy to implement BDA), *opposition or limited understanding* (employees have limited knowledge/ experience), and *change management* to

6

an organization's data-centric strategy. Consequently, it is vital to investigate BD's in-depth aspects and practices.

BD and innovation in service organizations

Companies try to exploit the flexible, dynamic and agile digital technologies to create innovative service offerings (e.g., Buhalis et al., 2019). There are strong arguments demonstrating the need for understanding the customers offering and delivery of the service using the most enhanced ways to add benefits to the customer experience (Buhalis and Sinarta, 2019). Thus, service innovation through ICT applications shape novel and individuated customer value propositions permitting companies to diverge from their competitors and develop strategic value (Gonzalez et al., 2019; Günther et al., 2017).

Service organizations, especially those in hospitality and tourism, are heavily BD-dependent, due to the complexity of the service provision and the need to co-ordinate several stakeholders (Buhalis and Amaranggana, 2015). When new value and service innovation elements are introduced by organizations and customers jointly, the service provision optimization can be anticipated to the benefit of both sides (Benoit et al., 2020). The implications of BD intelligence in producing service innovation within volatile and time-sensitive organizations are massive given that they are emerging in various sectors. Developing an empirically grounded theoretical framework would match and add to previous studies, highlighting how the developments of digital technologies facilitate service innovation (Lehrer et al., 2018).

Marketing of dynamic, volatile and time-sensitive tourism organizations

BD offers real time and spatially specific complex data in support of marketing intelligence and planning (Lehrer et al., 2018). Four characteristics of BD have recently been reported as

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critical for supporting organizations to achieve their goals, namely: portability, interconnectivity, quality and relevance (Günther et al., 2017). Portability focusses on the capability to transfer and access BD from one contextual setting of application that extends to other contexts. BD-enabled organizations embrace a decentralized management culture and approach allowing BD portability across functional silos (Demirkan and Delen 2013). The interconnectivity of BD enables organizations to improve existing systems patterns of analyzing various databases in a combined manner. BD requires high quality and relevant data and, therefore, they need to be properly managed and devised at a high hierarchical level (Li et al., 2018).

Although conceptual frameworks have previously included organizational agility in the BD operationalization, these were mainly focused on consumer markets (Mariani and Wamba, 2020), supply chains (Mandal, 2019), and IT operations (Urbinati et al., 2019). Tourism organizations face uncertainties and challenges emerging from an increasingly complex external environment (e.g. political developments and terrorism, biological crises and epidemics, natural disasters and degradation of natural the environment), and a highly volatile competitive business environment. They also need to deal with the dynamic nature of customers' needs and preferences (Buhalis and Sinarta, 2019). Managing their supply chains, the B2B, B2C, C2C relationships, and keeping up with the most recent developments of Industry 4.0 via BD applications, are key for organizations in the tourism sector to operate under conditions of volatility and demand for nowness. In this setting, service agility emerges as a key factor for securing business viability (Mandal, 2019).

BD in Tourism

Previous studies have demonstrated the high potential of BD in transforming for-profit organizations utilizing the power of digital platforms and online communities (e.g. Hartmann

et al. 2016). The tourism sector is very context dependent and requires real-time dynamic information to optimize business performance and customer experiences (see Table I). Marketing analytic solutions using BD may benefit organizations for the broader tourism sector; including airlines, hotels, entertainment companies, and tourism destination organizations. This is possible via interactive reports and dashboards for managers, forecasting tourism demand and destination trends, and identifying customers' responsiveness to marketing campaigns based on tourism brands using social media (Del Vecchio et al., 2018). Chareyron et al. (2014) provide examples of photo sharing websites (e.g. Flickr, Instagram), and review/opinion ones (e.g. Tripadvisor) as important sources of BD in textual, picture and video formats to support decision-making, and create dynamic connections and interoperability across the travel and tourism industry (Mariani et al., 2018; Sigala et al., 2019).

Customers are co-creators of value and thus, service organizations need to gather and analyze customer data to gain useful insights (Casaló and Romero, 2019; Sigala, 2018). Researchers have further illustrated the potential value of BD in advancing our knowledge of customers' experiences, feelings, interests, opinions, preferences, and behaviors for tourism organizations (Xiang et al., 2015). Affordable technical solutions have also been proposed to leverage the enormous volume of trace data individuals leave via their online activities associated with travel and tourism services, which would optimize extraction and analysis of information from an array of sources (d'Amore et al. 2015). Nonetheless, BD cannot create strategic value automatically, but rather by applying holistic understanding of stakeholders' involvement in shaping tourism-related services alongside Industry 4.0 applications within a BD multidimensional context (Sigala, 2018).

