

研究論文

Developing a Smart Tourism Destination through Social Big Data: Multiple Case Studies from Wakayama Prefecture

大池 洋史^{1、2}、佐野 楓³

Hiroshi Oike, Kaede Sano

1 和歌山県庁

2 和歌山大学大学院観光学研究科博士前期課程短期履修コース（9期生、2021年3月修了）

3 和歌山大学観光学部准教授

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Abstract :

This study uses Wakayama prefecture as a showcase to demonstrate how local governments and Destination Management Organizations (DMOs) can develop a smart tourism destination (STD) themselves through the social big data available from tourists. This study highlights the misunderstanding that STD can only be built based on state-of-the-art technology supported by national government through the conceptualization of an STD. Social big data is an essential resource that can assist local governments and DMOs in enhancing tourists' smart experience and supporting smart business ecosystems. This study also emphasizes the importance of shifting from government-centered STDs to value co-creation among all stakeholders. Finally, the implications for researchers and practitioners interested in the managerial exploitation of social big data in planning and developing STDs in local places are presented.

1. Introduction

Smart tourism destination (STD) is a novel concept established by the rise of smart tourism and has been identified as a marketing strategy to improve competitive superiority in tourism (Gretzel, Werthner et al., 2015). The concept of a smart destination is a component of smart tourism (Gretzel, Sigala et al., 2015) and is built on an infrastructure of state-of-the-art technology (Gretzel, Werthner et al., 2015). To enhance their destinations' competitive superiority, more local governments are making efforts to integrate information and communication technology (ICT) into physical infrastructure and implement numerous related policies (Park et al., 2016). Strong technological foundations have, therefore, become a necessary condition for developing STDs (Tribe & Mkono, 2017). However, such foundations require immense institutional and financial support from governments, which negatively affects the self-development of STDs (Gretzel, Sigala et al., 2015).

Regarding STD development, past studies (e.g., Hernández-Martín et al., 2017; Ivars-Baidal et al., 2017; Park et al., 2016; Trinchini et al., 2019) tend to emphasize the roles of governments, destination management organizations (DMOs),

or business entities but overlook the importance of value co-creation among stakeholders, especially the role of tourists themselves. That is, not only practitioners but also scholars have paid more attention to STDs driven by governments, DMOs, and business entities than by individual tourists. Regrettably, this situation works against STD foundation because STDs are characterized as business ecosystems that encourage open innovation among stakeholders (Gretzel, Sigala et al., 2015).

It is essential, therefore, to discover an efficient but low-budget way to build and develop STDs as well as to consider how to enhance value co-creation to achieve this goal, thus benefiting local areas that may receive limited financial support from national government. An STD is the result of interaction among multiple destination stakeholders through dynamic platforms, knowledge-intensive communication flows, and strengthened decision support systems with the goal of creating a smart experience (Vecchio et al., 2018). From this perspective, social big data generated from social media, along with interconnectivity, real-time synchronization, and intelligent use of data, has become the major driver for value

creation from tourists (Gretzel, Sigala et al., 2015; Vecchio et al., 2018). In this paper, social big data is defined as “processes and methods that are designed to provide sensitive and relevant knowledge to any user or company from social media data sources when data sources can be characterized by their different formats and contents, their very large size, and the online or streamed generation of information” (Bello-Organ et al., 2016, p. 66). Based on this definition, it is assumed that social big data can assist destination planners in better understanding tourist needs, thus providing an improved tourism experience within the smart tourism context (Buhalis & Foerste, 2015). More importantly, social big data as a proxy for the infrastructure of state-of-the-art technology greatly enhances the development of STDs in local areas.

Focusing on the nexus of STDs and value co-creation through social big data, this study aims to contribute a theoretical lens to conceptualizing STDs. Service dominant logic (SDL) has been proposed as a theoretical foundation for smart destination ecosystems since 2013 (Wang et al., 2013). However, studies in this field frequently emphasize STD’s strategic-relational, instrumental, and applied levels (Ivars-Baidal et al., 2017) but overlook its conceptualization, resulting in a misunderstanding of STDs. This study also suggests how social big data can assist local governments and DMOs in understanding tourists’ needs and in creating a smart experience for tourists; thus, it practically contributes to developing STDs. This is an exploratory multiple case study that takes four popular tourist destinations in Wakayama prefecture as the research context. Cross-case analysis is a useful method for understanding the value creation challenges brought about by social big data associated with unconventional experiences in a STD (Vecchio et al., 2018).

II. Theoretical background

1. Conceptualization of a smart tourism destination

An STD is a destination that can offer to visitors and local residents a rich experience by using state-of-the-art ICT or exchanging and sharing information (Gretzel, Werthner et al., 2015) and is one component of smart tourism (Gretzel, Sigala et al., 2015). An STD is conceptualized as a smart city (Del Chiappa et al., 2015) whose platforms are built using smart technologies. Initially, smart cities typically aim to employ these technologies innovatively to enhance the lives of residents, but the sophisticated atmosphere produced by smart buildings, infrastructures, and networks is then exploited to attract tourists. According to Gretzel, Sigala et

al. (2015), in addition to STDs, smart experiences and smart businesses are the components of smart tourism. A networked system of stakeholders provides services to tourists to create smart experiences and functions as a platform to bring about interactions related to tourism, with the goal of maximizing user and customer satisfaction (Del Chiappa & Baggio, 2015). Smart business can be approached as a business ecosystem (Gretzel, Werthner, et al., 2015) that includes complex relationships between the interested parties.

While the comprehensive framework of smart tourism defined by Gretzel, Sigala et al. (2015), it lacks discussion regarding how the three components relate to each other. According to Lopez de Avila (2015, n.p.), an STD is “an innovative tourist destination, built on an infrastructure of state-of-the-art technology guaranteeing the sustainable development of tourist areas, accessible to everyone, which facilitates the visitor’s interaction with and integration into his or her surroundings, increases the quality of the experience at the destination, and improves residents’ quality of life.” Therefore, STD is a wider concept and includes both a smart business ecosystem and smart experience. In other words, to support and develop an STD, building smart business and enriching tourists’ smart experience are essential. Del Chiappa and Baggio (2015) emphasized the importance of the real and virtual aspects of STDs connecting with each other through network systems. These networked systems are supported not only by technological constructional infrastructures but also by platforms of information technologies, such as physical networks for information communication, digital applications, and services offered through ICT. Such networks are built to obtain, store, and share data, information, and knowledge to better understand tourists’ preferences, aiming to provide them with a smart experience at a certain destination. A smart experience also needs support from a smart business ecosystem (Corrêa & Gosling, 2020; Wang et al., 2016). Normally, a business ecosystem comprises the suppliers of products or services, and the value of their products or services is created and improved only in this ecosystem. In a smart tourism ecosystem, however, the interested parties consist of tourism suppliers, suppliers from other industries, government agencies, DMOs, and ICT infrastructures as intermediaries, touristic consumers, and residential consumers (Coca-Stefaniak, 2020). Therefore, in a smart tourism ecosystem, not only destination makers but also consumers contribute to creating the destination’s value. Value co-creation by both consumers and the destination stakeholders is essential for the development of an STD. Hence, it is crucial to correct the

misunderstanding that only government-driven, state-of-the-art technology can serve as the foundation of an STD to positively promote value co-creation with tourists.