[Please insert Table I here]

9

Harnessing the power of BD and the BDSS framework

BD has not been implemented systematically to create value across the enterprises to date (Côrte-Real et al., 2019). This is either due to a lack of analytical skills of employees to navigate its use and interpretation (Phillips-Wren and Hoskisson, 2015), or as a result of managerial failure to develop integrated approaches to deal with customers and their needs (Hartmann et al. 2016). Operational departments do not generally share information with each other leading to practices that are limiting the wider application of data across the organization, thus confining the agility and business intelligence that may have previously been built into an organization-wide perspective.

This study uses the BDSS framework (Sigala et al., 2019) as a lens to investigate the various factors and dimensions of BD implementation in time-sensitive industries. This is a conceptualization that seeks to identify and implement BD innovation strategies, and consists of four major parts: 1) inputs required for BD innovation (i.e. purpose, objective, data types); 2) spatial processes required to implement BD innovation and relevant criteria (i.e. access, scale, units, data sources); 3) temporal criteria of BD innovation (i.e. activity span, timeliness, pattern of repetition); and 4) contextual factors that shape BD exploitation and practicality in advancing quality and relevance (i.e. presentation, depth and re-use of datasets). The corresponding elements of the BDSS framework provide a systematic way to a) integrate various service activities across the tourism sector; and b) investigate the influence of BD on digitally enabled service innovation and marketing performance of organizations. A qualitative research approach would shed light on the specific parameters of implementing BD successfully in the volatile and time-sensitive service organizations of the tourism sector.

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Methodology

Methodological approach

An ethnographic approach in a qualitative research context was applied because of the exploratory nature of the investigation (Berg et al., 2004). Historically, the purpose of an ethnographic study was to explore reality by investigating ordinary experiences and the understandings of specific people or groups (Holloway et al., 2010). The professional identity of the BD professionals forms the group culture, and the ethnographic approach is utilized in studying the social meanings of their group/ cultural elements (Goulding, 2005). In this case, the research design follows an abductive approach where the collected data and theory are jointly being considered, thus reassessing key concepts emerging from the focus groups discussions, consequently leading to an improved conceptual development.

Sampling considerations, measurement instrument and data collection

A purposive sampling approach was used to gather data from the ICT and data science experts. This sampling approach was deemed most appropriate when studying a certain cultural phenomenon for knowledge experts such as BD professionals (Holloway et al., 2010). The interviewee sample was generated from the authors' respective searches of LinkedIn using a purposive sampling approach. Krueger and Casey (2014) identified that a focus group is a key data gathering options for qualitative research to gather in-depth responses. The online focus group approach to data collection was selected as all respondents reside in the UK and Oceania (Australia and New Zealand). The moderator and observer invited pre-screened, qualified

11

respondents to login to video-conferencing software meeting time for the online focus group (Richard et al., 2018).

The overall group of participants consisted of 20 ICT software experts, seven software architects, and eight database consultants, thus 35 professionals work for ICT and data management firms serving the wider tourism and hospitality industries in the UK, Australia and New Zealand (see Table II below). They participated in five online focus group discussions with 7 different members in each, who shared their experiences of BD applications in the tourism sector with the moderator. The selected group size is regarded to be optimal (i.e. six to eight) for a focus group (O'Neill, 2012), thus our group sizes are ideal to manage the group discussion, and encourage engagement of all participants to share their insights on agility and competitiveness of tourism organizations using BD. The five online focus group discussions took place via videoconferences in October 2019. Each online discussion lasted between 80 and 93 minutes in total.

After introductions among participants took place, relevant information about the discussion topic and practicalities of conducting the focus group field tasks were provided. Then, the moderator moved the discussion on to the main part of the online focus group activity by facilitating the members' free and frank discussion about the questions. The moderator progressed the discussion on to the next question/topic when there were enough answers provided. All conversations were recorded, and a systematic thematic analysis was performed later. To enhance the reliability of data collection, the same moderator conducted all focus groups as this would potentially enhance predictability and trust in during the discussions across all five groups (Albrecht et al., 1993).

An in-depth discussion guide with the questions was designed based on existing literature (Morabito, 2015; Xiang et al., 2015). Content relevance and readability were examined based on the research questions to confirm better levels of content validity. The guide

included 11 open-end questions. It has been designed to elicit responses from participants based on their personal experiences on BD utilization in organizations of the wider tourism sector, including present and future opportunities and challenges (see Appendix A).