2. Service-dominant logic as a foundation for smart tourism destination

SDL was originally a theory used in the marketing field to redefine the value exchange between supplier, producer, and consumer (Vargo & Lusch, 2004). It is a logic of economic science and advocates that the values of products or services are not only determined by suppliers; rather, values are generated at the time the consumer perceives them. The core concept of SDL is that value is user-defined and co-created (Lusch & Vargo, 2016). Based on SDL foundational premises (FPs), “the customer is always a co-creator of value” (FP6), and “all social and economic actors are resource integrators” (FP9). Vargo and Lusch (2004, 2008) have argued that consumers do not merely receive the value created by the company but also become participants in the creation of value. As can be seen from the definition of service, all entities that apply competences for the benefit of others and themselves—that is, consumers, in terms of SDL—are also service providers. In SDL, therefore, the consumer’s feedback on the service provided by the company is regarded as a service provision. Such a process of exchanging services can be called value co-creation.

Although the SDL lens might lack the profoundness necessary to acknowledge the complexity of an STD (Wang et al., 2013), it has become a recognized approach for understanding the STD context and future directions (Boes et al., 2016). As discussed previously, the overemphasis on state-of-the-art technology necessary to develop an STD has resulted in the misunderstanding that smart destinations require large budgets and government-driven development, which has blocked the growth of local areas as STDs. However, STD is ultimately the connection between human actors and their interactions with technology for value co-creation (Boes et al., 2016). From the SDL perspective, an assumed premise of cooperation is open innovation, which emphasizes that tourism destination stakeholders are resource-integrating actors, interconnected and engaging in value creation together (Dahlander & Gann, 2010). Consequently, value “is obtained through the application and exchange of specialized knowledge and skills” (Vargo & Lusch, 2004, p.7), where all actors should be involved in the process of STD construction (Boes et al., 2016). Therefore, SDL is central to value co-creation in an STD (Boes et al., 2016).

3. Value co-creation through social big data

Big data can be categorized into two main types: data from and about the physical world (obtained from sensors, scientific observation, etc.) and data from and about human society (obtained from social networks, the Internet, marketing, etc.) (Jin et al., 2015). Social big data related to the latter is crucial for the development of STDs. Social Networking Service (SNS) strongly and easily facilitates interconnections among STD actors; therefore, with its emphasis on interconnectivity, SNS functions as an essential intermediary in STD (Gretzel, Sigala et al., 2015).

Social big data may include customers’ preferences, reputations, behaviors, pictures, and interactions with other tourists or residents. These data often indicate the uploader’s location and attributes, such as age, gender, and place of residence. There are enormous amounts of social big data on the Internet, which are updated in real time and can be distributed, exchanged, obtained, and used easily and inexpensively (Zeng & Gerritsen, 2014). Several studies have reported that user-generated text data included in SNS or word-of-mouth sites can be analyzed to ascertain the user’s preferences, positive/negative opinions, and emotions, as well as to improve destination management based on the results of social big data analysis (Brandt et al., 2017; Marine-Roig et al., 2015). Vecchio et al. (2018) conducted a statistical analysis of social big data and requested that tourism institutions complete a questionnaire to reveal the practical uses of social big data. Some studies utilize not only user-generated text data but also location data (e.g., geotag, GPS footprint) to estimate users’ behavior and the movement of crowds (Brandt et al., 2017; Salas-Olmed et al., 2018). Another source of social big data is geotagged photos uploaded to image-hosting web services, such as Flickr. Miah et al. (2017) analyzed geotagged photos with textual metadata on Flickr from the following four aspects: textual analysis, geographical analysis, representative photo identification using image features, and time series modeling for tourism destination management.

Social big data is an essential resource for enhancing value co-creation in destination management and marketing (Vecchino et al., 2018). In terms of STDs, social big data can assist DMOs in providing tourists with a smart experience (Buhalis et al., 2015)—that is, a rich, onsite tourism experience facilitated by personalization, context awareness, and real-time monitoring through the use of smart technology. To realize this, real-time aggregation of information on and ubiquitous connectivity at the destination are required. Therefore, as well as the intelligent use of social big data, an ICT infrastructure

must be established that can realize these functions at a high level with synchronization and real-time information sharing (Neuhofer et al., 2015; Tu & Liu, 2014). Social big data can also contribute to developing STDs from a business perspective (Gretzel, Werthner et al., 2015). Secundo et al. (2017) list the following four reasons for utilizing social big data in STD from the perspective of value co-creation: improving the decision-making process, enhancing and enriching tourists' experiences, developing new business models and new products/services, and creating interconnectedness within the business ecosystem. Such utilization leads to co-creation of the tourism experience, improved decision-making through data processing, and the anticipation of user needs (Vecchino et al., 2018).

4. Conceptual framework

As its conceptual framework, this study applied the theory of SDL to the STD concept. This framework describes the interrelationship between social big data and value co-creation in a smart tourism ecosystem. The framework includes three main elements: tourists, social big data, and destination makers. Tourists, the first element, are resource-integrating actors (Dahlander & Gann, 2010) who create social big data through social media. Social big data is an essential resource for open innovation among various stakeholders (Gretzel, Werthner et al., 2015). Lastly, destination makers, like tourists, serve as resource-integrating actors (Gretzel, Sigala et al., 2015) who aim to provide a smart experience for tourists and build an STD through social big data in the smart tourism ecosystem. Importantly, this framework contributes to the practice of SDL in the smart tourism ecosystem and suggests how to think of value co-creation through the application of social big data. Figure 1 outlines the framework of this study.

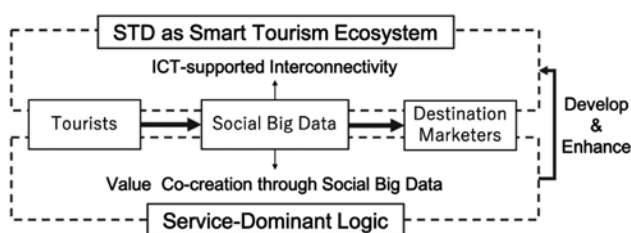


Figure 1. Conceptual framework

III. Methodology

This study employs multiple case study analysis to explore a set of regional tourist experiences related to four popular and representative destinations in Wakayama prefecture to derive patterns and opportunities of value creation generated by social big data in tourism. As mentioned above,

cross-case analysis is appropriate for monitoring contemporary events and behaviors that cannot be controlled, as well as for deriving theory from contemporary, real-life phenomena (Yin, 2017). Importantly, the method of multiple case studies is relevant “when multiple events are examined in their natural setting, employing different explorative approaches and tools for social big data retrieval and analysis” (Vecchio et al., 2018, p. 851).

1. Research target areas

Wakayama prefecture is located in western Japan and is famous for its natural resources. Tourism is a pillar industry in this prefecture's economic development. The number of visitors to the prefecture was 34,618,849 in 2018 and has increased by 111.8% since 2010 (Tourist Promotion Section of Wakayama prefecture, n.d.). Moreover, the economic ripple effect generated by tourism has been increasing, with tourist spending in the prefecture totaling 4,760 billion yen in 2014. This amount comprised 6.7% of the prefectural production value of Wakayama prefecture and marked a growth rate of 128.0% compared to the values reported in 2008 (Wakayama Prefecture, 2015).

However, Wakayama prefecture is a provincial area with a relatively small population by Japanese standards. Its population is the seventh smallest among Japan's 47 prefectures (Research and Statistics Division of Wakayama Prefecture, 2019), and the budgets of the local governments and DMOs can be considered small. The aim of this study was to ascertain how to develop an STD in an inexpensive way for institutions with small budgets. Therefore, it is reasonable for destinations in such areas to be surveyed to demonstrate the effectiveness of this study.

In this study, the following four research target areas were selected as popular and representative destinations in Wakayama prefecture: Tomogashima, Koyasan, Kumano Kodo, and Shirahama.

(1) Tomogashima

This area is an uninhabited island located on the sea in the northwestern part of Wakayama prefecture. It belongs to Wakayama City and is a part of Setonaikai National Park. In the past, this island was used for military purposes, and the remains of military facilities, such as batteries, are a major tourist attraction. As there is no residential area on this island, almost all visitors to this area can be considered tourists.

(2) Koyasan

This area is located in the mountainous area in the northeastern part of Wakayama prefecture. As the location of the head temple of the Koyasan sect of Shingon Buddhism, it is a sacred place and contains many traditional temples that serve as major tourist attractions. Some of these temples can accommodate overnight visitors, such as Shukubo. As part of this area is a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage site, included in the Sacred Sites and Pilgrimage Routes in the Kii Mountain Range (Tourism Exchange Division of Wakayama Prefecture, n.d.), the area is well known to foreign tourists (Tourist Promotion Section of Wakayama Prefecture, n.d.).

(3) Kumano Kodo

This is a general term for the ancient pilgrimage routes leading to Kumano Sanzan and represents three shrines: Kumano Hongu Taisha, Kumano Hayatama Taisha, and Kumano Nachi Taishaisha. The pilgrimage routes crisscross the Kii peninsula and span the Wakayama, Osaka, Nara, and Mie prefectures. The shrines, which serve as tourism attractions, are located in the southeastern part of Wakayama prefecture. Part of these routes was named a UNESCO World Heritage site as part of the Sacred Sites and Pilgrimage Routes in the Kii Mountain Range in July 2004 (Kumano Hongu Tourism Association, n.d.). Like Koyasan, Kumano Kodo is popular among foreign tourists (Tourist Promotion Section of Wakayama Prefecture, n.d.).

(4) Shirahama

This area is located in the southwestern part of Wakayama prefecture. Shirahama beach, recognized for its beauty, hot springs, and Adventure World, which is a zoo and amusement park where giant pandas are bred and exhibited, are the main tourist attractions. This area has the largest number of overnight tourists in Wakayama prefecture (Tourist Promotion Section of Wakayama Prefecture, n.d.).

2. Twitter as data source

Social media development and application in the tourism have brought a significant impact on individual tourist decision making process, as well as the ways of DMOs' understanding of tourists' preferences (Parra-López et al., 2011). Facebook, Instagram, and Twitter – the widely used social media serve as the essential tool to monitor how tourists evaluate certain destinations. Facebook is frequently used for destination promotion by DMOs (Kumar et al., 2021), and

online essays posted by individual tourists. Instagram provides the “visual focus” of destinations to tourists (Yu et al., 2020). Nevertheless, the current study aims to examine tourists' timely short context-based post, thereby the characteristics of Facebook and Instagram are not fit for the study purposes. According to Ćurlin et al. (2019), the prevalence of Twitter generated significant implications for the tourism industry. Twitter, a microblog service launched in 2006, is one of the world's major SNSs (Kwak et al., 2010). Text messages posted on Twitter are called tweets and contain a maximum of 140 Japanese characters or 280 characters of the Roman alphabet (until November 2017, this limit was also 140) (Rosen & Ihara, 2017). Text messages or articles with deep thoughts are more commonly posted on other blog services or SNSs that do not limit the number of letters posted. By contrast, on Twitter, as only short messages can be posted systematically, articles or events based on deep consideration cannot be written about at length. However, this limitation also makes it easy to tweet (Toriumi, 2015).

Important to this study is the co-creation of value by users and service providers as destination makers. To achieve this, it is necessary to convert the user's candid opinions that appear on social big data into the value of the destination from the perspective of the smart tourism ecosystem. These user-generated contents are also a criterion by which other consumers evaluate the value of tourism destinations. Twitter allows users to easily express various opinions and is used by many people worldwide. Therefore, from the perspective of value co-creation, Twitter is a suitable research subject for this study given the aim of this research and its theoretical background of using social big data to develop STDs.

Twitter is also equipped with a functionality that adds geotags to tweets. Geotagging is considered particularly useful for marketing analysis (Brandt et al., 2017; Miah et al., 2017; Salas-Olmed et al., 2018). Recently, however, in many cases, users have refrained from posting location information to protect privacy. According to Toriumi (2015), only about 0.1% of all tweets have geotags. Analysis using geotags (Brandt et al., 2017; Miah et al., 2017; Salas-Olmed et al., 2018) can be seen in previous studies that use slightly older data, which may be difficult to use for actual analysis. In this research, we adopted a method that does not rely on geotags. Thus, the methodology of this study matches the actual situation regarding how people use Twitter.

3. Latent Dirichlet allocation as a method for analysis

It is important for destination makers to recognize consumers' topics or trends to create and increase the value of the destination. Although social big data has potential as a source to enhance such value co-creation, which is essential for an STD, it is very time-consuming. It is also difficult to obtain useful information by inspecting the individual elements that make up social big data because of its enormous volume. To transform such data into value requires systematic and efficient information organization and knowledge aggregation. To achieve this, the current study adopts latent Dirichlet allocation (LDA)—the method proposed by Blei et al. (2003) to find latent topics included in discrete data, such as text corpora. In LDA, a topic model is generated from the collection of the texts designated as the training dataset. The topic model includes a predefined number of topics found in the training dataset. However, the concrete title of each topic (e.g., the genre or type of document) is not determined by LDA. Instead, each topic included in the estimated topic model is represented by the probabilistic distribution of the words composing its topic. That is, the topics found by LDA are expressed as words that were included in the topic and at the indicated probability.

Initially, as the generated topic model was used to estimate a document's unknown topic, this study focused on the topic model itself created from the training dataset. This was done to allow the analyst (actors in destination making) to glance at the words comprising each topic in the resulting topic model and interpret the latent topics included in the training dataset. The advantage of using LDA is that analysts do not need to prepare predefined topics, assumptions of concrete titles, or the content of the topics.

In this study, a set of text data about each target area collected from Twitter was used as the training dataset, and LDA was applied to these sets respectively. From the topic model generated by this process, this study estimated and interpreted the latent topics contained in the set of tweets and examined potential indications for the development of an STD.