[Please insert Table II here]

Data Analysis

The starting point of thematic analysis applied open coding, thereafter the audio recordings were transcribed (Berg et al., 2004). The open codes were then grouped into axial codes to identify common themes and patterns as these emerged from comparing the codes. Nvivo qualitative content analysis software was used for the analysis, as this allows researchers to categorize and summarize the coded results. Thus, firstly, Nvivo was used to code the data into the first level of coding, guided by the BDSS framework to develop the codes abductively in conjunction with the collected data. Secondly, the themes were identified in the data with Nvivo extracting the main text where participants spoke about these specific themes. Subsequently, the themes were categorized and re-evaluated by revisiting the literature, and amendments were made to the themes' structure. This involved an iterative process to review all the codes and gradual modification of the coding structure by creating, deleting, and regrouping codes. Overall, information collected was summarized into first order categories, which contributed to the creation of second order themes, and finally a set of dimensions (meta-themes) were generated.

To enhance the reliability of data analysis, two of the authors, who did not participate in the online focus groups discussions, acted as moderators (Sykes, 1990) and reviewed the collected data from a critical perspective. The authenticity and plausibility of our written outputs was achieved by discussing and questioning our interpretations with the participants.

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Thus, trustworthiness and fairness of the findings were secured by sharing preliminary versions of the corresponding output reports with the focus group participants, and they were subsequently invited to add any content, correct any mistakes or misinterpretations, and amend phrasing as appropriate.

Results

The results reveal the views of respondents on the use of BD in building agility, opportunities and challenges of customer experiences, and marketing intelligence in dynamic, volatile, and time-sensitive industries, particularly in the tourism sector. They also discussed future trends and how to reach BD's full potential.

The thematic analysis of empirical data produced four overarching meta-themes/aggregate dimensions, illustrated as a) BD stakeholders' needs and requirements, b) spatial-driven BD value creation, c) temporal-driven BD value creation, and d) BD utility contextual factors, following the abductive approach. The first one reflects the specification of organizational requirements in BD with respect to their business objectives and serving customer needs (Urbinati et al. 2019). The second dimension refers to spatiality, i.e. the sources and origins of BD, including BD stakeholders' locations (Klauser and Albrechtslund, 2014). The third dimension introduces the temporal aspects, and it is regarded as key to BD management (e.g. Conboy et al., 2020). The fourth, utility contextual factors, relates to the potential BD offer within and across various interconnected business fields to support marketing intelligence and solve complex managerial problems via enhanced utilization and interpretation (Centobelli and Ndou, 2019).

The data structure is presented in Figure 1, which is explained and discussed in the following sections. The results reported below are based on representative comments of respondents during the online focus group discussions.

14

[Please insert Figure 1 here]

4.1 BD Stakeholders needs and requirements

The participants referred to cases from across the travel, tourism and accommodation spectrum, including accommodation/hospitality, aviation/airliners (transport), attractions/events, and tourism-related governmental agencies. The *prioritized purpose* was discussed as a theme in order to deliver information about and connect various stakeholders.

> *'It is useful for loading people's profiles and information that contribute to marketing intelligence and at the same time to chase people that don't pay their bills on time'.*
> *(P12)*

The focus group participants also discussed specific marketing strategies for approaching potential customers and reinforced the relationships with existing ones, addressing issues based on *evidenced objectives*. This theme is a key part of implementing the BDSS framework. Participants reported they primarily use BD to target prospective customers and also to engage in conversation towards improving sales and fostering value co-creation, for example:

> *"Understanding customer behavior and demand patterns in detail enable us to optimize our revenue by using appropriate pricing. Prices are subject to demand fluctuations... Using BD to understand purchasing patterns and maximize revenues"*
> *(P26).*

A representative of the aviation industry commented that they felt most airlines had to develop mechanisms to manage BD, and to exchange large volumes of information of various *data types* with partners and authorities. She explained that:

15

"The combination of structured and unstructured data coming from diverse sources over different time periods and even gaining real-time data is what we need to have a comprehensive view of market reality at each time." (P4)

4.2 Spatial-driven BD value creation

The spatial-driven BD value creation was also discussed by the focus-groups participants, who agreed with the wider concept of *spatiality* as proposed in Klauser and Albrechtslund's (2014) framework. In this respect, the first theme focuses on the *data accessibility* with more in-depth explanations of the use of BD by regional tourism associations:

"The main reason for those interested in BD is to fill a gap in the information they require. For example, quite a few regional tourism organizations use mobile phone data to track variables that are not tracked in the core tourism government data. This is administered through a company called Qrius." (P1)

Focus group participants were very optimistic about the future opportunities and trends of BD for the dynamic and time-sensitive tourism ecosystem. They elaborated that merging structured and unstructured open data (*unit of analysis*) and analyzing them dynamically was useful for co-creating value for all stakeholders in NZ (*geographic scalability*). The discussion included comments on the use of BD in tourism, such as:

"BD will have a much bigger role and as organizations seize the opportunity presents, a more coordinated and holistic process to meet a wide range of user requirements will be needed. Data conversion abilities are key in doing so" (P31),

and

> *"The tourism industry in NZ is moving from being market centric*
>
> *to destination management centric and needs BD to address these*
>
> *issues and opportunities by combining locus-specific data from*
>
> *certain regions." (P7)*

The hotel and theme park representatives also use BD for targeting possible consumers and to engage in conversation with previous visitors (*origin and sourcing*). They also use BD for pricing and yield management via innovative techniques to interrogate BD sources and optimize prices for different demand levels:

> *'We keep interrogating our CRM systems as well as our social media*
>
> *interactions to identify potential customers and target them to*
>
> *increase conversion." (P19),*

and

> *"Using BD by extracting industry wide pricing-related data to*
>
> *understand patterns and dynamically predict demand, helps us to*
>
> *optimize our pricing" (P29).*

4.3 Temporal-driven BD value creation

Temporality and the ways people interact with time is a major philosophical and managerial area of inquiry (Conboy et al., 2020). Conceptions of time and mapping activities to time are very influential to organizational operations both from consumption i.e. inventory management and production viewpoints i.e. demand for resources. This is most prevalent in the current dynamic environment of accelerated business activities driven by digitalization and BD influx. For BD applications and usage rate amongst tourism administrators of various tourism organizations (*activity span)*, participant 6 mentioned:

17

"It is useful for understanding the market composition of customers

and to create profiles of customers who have a propensity to pay late

or who do not pay at all. Data modelling can be applied to the data to

assess the customer behaviors and create customer profiles." (P6)

The online focus group participants agreed that a greater range of BD is available in various systems, but they are still underutilized for different reasons. Comments below reflect the issues of standards and access to reliable data being timely and being monitored properly, epitomizing the key issue of *timeliness*:

'Checking demand fluctuations is paramount. We need to use the

data in ways that are beneficial to the organization and customer by

making predictions to adjust bookings and try to somehow flatten the

demand curve especially when there are certain peaks.' (P35),

and

"The data is out there, but until now we haven't had a clear insight

framework to work within. Therefore, a joined-up synergetic approach

via real-time feedback and feedforward should somehow emerge."

(P13)

The access to data for more collections such as for time series data collections are currently being considered an issue and data integration within the organization was discussed. The consideration of *collection repetition* from respondents would help aid data integration:

"There are some discussions about the use of the data, but the actual

model of sharing data and integrating is still nascent. The current

discussion is mostly about the compliance of sharing data and focus

18

on keeping data private based on current codes such as the GDPR".

(P5)

"To collect data at the individual level, rather than aggregated, as

access can be challenging; conducting multiple data collections in

this respect, real-time if possible, is what is needed." (P24)

and

"It is challenging to access data from different sources. It requires a

change in mindset to focus on decisions based on longitudinal data

and thus integrate the data over certain periods of time." (P18)

4.4 BD utility contextual factors

Participants spoke about the use of social media data and other open source data platforms to support/inform in-house databases and develop a comprehensive BD utilization mechanism (*interconnectivity and portability*). Advanced BD can be used for a differentiated tourism product, through better understanding and consequently enhancing a destinations image, visitor experiences and destination branding. They also suggested that dynamic marketing via smartphones is now feasible at the local level. Social media datamining and online chatting increases the online reputation management and problems resolution (Williams et al., 2015).

"Go to Facebook or other social media and get information to

aggregate with in-house databases. It thus makes it easier to do

direct marketing campaigns". (P2)

and

"We explore new methods to collect any reference to our brand as

they appear in social media and analyze them to see their impact on

19

our online reputation. Marriot hotels have revolutionized technology

to geofence their properties and monitor what people say about

them." (P33)

For BD to be analyzed and create the intended value, respondents suggested that the

way current systems are run needs to be overhauled to create more flexible and properly

coordinated flows of data integration across the organization. The *interpretation*

process is needed to provide holistic and integrated systems to meet stakeholders'

requirements. Participants stated that:

"To access and interpret the available flows of data is really hard.

Selected software needs to be engineered and employed to make

sense out of it. (P14)

"There are difficulties in assessing the data from different sources. It

requires a change in mindset to treat the data holistically. There is a

need to focus on data and software architecture that can be properly

integrated within the organization and across partners." (P26)

Respondents have clearly identified BD opportunities for agility and marketing intelligence.

Apart from operations management, BD are used primarily for marketing purposes. Targeting

prospective customers, converting sales, managing customer relationships and delivering an

excellent experience are key objectives.

By reengineering business processes to upgrade BD utility there is a challenge with

BD-related organizational capabilities, as they are not fully explored or/and exploited. There

is an urgent requirement to advance skills and capability to develop enterprise architects and

20

experts in machine learning to perform advanced data mining to create value. Talent

management for those employees is therefore essential.