4. Data description

As a training dataset, tweets related to the four survey areas (Tomogashima, Koyasan, Kumano Kodo, and Shirahama) were collected from Twitter using a keyword search function offered by Twitter through an Internet browser. The words for the keyword search were set as the area name, such as “友ヶ島” or “tomogashima,” “高野山” or “koyasan,” “熊野古道” or “(kumano AND kodo),” and “白浜” or “shirahama.”

The period of the subject data was from January 1, 2018 to December 31, 2018. The content collected from the tweets for the dataset included the date and time of the post, text message (including hashtag), username, language, and number of retweets and likes. The number of tweets in each dataset was as follows: Tomogashima: 8,351; Koyasan: 58,583; Kumano Kodo: 31,001; and Shirahama: 226,258. Both Japanese-character notation and Roman-letter notation were used for the keyword search to capture tweets posted by both domestic and foreign tourists for the analysis.

The temporal distributions of the datasets are shown in Figures 2 and 3. Figure 2 illustrates the temporal transition of the number of tweets in a day. The horizontal and vertical axes represent hours of day and the proportion of the number of tweets in each dataset, respectively. A similar trend was observed in all four datasets. Unsurprisingly, Twitter users were less active during night (1pm – 6pm). An increase in the number of posts per hour was observed from 7pm and peaking at noon. The number then decreases slightly until about 3 pm (until about 5 pm in the Tomogashima dataset) and then rises again, peaking again around 9 pm and decreasing toward midnight.

Figure 3 shows the number of tweets by month. The horizontal and vertical axes represent the month and proportion of the number of tweets in each dataset, respectively. While the trend of the Kumano Kodo dataset was flat, for the other three datasets, a large number of tweets was seen in August, which is the summer holiday season. For the Tomogashima dataset and the Koyasan dataset, the number was relatively high in May and November, respectively.

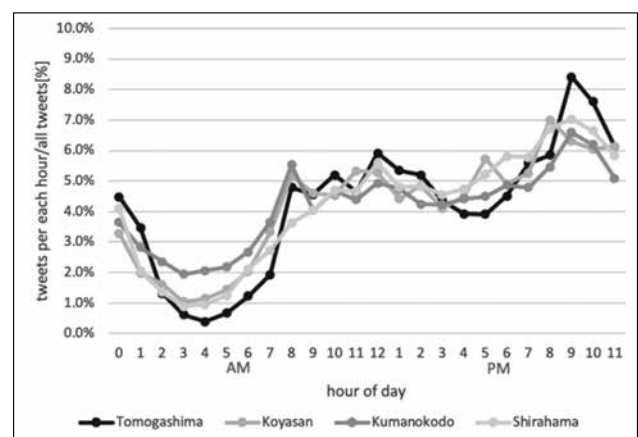


Figure 2. Transition of number of tweets per each hour

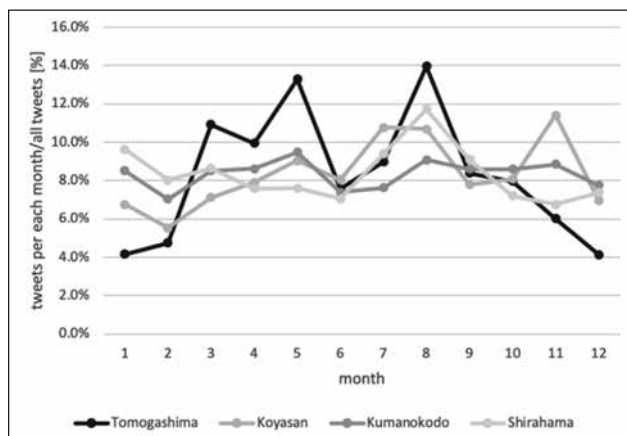


Figure 3. Transition of number of tweets per each month

IV. Data analysis and findings

In this section, the concrete process for estimating the topic model by LDA and the resulting findings are discussed. As the research target is Japanese tourists (domestic tourists), only the tweets in Japanese have been examined. While this paper is written in English, the subject data are in Japanese. Therefore, in this study, the Japanese word is notated as follows: “Japanese Word (translated English word if there is suitable one).”

1. Process for estimating the topic model with LDA

Before applying LDA to text data, the words, including the text message, must be identified. Japanese is categorized as an agglutinative language in terms of morphological classification and has a structure in which multiple adjunct words (particles, etc.) are combined with independent words without using spaces. Therefore, applying LDA of natural language processing to Japanese sentences requires morphological analysis to identify the boundary of the word and adjunct, followed by abstraction of the word. In this study, Janome v0.4, which can be driven by Python, was used to conduct morphological analysis; thus, the words and their word classes in each tweet in the dataset were identified and abstracted.

The next step was the elimination of noise factors. In this step, words and tweets that may have a bad effect on the reliability of the topic model estimated by LDA were eliminated. Although there are various kinds of tweets on Twitter, not all include meaning. Examples are tweets that have only a symbolic character or URL or are relatively short. Given that the key feature of Twitter is convenient text messaging, such tweets are often intended to be interpreted in a wider context. For methods that estimate the topic probabilistically,

like LDA, if such meaningless data are included in the training dataset, the accuracy of the estimation is likely to decrease (Xhao et al., 2011). In this study, strings that had the following conditions were regarded as stop words (signifying characters or strings that should be excluded from the input data for LDA): URLs, single-byte symbolic characters, usernames, and words composed of a single hiragana, katakana, or alphanumeric character. Furthermore, the word classes of the words used as the training dataset for LDA were nouns and adjectives (Kitada et al., 2015). Verbs, adverbs, and other word classes were excluded because many near-meaningless words are abstracted in the construction of the topic model (e.g., for verbs: “する [do]” and “やる [do]”; for adverbs: “いつも [every time]”). In each dataset, words that appeared in more than 70% of all tweets and that appeared once in the dataset were also excluded from the input words for LDA as they might also be noise for the estimation of the topic model (Xhao et al. 2011).

After these processes were conducted, the topic model was estimated by using LDA. As a tool for LDA, Gensim v3.8.3, which is implemented as a module for Python, was used in this study. In LDA, the number of topics included in the estimated topic model must be predefined. In this study, the number of topics was empirically set to 30.

The results are shown in Appendices 1 to 4, which include the top 10 words estimated to be highly relevant to each topic included in the topic model estimated from each dataset. As mentioned above, the model obtained by LDA does not explicitly indicate the topic type, its name, or its genre. Instead, it provides a list of words related to the topic. As these models are probabilistically and mathematically estimated, some topics are difficult for humans to interpret. That is, there is uncertainty about the practical relevance of the topics presented by LDA and the words that constitute them. However, the data analysis result also includes topics that analysts can interpret subjectively and experientially. From these words, the analyst can infer what the topic is about, and this interpretation process may highlight latent topics of which the analyst was previously unaware in the social big data used as training datasets for LDA. Therefore, the analyst needs to perform this interpretation as the next analytical step. The following sections present the findings from each dataset, review the experimental results in comparison with the actual tourism situation in each survey area, and discuss the practical interpretation of the representative topic in the topic model estimated by LDA.