> *"In the next 10 years BD will become the norm. There is a need to*
>
> *have enterprise architects and experts in machine learning. They will*
>
> *be key to extract value from the data in real-time and point-in-time*
>
> *data" (P3)*

Effective business models can support the use of BD in coordinating all stakeholders in

tourism, hospitality and travel sectors (Mihalic and Buhalis, 2013). There is an urgency to

develop models tailored to meet these challenges identified in the *cross-utilization,* and

respondents suggest that:

> *"As a starting point, TIA (i.e. the New Zealand Destination*
>
> *Management Organization) is currently working on the BD 'Tourism*
>
> *Insights framework'. BD will certainly play a key role in this*
>
> *framework serving as the 'brain and nerves' of it. This will be across*
>
> *private and public-sector platforms." (P32),*

and

> *"Perhaps the best example is the ATDW platform https://atdw.com.au/*
>
> *which represents over 40,000 small and medium sized tourism*
>
> *products and destinations. This creates a great infrastructure for*
>
> *managing and exchanging BD to bring the industry together." (P25)*

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Discussion and Conclusions

BD for Agility and marketing intelligence

BD has become a key tool for industries which are characterized by high volatility, dynamic marketing characteristics (e.g. pricing, consumer demand trends) and real-time response to customers' needs and collaboration with other stakeholders (Buhalis and Volchek, 2020). This is imperative for context-dependent service organizations, such as tourism, travel, and hospitality firms (Chareyron et al. 2014). However, there are currently few studies outlining the factors that influence, and preferably increase, the performance of processing BD, especially in tourism organizations (Centobelli and Ndou, 2019). The online focus group discussions concentrated on how BD may enhance the marketing and performance of organizations, also on the challenges of taking full advantage of BD data flows which emerge from various sources concurrently.

Starting from the reasons for using BD, all participants appreciated the ability to have evidence-based decision making by analyzing BD from a variety of sources. AI and machine learning form a powerful technical basis for analyzing and predicting consumers' behavioral patterns, forecasting travel and tourism trends, understanding tourists' needs proactively, targeting personalized offerings directly to interested customers, and understand staffing levels for planning purposes. This would match organizational investments in people and digital platforms and customer expectations, to ultimately achieve enhanced value creation. The participants spoke about the options for creating personalized offerings for visitors/guests and unique product and service propositions based on available data flows. This concurs with Xiang et al. (2015) who showed how BD can be used to create and analyze optimized customer information for added value.

Participants appreciated that service industries, in this case tourism, travel and hospitality, face several challenges which impede the best use of BD. They spoke about

22

impediments with hardware in the process of mining BD. Participants discussed data reliability; the processes of accessing, transmitting, and linking data sources; and the complications of treating data at the individual level. These go beyond IT infrastructure challenges (e.g. networks parameterization, vendor support services and compatibility), and financial and managerial factors (e.g. financial readiness, IT management, organizational capabilities) of adopting BD by individual organizations (Baig et al., 2019). Participants related that organizations are not prepared to share their data and facilitate data integration, due to privacy legislation. They believe that this is part of their own competitive advantage, so the relevant risks around these areas persist and the data silo arrangements are entrenched. This is a very important outcome of this study, as most organizations do not currently see that BD is an industry-wide asset that needs to be treated as such, rather than a business unit level competitive advantage. BD enables synergetic value creation across different organizations within a business sector, thus organizational performance is boosted by managing BD via a collective and holistic approach with partners, suppliers, and competitors. Demirkan and Delen's (2013) study supports this finding and includes two fundamental elements, i.e. reliability and customizability, to ensure a sector-wide BD success and empower the competitiveness of the entire business ecosystem.

Overall, the main strength of the proposed framework, which has emerged from empirical research and was motivated by Sigala's et al. (2019) work, is the identification of the factors contributing to value creation based on BD usage across the tourism business ecosystem. This framework provides a tourism sector-wide mapping of factors for BD to achieve service innovation and marketing performance increase of relevant organizations (Buhalis and Leung, 2018). Indeed, all participants reported that data management flows and analyses need to be organized in better ways in the future, to create more agile responses based on business insights and support value co-creation.

23

Theoretical Implications

From a theoretical viewpoint, this paper identifies the BD factor structure to support organizations in their effort to develop competitive offerings in complex, dynamic, volatile and time-sensitive industries, in this case organizations from the tourism sector. Interconnectivity of all partners that operate in the ecosystem is essential for the collective competitiveness of the system. This research specifies the corresponding set of inputs for BD innovation, spatial and temporal data processes, and the relevant contexts for effective BD exploitation in the tourism sector, as per BDSS generic structure (Sigala et al., 2019). Based on the results emerging from the focus groups discussions of the current study, the main factors of suitable sourcing and BD exploitation in the tourism sector have been mapped in Figure 1. These can be used to design and implement effective marketing strategies, as well as enhance the competitiveness of the entire business ecosystem. The proposed BD-enabled framework seeks to stimulate analytical thinking and support evidence-based decision making.

Engaging dynamically, efficiently, and profitably with relevant ecosystem stakeholders is at the epicenter of managing complex supply chains in an agile manner, as it has also been suggested by Mandal (2019). In this context, a key contribution to theory is the need to integrate all available data sources according to organizational needs and BD contextual factors with respect to time and space dimensions. Combining all relevant BD flows would provide a comprehensive and systematic way to dynamically analyze business settings and provide evidence-based solutions (Urbinati et al., 2019). This allows for personalization and aid design to support the marketing of authentic customized service solutions, matching them with consumers' detailed profiles (Mariani and Wamba, 2020). This is also consistent with Demirkan and Delen (2013) postulating that responding successfully to

24

market volatility requires an in-depth insight and better interoperability of the constituent

elements within a dynamic business framework. The proposed framework encapsulates the

essential elements to leverage the synergetic power of BD and facilitate the collective

competitiveness of the tourism ecosystem. The factors (themes) and corresponding

dimensions (meta-themes) included in the framework respond to recent research calls for new

business models to optimize the performance and agility of organizations via leveraging the

power of big data flows (Centobelli and Ndou, 2019). The success factors for BD's

performance within the tourism industry were revealed, as empirically investigated through

BD experts' group discussions. These factors do not refer to BD adoption processes

undertaken by the organizations, but rather signify ways to specify contextual factors,

organizational requirements, and data types, as well as detail BD value creation features, thus

extending Del Vecchio's et al. (2018) relevant work. This should be of immense importance

to scholars pursuing research in the areas of value co-creation, behavior and data science,

supply chains, and operations management within a tourism context.

Practical Implications

BD facilitates evidence-based decision making, emphasizing on data exploitation attained

from various sources. The combination of all available data for specific times and

geolocations would drive a range of new processes and properly support managerial decisions

in real time through an unparalleled level of data quality (Lehrer et al., 2018). Marketing

analytics using BD offer managers a wider variety of opportunities, including pinpointing

customers and respective markets with a higher probability to convert sales using digital

marketing techniques. The use of smart devices in ambient intelligent environments, and the

application of datamining by organizations from the tourism sector can improve insights to

provide personalized, contextualized value propositions for tailored-made services (Buhalis,

25

2020). Time-sensitive service industries would benefit from 5G wireless technologies and relevant emerging applications.

BD collection and analysis can also offer accurate and dynamic projections of customer preferences and make dynamic predictions of reservations. Machine learning through BD can also setup up more viable and appropriate pricing strategies. This is critical in the (post) COVID-19 era, as it is imperative for organizations to access data relating to their business stakeholders, both from the supply and demand sides. Managers in the tourism sector need to work with data specialists/ data scientists and create the necessary ICT infrastructure, platforms, and software, to collect and effectively analyze BD, that would ultimately serve real-time needs and circumstances (Li et al., 2018). For instance, tourism-related organizations can benefit from computer vision, which can obtain enriched information from analysing series of images and other user-generated content posted online by individuals (Williams, et al., 2015).

Managers should also aim to implement a BD-enriched system of business intelligence to resolve organizational problems. This view is mirrored by Muhammad et al.'s (2018) findings that BD offers the necessary data flows required for sophisticated systems' operation, thus backing marketers in overcoming traditional slow-paced data analysis. Database managers need to move away from the siloed thinking about sharing data, so that better performance would be achieved from BD-driven supported decisions. Extra value can be created by using the data in more integrated ways, bringing together all stakeholders. In practice, the use of BD could literally save many organizations in the tourism sector from becoming bankrupted or losing market-share. Action is also needed to develop skills and capabilities for employees within organizations (Sigala et al., 2019), to establish advanced data-driven decision-making infrastructure for BD functionality.

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Limitations and suggestions for future research

This research has some limitations as is the case with all empirical studies. Although the empirical data originate from three different countries, these represent major Anglo-Saxon tourism sectors. Further research could investigate relevant data and insights covering other major regions, such as the Americas and Asia. This study is qualitative in nature, aiming at gaining detailed insights from experts. Future studies may build on the proposed framework to generalize the outcomes and test relationships between the factors (themes) provided. More research is required to gain insights for using BD strategically with respect to various types of disruptions (Buhalis et al., 2019), and consider the applicability of the proposed framework in various circumstances. Scholars may also examine the applicability of the proposed BD-specific framework in other dynamic and time-sensitive service industries, such as global trade or supply chain services. Much attention should be given particularly to the temporal dimension of BD, which would significantly enhance the usefulness of empirical analyses alongside the spatial dimension of BD sourcing. The temporal and spatial dimensions together can shape a comprehensive view of the time sensitive needs of BD trends in the tourism sector. Moreover, based on the BD contextual factors specified in the proposed framework, researchers can better identify how to produce more relevant BD outputs to the dynamic and volatile nature and needs of organizations in tourism industries. Researching BD implementation in an integrated manner would positively impact the planning and running of operations in smart tourism destinations.