2. Findings

(1) Tomogashima: A setting for *Laputa: Castle in the Sky*

Tomogashima has been officially promoted as an uninhabited island containing numerous gun batteries and air raid shelters built by the Japanese military during World War II. Accordingly, Tomogashima is one of representative historical attractions in Wakayama Prefecture. Moreover, because of the beautiful landscape and rich natural resource, it is also a popular place for strolling.

In addition to the historical attraction, Twitter users more frequently recognize Tomogashima as a setting for *Laputa: Castle in the Sky*, a famous Japanese animation movie produced by Studio Ghibli. Topic 3 included the words “アニメ (animation),” “舞台 (stage),” “廃墟 (ruin),” and “注目 (notice).” Topic 21 included “城ラピュタ (castle Laputa)” and “神秘 (mysterious),” while Topic 23 included “ジブリ (Ghibli).” Topic 24 was strongly related to “島 (island)” and “ラピュタ (Laputa).” From these four topics, it could be inferred that people associate Tomogashima, its military ruins, and the

setting of the animation movie. In fact, some media outlets, such as news sites, have introduced Tomogashima as an island whose atmosphere can give visitors a sense of being in the scenery of *Laputa: Castle in the Sky* (Nikkey, 2014). LDA also suggested a topic related to such an online article in Topic 24, which included the word “linenews” and “ラピュタ (Laputa).” In Topic 27, the words “聖地 (sacred place),” “デスクリムゾン (Death Crimson [title of a Japanese video game]),” “ラピュタ (Laputa),” and “ロケ地 (location)” appeared; therefore, this topic may be interpreted as concerning pilgrimage to places sacred to Japanese subcultures, such as animation settings (Okamoto, 2015) (Appendix 1).

(2) Koyasan: A sacred place of religion

Unlike Tomogashima, Koyasan seems to be recognized according to its traditional image—as a sacred place of religion. For example, Topics 1, 2, 4, 5, 6, 9, and 14 present similar words, such as “聖地 (sacred place),” “宗教 (religion),” “坊さん (priest),” “金剛峰寺 (Kongobuji Temple),” and “極楽橋

Appendix 1: Topics estimated by LDA and the first 10 words in each topic for the Tomogashima dataset.

Tomogashima										
Topic1	キャンプ	次	ロケ	夏	軍艦島	昔	絶対	場所	お願い	撮影
Topic2	和歌山	海	無人島	興味	キャンプ	加太	山	友達	家	休み
Topic3	アニメ	舞台	よう	島	日本軍	廃墟	注目	加太	他	和歌山
Topic4	高野山	更新	ない	画像	桜	戦争遺跡	いい	和歌山	アメプロ	場所
Topic5	作品	羨ましい	早い	夏	和歌山	運休	一度	今日	皆さん	手前
Topic6	和歌山県	和歌山市	in	at	im	上陸	気温	3砲台跡	和歌山	ない
Topic7	場所	気	ほう	遠い	和歌山友ヶ島	こちら	フェリー	白浜	問題	和歌山
Topic8	海	家	和歌山	今朝	一友ヶ島	無人島	波	459	風	73
Topic9	廃墟	紹介	和歌山県和歌山市加太	6回目	心霊スポットシリーズ	事	雷	監視	乗員130名	発生艦首
Topic10	人	加太港	感じ	淡い	前	淡島神社	フェリー	嶋神社	少ない	いい
Topic11	あと	もの	和歌山	明日	ラピュタ	news	神秘的	全部	コスプレ	楽しい
Topic12	天候	北	6月	市内	長い	ほんと	久しぶり	大久野島	味	忙しい
Topic13	どこ	誰	5月	船	欠航	和歌山	仕事	加太	3月	風
Topic14	ない	中	こと	予定	猿島	孔雀	和歌山	さん	事	煉瓦
Topic15	私	今	人	世界	和歌山	ファインダー越し	写真	砲台跡	自分	自然
Topic16	友ヶ島汽船乗り場	僕	イベント	平日	和歌山	一人	こと	方	あなた	和歌山県
Topic17	和歌山	寒い	今年	今日	photography	私	海	旅	オススメ	楽しみ
Topic18	ここ	ええ	和歌山	猫	感じ	こと	時	声	凄い	わたし
Topic19	本気	方	なん	とき	和歌山	住所	そう	1回	景色	こと
Topic20	好き	多く	虫	沖ノ島	天空	城ラピュタ	建物	紀淡海峡	いい	砲台
Topic21	海	無人島	和歌山	城ラピュタ	天空	家	今日	神秘	展望台	ブログ
Topic22	ボブテビック	船	暖かい	とこ	撮影	一緒	友ヶ島行き	デスクリムゾン	ない	無い
Topic23	キャン	海苔	美味しい	ほしい	ジブリ	廃墟	モデル	加太	つもり	キャンプ場
Topic24	島	linenews	ラピュタ	チャレンジ	和歌山県	人	line アカウントメディア	どこ	別名ラピュタ	新宮加太海南北浜答え
Topic25	ない	春	こと	強い	和歌山県友ヶ島	真鯛	最後	和歌山市	秋	加太
Topic26	加太	無人島	和歌山	ブログ	砲台跡	時間	電車	面白い	友ヶ島ブログ更新	yahoo ブログ
Topic27	聖地	デスクリムゾン	ため	和歌山	ラピュタ	撮影会	テンション	去年	ロケ地	森
Topic28	ラピュタ	良い	よう	日	雰囲気	人気	写真	時	島	話題
Topic29	写真	いい	時	和歌山	笑	探検	こと	楽しい	これ	やつ
Topic30	海	和歌山	島	すごい	風	天気	良い	無人島	近い	家

(Gokurakubashi bridge),” which describe the characteristics of Koyasan.

As well as words relevant to the sacred place of religion, the results also included the specific word “プラタモリ”. “プラタモリ,” which is an NHK television program. Koyasan was featured in the program in 2017 (NHK, 2017), which evinces the program’s influence in destination marketing. Other topics included those that could be categorized as a reaction to or impression of Koyasan according to the season. Topic 13 is composed of the words “寺 (temple),” “素敵 (nice),” “秋 (autumn),” and “紅葉 (fall leaves).” From this topic, it could be inferred that autumn leaves are a major attraction in Koyasan in the autumn. Topic 25 was composed of the words “寒い (cold),” “宿坊 (Shukubo),” “雪 (snow),” “笑 (smile),” and “美味しい (delicious).” The word “寒い (cold)” seems to indicate a negative impression, but the topic also included “笑 (smile),” which is a character used in messages about something fun or interesting, as well as “美味しい (delicious)” and the tourism-related word “宿坊 (Shukubo).” Hence, it seemed that the

tourists likely enjoyed the cold weather. By contrast, although no concrete idea could be ascertained, Topic 17 appeared to represent a negative image as it comprised the words “ない (nothing),” “悪い (bad),” and “・・・グスン (sad)” (Appendix 2).