Additional empirical research would also benefit from explicitly considering the COVID-19 effect on tourism decision-making processes and the impact the viability of tourism organizations, given the unprecedented pandemic circumstances. The importance of BD for the tourism sector in the COVID-19 era needs further investigation. In times of crises

multiple sources need to be combined in real-time to respond to the social and business challenges, e.g. the disruption of the usual patterns of travel planning and accommodation reservations. Building on the framework and the respective dimensions proposed in the present study contributes to optimizing the usage of BD to strengthen the tourism business ecosystem for the future.

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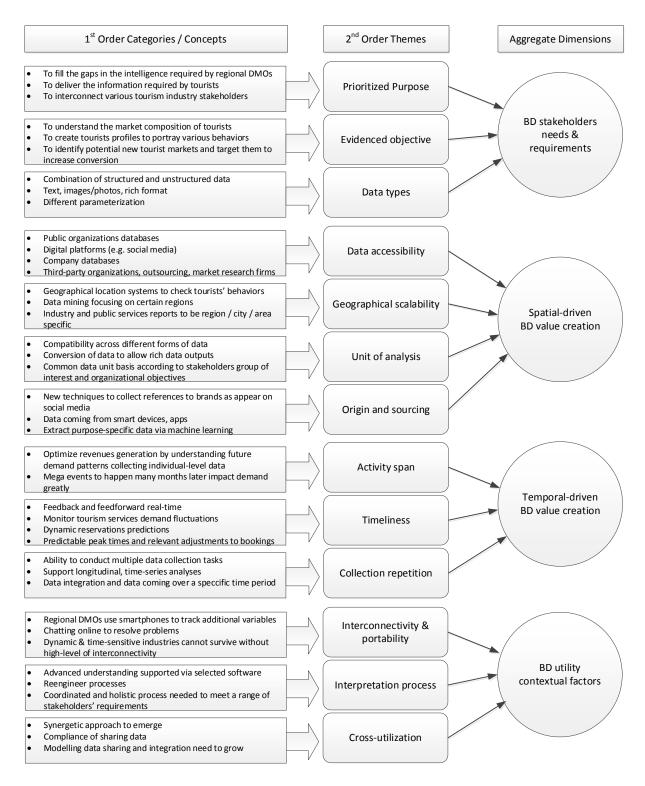**Table I.** Key Research in Tourism and Hospitality with Big Data.

Authors	Theory	Method
Buhalis, and Sinarta (2019)	The focus for the paper is on understanding the 'Real-time co-creation and nowness service' by exploring how customers interact with the brands of hotels such as Marriott.	An exploratory research examined brands to develop their technology and show how social media is used with consumers in real-time. Both secondary and primary data were used to investigate 'real-time service' of social media accounts for Marriott hotels.
Centobelli and Ndou (2019)	The article focuses on the issues associated with the use of big data in tourism and identifies future research directions to focus on customer knowledge and Big data.	A Systematic Literature Review (SLR) using citation network analysis, is adopted on 109 works.
Donthu and Gustafsson (2020)	State of the art focus on COVID-19 impact on business and management. Theoretical contributions are summarised for business and tourism as: **Proposition 1a** *The COVID-19 crisis not only requires short-, medium-, and long-term plans to rebalance the economy but also raises a clarion call for robust and sustainable business strategies across every sector.* **Proposition 1b** *The COVID-19 crisis demands new operating models to meet changing demand patterns and remain agile and productive.* **Proposition 2a** *The COVID-19 crisis indicates the acute necessity of the implementation of advanced technologies across different sectors.*	Bibliometric Analyses were used to analyse research and provide a literature review of 107 articles research on Covid-19 in Business and management.
Li, Hu, and Li (2020)	Tourism demand framework using Big data for platforms.	Internet big data from multiple sources (i.e., the Baidu search engine and two online review platforms) are analysed for forecasting. Demand forecasting based on multisource big data from a search engine and online review platforms were analysed using forecasting techniques for multiple platforms and thus providing better modelling precision.

Mandal, and Saravanan, (2019)	The study explores strategic orientations by considering the influence of entrepreneurial, environmental, supply chain, technology, market and learning orientations in the development of tourism supply chain agility and tourism supply chain resilience.	The method uses an online survey of different tourism supply chains where 276 completed responses were gathered and analysed using Partial Least Squares.
Mariani, Baggio, Fuchs, and Hoepken (2018)	This review provides information on Business Intelligence and Big Data features within the hospitality and tourism literature up to 2016.	A systematic literature review of academic articles indexed on the Scopus and Web of Science databases was conducted. The method of systematic literature review found 77 articles related to BI and 96 articles related to Big Data.
Sigala, Beer, Hodgson, and O'Connor (2019)	The work presents a process framework for employing big data initiatives and a decision framework for choosing big data sources namely: need, value, time and utility.	The work considers the framework based on a review of research on Big data to understand the ability to sources Big data for value.
Stylos and Zwiegelaar (2019)	The role of stakeholders and necessary resources are explained, and the full potential of big data in tourism and hospitality is revealed. The research presents models of the Big data flows of a tourism and hospitality organization (BDF) and the Big Data Tourism Analytical (BDTA) Framework which shows the data that flows in and out of the organizational boundaries and interactions with key stakeholders.	A review of the literature on Big data in tourism and hospitality is presented and a review is provided with the capability issues identified as either emergent or established.

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Table II: List of participants' general characteristics.

Participant ID	Job title	Industry	Expertise	Years of Experience
P1	BD manager	Tourism	Destination management	10 years
P2	Digital marketing manager	Hospitality	Digital marketing	15 years
P3	Enterprise architect	Tourism	IT infrastructure	14 years
P4	IT architect	Aviation	Database management	11 years
P5	Database consultant	Hospitality	Destination management	9 years
P6	Data scientist	Tourism	Data Insights and analytics	12 years
P7	IT analyst	Hospitality	Software analysis	10 years
P8	BD specialist	Tourism	Destination management	8 years
P9	Database manager	Tourism	Database programming	11 years
P10	Data analyst	Hospitality	Analytics	9 years
P11	IT programmer	Aviation	IT functionality	8 years
P12	Data analyst	Tourism	Data analytics	6 years
P13	Data architect	Tourism	Data infrastructure	16 years
P14	IT developer	Hospitality	IT functionality	12 years
P15	Database manager	Aviation	Database integration	10 years
P16	Digital media manager	Tourism	Digital marketing	8 years

P17	IT developer	Tourism	IT functionality	12 years
P18	IT programmer	Aviation	Programming	13 years
P19	CRM manager	Tourism	Customer insights	7 years
P20	Database manager	Aviation	Database integration	9 years
P21	Data analyst	Tourism	Analytics	10 years
P22	CRM manager	Tourism	Customer insights	8 years
P23	IT developer	Aviation	IT functionality specialist	12 years
P24	Database architect	Tourism	Data infrastructure	8 years
P25	Database manager	Tourism	Database integration	9 years
P26	Database architect	Aviation	Data management	6 years
P27	Data analyst	Tourism	Data Analytics	9 years
P28	Social media manager	Hospitality	Social media functions	6 years
P29	Data insights manager	Hospitality	CRM systems	9 years
P30	IT project manager	Aviation	Project management	15 years
P31	Tourism manager	Tourism	Business management	12 years
P32	IT manager	Tourism	IT services	18 years
P33	Social media manager	Hospitality	Social media functions	7 years
P34	Database consultant	Tourism	Business management	8 years
P35	Data analyst	Tourism	Analytics	5 years

Figure 1. Data structure explaining inductively generated dimensions on BD.

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58
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Appendix A: Big Data in Tourism sector – Focus group Guide

1.a What are the tourism industries where you have seen big data in use?

1.b. What are the reasons for using big data in dynamic, volatile and time-sensitive

industries, as those of the tourism sector?

2.a. Is the uptake of big data helpful in the context of tourism-related services?

2.b. How would you assess the usage rate of big data amongst tourism-related

business managers?

3. How do managers and marketers use big data to solve business issues in the tourism

   sector from both a technological and a managerial perspective? (this could be from

   either corporate, business or functional and/ or combination)

4. What are the challenges for adopting Big Data in the dynamic, volatile and time-

   sensitive industries of the tourism sector? (capability, resources, barriers/ constraints)

5. What business models are being used for developing a knowledge base for integrating

   big data for businesses of the tourism sector?

6. How can Big Data be used to improve and integrate departments, such as operations,

   marketing, IT, and supply chains?

7. How can management use big data to create a differentiated tourism product, through

   unique selling positions that may lead to a competitive market advantage?

8. How can management use big data to enhance product offerings, customer

   experiences, and branding within and across organizations in the tourism sector?

9. What do you think is the likely future of big data in dynamic, volatile and time-

   sensitive industries, and particularly those of the tourism sector?