(3) Kumanno Kodo: An enjoyable world heritage site

As Topic 1 was composed of the words “世界遺産 (world heritage),” “参詣道 (pilgrimage route),” and “紀伊山地 (Kii Mountain Range),” it could be interpreted as focused on Kumano Kodo as a UNESCO World Heritage Site. Topic 2 included “巡礼 (pilgrimage),” “神社 (shrine),” and “遠い (far),” suggesting that the shrines were dotted around the pilgrimage route area. Topic 9 could be interpreted as geographical from the words “三重県 (Mie prefecture),” “和歌山県 (Wakayama prefecture)” and “奈良県 (Nara prefecture).” Topic 11 might relate to tourist attractions as it comprised the words “那智 (Nachi),” “滝 (waterfall),” “熊野那智大社 (Kumano Nachi Taisha Shrine),” and “熊野本宮

Appendix 2: Topics estimated by LDA and the first 10 words in each topic for the Koyasan dataset.

Koyasan										
Topic1	聖地	道場	こちら	プラタモリ	姿	投稿	日本仏教	我孫子市	詳しい	平安時代
Topic2	僧侶高野山	仏教	怒り	仕事	すべて	新しい	rt	歌	夏	大師遍照金剛
Topic3	今年	高野山	私たち	ところ	人	好き	初詣	年	多く	価値
Topic4	高野山真言宗	外国人観光客	高野山行き	宗教	神社	関係	近畿	うち	なべ町	寺院和歌山県
Topic5	坊さん	よい	高野山	面白い	一つ	麓	優しい	御朱印帳	nara	香り
Topic6	高野山	金剛峯寺	案内	犬	さん	意識	ケーブルカー	極楽橋	遠い	山道
Topic7	高野山	in	at	和歌山県	奥の院	im	高野町	壇上伽藍	高野山駅	無理
Topic8	和歌山	高野山	私	世界	写真	yahoo ニュース	女人禁制	御朱印	女性	綺麗
Topic9	方	唐	高野山	やすい	比叡山	天台宗	空海弘法大師	最澄伝教大師	金剛峰寺	真言宗
Topic10	心	弘法大師	空海	誰	仏	真言	人々	連想	口	次
Topic11	人	高野山	これ	野山	参拝	開祖	夜	欲しい	歴史	家族
Topic12	言葉	時	良い	高野山	こと	世界遺産	寒い	私	深い	道
Topic13	高野山	寺	素敵	秋	和歌山県	紅葉	場所	コラボレーション	旅	対応
Topic14	空海	真言宗	密教	大日如来	即身成仏	加持祈祷	八幡山東寺	高野山金剛峯寺	高野山	寺院
Topic15	ため	そう	高野山	無い	南海	きつい	台風	今回	意味	近く
Topic16	こと	高野山	自分	ない	楽しい	前	よう	ここ	すごい	野山
Topic17	ない	高野山	koyasan	悪い	temple	・・・グスン	koya	de	koyasan	en
Topic18	高野山	いい	多い	山	明日	それ	手	野山	みたい	どこ
Topic19	今日	高野山	事	よう	護摩行	野山	昨日	少ない	時間	外国人
Topic20	koyasan	急	exp	高野山極楽橋 rapid	僧侶	高野山	人間	大変	つもり	that
Topic21	もの	高野山	辺路	院	奥	確か	伊勢路	熊野古道	高い	紀伊路
Topic22	営業	水	伝統	お守り	くじ	高野山	供養塔	不動明王	3日	まもり
Topic23	高野山東京別院	春	みなさん	難しい	教え	真言密教	高野山高校	高野山	皆様	際
Topic24	日本	高野山	俺	墓石	一番	家	でかい	強い	南海電鉄	静か
Topic25	高野山	高野山金剛峯寺	寒い	宿坊	雪	笑	今	お寺	野山	美味しい
Topic26	koyasan	japan	the	in	of	霊場	to	and	travel	紀伊山地
Topic27	お願い	本日	大阪	高野山	イマソラ	心豊か	have	料理	感謝	暖かい
Topic28	高野山	修行	とき	次	駅	ほう	一部	変更	ええ	急行
Topic29	高野山	誕生日	更新	空海上人	誕生	伝承	魚	6月15日	香川県善通寺市	宗祖降誕会青葉まつり
Topic30	天	koyasan	高野山極楽橋 tenkunonreserved	空自由席	高野山奥の院	どこ	お参り	車	mcba	九度山

大社 “Kumano Hongu Taisha Shrine,” which are included in the World Heritage sites. Topic 29 is composed of the words “自然 (nature),” “夏 (summer),” “美しい (beautiful),” and “すごい (great),” which likely points to a set of tweets related to people’s enjoyment of Kumano Kodo in the summer.

Although these topics were the result of LDA automatically extracting already-known facts, some specific topics were also extracted. For example, Topics 10, 15, and 17, included the words “花 (flower)” and “友達 (friend),” “恋人 (boyfriend/girlfriend),” and “駐車場 (car park),” respectively. It is difficult to identify immediately how these words relate to Kumano Kodo, or whether these topics should be monitored in terms of tourism or have the possibility of becoming a topic in real scenarios (Appendix 3).

(4) Shirahama: A destination related to other tourist destinations

Shirahama is one of the most popular destinations in southern Wakayama prefecture and attracts millions of tourists every year, especially families. Topic 10 included the words “アドベンチャーワールド (Adventure World),” while Topic 12 contained “白浜温泉 (Shirahama hotspring)” and “湯 (hot water).” Topic 16 comprised “南紀白浜 (Nanki Shirahama),” “ホテル (hotel),” and “千畳敷 (Senjojiki),” and Topic 21 included “白良浜 (Shirarahama).” From these sets of words, it can be inferred that the topics involved tourist destinations or other tourism-relevant ideas. These topics were also composed of words representing impressions, opinions, and comments; for example, Topic 10 included “美味しい (delicious),” Topic12 included “楽しい (fun),” Topic16 included “最高 (best)” and

Appendix 3: Topics estimated by LDA and the first 10 words in each topic for the Kumano Kodo dataset.

Kumano Kodo										
Topic1	世界遺産	参詣道	霊場	紀伊山地	熊野古道	凄い	盛りだくさん	春	マメ知識8選	雑学
Topic2	巡礼	遠い	神社	美味しい	旅行	熊野古道	最高	一部	紀北町	三重県立熊野古道センター
Topic3	道	in	和歌山県	熊野古道	駅	幻想	at	im	田辺市	ブログ
Topic4	山道	九州	いかが	熊野古道サポーターズクラブ	tanabe	熊野古道大門坂	伊勢志摩	one	熊野古道	かわいい
Topic5	熊野古道	熊野古道中辺路	海	無い	いつか	石畳	心	今回	昨日	途中
Topic6	キタノ	*1	連休	営業	金土	問い合わせ	予約	熊野古道	本宮町	民宿
Topic7	熊野古道	温泉	場所	いい	とこ	ここ	宿	一緒	中	参拝
Topic8	店	メニュー	連休	営業	予約	金土	中辺路なか	温泉情報	*2	願
Topic9	日本	三重県	世界遺産	和歌山県	奈良県	紀伊山地	霊場	参詣道通称熊野古道	国	過去
Topic10	熊野古道	ため	花	参詣道	登山	熊野古道行き	熊野三山熊野本宮大社熊野速玉大社熊野那智大社	総称	あと	世界遺産
Topic11	熊野古道	那智	滝	高野山	一つ	熊野那智大社	熊野本宮大社	南紀	世界	参加
Topic12	熊野古道	mie	旅	熊野	那智勝浦	japan	それ	雰囲気	kumanokodo	近い
Topic13	塩分高め	時	熊野古道	田辺市	お知らせ	一つ	梅干し	保全	good	内
Topic14	熊野古道	聖地	えり	よみ	白浜	紀伊民報	de	パンダ	ツボ	謎
Topic15	熊野古道	前	道	世界遺産	神聖	友達	水	自慢	恋人	盛りだくさん
Topic16	オススメ	古道	熊野古道	世界遺産	有名	ない	本	こと	熊野参詣道	道
Topic17	熊野古道	いい	コース	笑	駐車場	人	これ	辛い	さん	ところ
Topic18	和歌山	熊野古道	みたい	湯	紹介	所	峰温泉	家	僕	ニュース
Topic19	営業	連休	予約	願	*2	写真	掲載	金土	民宿 喫茶 カフェ お茶屋 大阪熊野古道	辺沿い貸し切りペンション
Topic20	三重	熊野	事	神	もの	高い	誰	知名度	それら	液晶テレビ鳥羽水族館伊賀忍者四日市ぜんそく
Topic21	kumanokodo	japan	the	県	rt	説明	共感	単語	kumano	三重県民
Topic22	パワースポット	辺路	中辺路	熊野古道	伊勢路	2月	熊野本宮大社	紀伊路	世界遺産	beautiful
Topic23	和歌山県	貸し切り別荘 世界遺産	一泊2名様 7500円	近所	熊野古道	予約	問い合わせ	*3	貸し切り別荘 喫茶カフェ	お茶屋大阪
Topic24	伊勢神宮	熊野古道	何	どこ	坂	車	大峯奥	大峰山	森	テレビ
Topic25	次	熊野古道	うち	新しい	人気	帰り	楽しみ	整備	目標	みんな
Topic26	そう	熊野古道	今	観光	絶景	紀伊半島	よい	歴史	奈良	本日
Topic27	熊野古道	感じ	京都	気	新宮	野山	嬉しい	もん	今度	予定
Topic28	熊野古道	こと	ない	方	良い	好き	今年	自分	時間	よう
Topic29	熊野古道	今日	世界遺産	自然	中	夏	美しい	すごい	海	熊野市
Topic30	予約	問い合わせ	熊野古道	民宿	ライダーズハウス・ペンション・旅館	キタノ	*1	醍醐	和歌山県本宮町伏拝王子	貸し切り別荘

Note: *1, *2, *3: The words that might include phone number, therefore, the authors removed the content.

“遠い (far),” and Topic21 included “楽しみ (pleasure),” “凄い (great),” and “オススメ (recommendable).” Thus, these topics also appear to concern the evaluation of tourism in the area. Topic 18 included “パンダ (Panda),” and Topic 22 included “かわいい (cute)” and “ジャイアントパンダ (Panda)” with “アドベンチャーワールド (adventure world),” both of which may indicate that the breeding and exhibition of pandas at Adventure World was attracting substantial interest.

Although, some topics in the analysis results for this dataset included the word “和歌山県 (Wakayama prefecture),” such as Topics 11 and 30, a relatively large number could only be tentatively related to Shirahama in Wakayama prefecture. For example, Topic 4 included the word “伊豆 (Izu),” which refers to an area in Shizuoka prefecture, Topic 5 included “京都 (Kyoto),” Topic 28 included “南房総市 (Minamiboso City)” in Chiba prefecture, and Topic 29 included “姫路市 (Himeji City)” in Hyogo prefecture. In fact, various places,

areas, facilities, and tourism attractions include the words “白浜 (shirahama),” and there is also “Shirahama Aquarium, Kyoto University” in Wakayama prefecture. Topics 4, 15, 25, and 27 also contained the word “白浜 (濱) (shirahama)” but in relation to an entertainer’s name. As such, this LDA result produced quite a few unexpected topics because the word “白浜” and “shirahama,” which were used for the keyword searches on Twitter, were less specific and more general and ambiguous words than those used in the searches used for the other locations (Appendix 4).

V. Discussion

1. Tourist smart experience creation through social big data

Smart experience is an important component of an STD, and social big data is expected to enhance tourists’ smart experience (Buhalis & Foerste, 2015; Gretzel, Werthner et

Appendix 4: Topics estimated by LDA and the first 10 words in each topic for the Shirahama dataset.

Shirahama										
Topic1	早い	今年	遅い	悪い	キス	撮影	結果	帽子	残念	近畿
Topic2	笑	メンバー	好き	中	爆笑	みんな	白浜	詳しい	春	大丈夫
Topic3	俺	昔	二人	白浜	最近	ほんま	町	今夜	営業	学歴
Topic4	夢	綺麗	ところ	高い	alan	伊豆	朝	映画学校	すさみ町江須崎島	和歌山県白浜町千畳敷
Topic5	一緒	mirai	宿	大好き	ヒーロー	京都	ライブ	1年	サーフィン	白浜旅行
Topic6	いい	ない	白浜	人	ため	兼一	by 白浜	やつ	ボク	関係
Topic7	下田	白浜	家族	顔	wakayama	945 発グランドウイング	17 号成田空港行	1145 発グランドウイング	25 号成田空港行	43 号成田空港行
Topic8	rt	質問箱	募集	時代	♀	わけ	2018 年	まじ	力	投稿
Topic9	海	もの	毎日	白浜	辛い	言葉	合宿	前日	恐怖	最後
Topic10	こと	アドベンチャーワールド	ない	美味しい	何	白浜	白浜駅	外見	ため	他人
Topic11	和歌山県	in	白浜町	at	im	東京	official	アドベンチャーワールド	市場南紀白浜	声
Topic12	楽しい	白浜温泉	湯	旅	帽子	白浜	アトリエ	料理	🍷	怖い
Topic13	くろい	ryo	私	白浜	これ	寒い	ほしい	特急	手	家
Topic14	お待ち	乗車	発車	営業開始	食堂車	南鉄白浜発車3分後	空港	二ビル発車3分後	1045 発グランドウイング	21 号成田空港行
Topic15	嬉しい	generations	気	gene	お願い	白浜	yahoo ニュース	こちら	さん	👤
Topic16	南紀白浜	白浜	遠い	最高	ホテル	夏	千畳敷	夜	本日	人たち
Topic17	人	多い	やばい	誕生日	もの	絶対	ご覧	部分	必要	どちら
Topic18	白浜	パンダ	和歌山	すごい	名前	子	うち	白浜アドベンチャーワールド	ここ	彼
Topic19	記事	僕	欲しい	日本	話	恥ずかしい	和歌山県白浜町	関西	白浜	地元
Topic20	大阪	みたい	白浜	世界	近く	千葉県	地震	一日	きっかけ	18号白浜海岸行
Topic21	白浜	感じ	楽しみ	白良浜	shirarahama	男	はず	身体	凄い	オススメ
Topic22	可愛い	チェック	上野	かわいい	あと	ジャイアントパンダ	施設	友達	図鑑	2アドベンチャーワールド和歌山県白浜町
Topic23	良い	白浜	今	前	仕事	なん	明日	どこ	場所	時間
Topic24	shirahama	of	the	de	by	名古屋	kamome	to	twitter	イメージ
Topic25	それ	自分	子ども	市場	頃	とき	exile さん	強い	私	白濱洋征
Topic26	目	こと	時	タイプ	たくさん	嘘	無い	親	自分	意味
Topic27	方	いい	白濱亜嵐	exile	白浜さん	いつ	車	参加	白浜	曲
Topic28	事	場所	少ない	白浜海岸	美しい	南房総市	返事	普通	恋	おすすめ
Topic29	そう	白浜	とこ	紀伊民報	次	10 万	姫路市	田辺	暖かい	冬
Topic30	白浜	よう	今日	温泉	砂	よい	写真	旅行	和歌山県	誰

al., 2015; Vecchio et al., 2018). Past studies have focused on technology-mediated tourism experiences as smart experiences (e.g., Buhalis & Amaranggana, 2015; Gretzel, Sigala, et al., 2015), but they have seldom discussed how DMOs and local governments can use technology to better understand tourist preferences and to tailor the destination image and service. By utilizing social big data that exists on the Internet and contains substantial amounts of user-generated content updated in real time, destination markers can immediately collect consumers' thoughts, opinions, and reactions and become aware of current trends (Fig. 1). For example, while DMOs and the Wakayama City Tourist Association continue to promote Tomogashima as an uninhabited island and a destination of dark tourism, social media (Twitter) posts show that more tourists tend to view Tomogashima as a sacred place and associate it with the film *Laputa*. Similarly, while the target market for Kumano Kodo was originally pilgrims, the social big data analyzed in this study show that Kumano Kodo is also an enjoyable destination for couples.

Real-time monitoring and analysis processes can be constructed by developing the methodology discussed in this study. Various SNS platforms, such as Twitter, provide an application programming interface (API) for systematically and programmatically collecting data (Twitter, Inc., n.d). DMOs, governments, and tourist industries may be able to quickly detect trends by building a system that uses these APIs and by collecting and analyzing social big data on a regular basis. Reflecting the suggestions obtained from this process in various policies and marketing in real time or immediately may help raise the value and competitive edge of their destinations. As Python is one of the programming languages suitable for using these APIs, the analysis conducted in this study can be easily applied to realize such goals. Social big data, therefore, makes it possible for local governments and DMOs to monitor tourists' behavior in real-time and assists them in achieving a smart experience by modifying the services provided at the destination (Fig. 1).

2. Smart business ecosystem foundation based on social big data

Another crucial component of an STD is a smart business ecosystem. ICT tools and applications enable DMOs and local governments to become "smarter" and support their smart business ecosystem (Sigala & Marinidis, 2012). However, such ICT-based platforms always require a large investment and substantial financial support from the national government, which inhibits the development of STD in

provincial areas (Gretzel, Sigala et al., 2015). It is urgent, therefore, to find low-cost but efficient ways to build and develop STDs. A business ecosystem emerges from value co-creation among all actors who serve as resource integrators (Lusch & Vargo, 2016). Based on this thinking, social big data is an essential resource for promoting value co-creation in the business ecosystem because it truly reflects tourists' preferences as well as their needs, without any business purposes (Tenkanen et al., 2017).

The results of the social big data analysis included words related not only to a certain destination but also to tourists' feelings, such as happy, sad, and exciting, allowing DMOs and local governments to understand tourists' sentiments while visiting popular spots. This study also found that some words have a weak relationship to the target destinations presented in the different topics, such as Minamiboso City and Izu. Those results can assist destination planners in widening and redefining the business ecosystem. Instead of ICT-based and government-led STDs, it is necessary to consider how existing resources (e.g., social big data) can be employed to build a healthy business ecosystem (Fig. 1).

3. Value co-creation through social big data

As STD is defined as an ecosystem, the self-adjusting system of resource-integrating actors interact each other which is supported by SDL thinking (Lusch & Vargo, 2016). Based on the conceptual framework (Fig. 1), tourists who visited Wakayama Prefecture shared their travel experiences through Twitter. The social big data in Twitter provides a strong data base used for monitoring tourists' preferences and behavior intentions by DMOs. Compared with the one-way value creation from DMOs to tourists, social big data collected from Twitter makes it possible to value co-creation. Thereby, the potential images (for example, positive image of Tomogashima) have been clarified that assist DMOs better understand tourists' needs and improve the services of destination.

VI. Conclusion

The purpose of this study was to investigate an inexpensive way to develop STDs by utilizing social big data as a form of value co-creation. Most previous studies have focused on developing an STD as a smart city, which requires significant financial investment. Given that the concept of STD is relatively new, studies on the subject are still rare, especially in the Japanese context. This study aimed to help fill these research gaps.

The study's target areas were Tomogashima, Koyasan,

Kumano Kodo, and Shirahama in Wakayama prefecture. Large sets of tweets related to these four areas were collected from Twitter and analyzed using LDA, which can estimate latent topics from a set of documents. Each topic estimated by LDA is represented by the probabilistic distribution of the words composing the topic. By interpreting these words, consumers' latent concerns relating to each survey area were inferred from the set of tweets.

The results obtained from the case study were discussed from the perspectives of smart tourism ecosystems and SDL to demonstrate that value co-creation can occur through social big data and contribute to developing a tourism destination as an STD. The practical implication of these findings is that tourists' perspectives can be obtained to a certain degree by analyzing a set of unstructured textual data that do not contain any additional information, such as geotags and images, and are not applied preprocessing of extracting tourism-related data. Moreover, any tourism-related organization (local government, DMOs, and tourism industries) can accomplish value co-creation through social big data in an inexpensive way. As such, based on the concepts of the smart tourism ecosystem and SDL, utilizing social big data can help any tourism destination develop as an STD, even if the relevant tourism organizations have a small budget.

Regarding academic research, while previous studies have focused heavily on state-of-the-art technology, such as ICT (e.g., creating smart cities [Piro et al., 2014]) and real-time sensing systems for onsite smart tourism experiences (Buhalis & Foerste, 2015; Del Chiappa & Baggio, 2015), tourism destinations have been less discussed to understand consumers' preferences in developing tourist-friendly environments. The theoretical implication of this study is to suggest a new form of STD.

As with most previous studies, the current study has some limitations, providing gaps to be filled by future studies. First, the social big data collected from Twitter may include biases because most Twitter users are relatively young and well educated, with a slightly higher number of male users than female (Brandt et al., 2017). Future work should examine the effects of such biases on value co-creation. Second, the analyst's subjectivity and knowledge may have influenced the interpretation of the topics obtained by the LDA analysis, and different analysts may have reached different conclusions. It is necessary, therefore, to consider various perspectives in interpreting the topics obtained by the LDA. Third, the LDA parameter adjustment could be improved. For example, in this study, the predefined number of topics was set experimentally,

but there is also a method to numerically evaluate the obtained topic model. Therefore, how parametrical differences affect the analysis should be investigated in the same setting. Lastly, this research focused on a single case study; the targets were areas in Wakayama prefecture, the analysis subject was Twitter, and the subject period was one year. Future studies should replicate these findings in other settings to verify our indications.

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