# *A Model of ICDT Internet flows on mobile devices for the travel and tourism consumer*

*Tourism Analysis,* Vol. 17, pp. 705–719
Printed in the USA. 

1083-5423/12 $60.00 + .00
DOI: http://dx.doi.org/10.3727/108354212X13531051127140
E-ISSN 1943-3999
www.cognizantcommunication.com

# A MODEL OF ICDT INTERNET FLOWS ON MOBILE DEVICES FOR THE TRAVEL AND TOURISM CONSUMER

STEPHEN BURGESS,* CARMINE SELLITTO,* AND STAN KARANASIOS†

*School of Management and Information Systems, Victoria University, Australia
†AIMTech Research Group, Leeds University Business School, UK

Despite the increasing use of mobile devices and their applications in the travel and tourism arena, there is a lack of literature that considers how mobile device tourism applications could be evaluated. Built around a discussion of information attributes (a series of dimensions by which the delivery of information can be assessed) that have been specifically developed for the tourism sector and an examination of the specific characteristics of mobile devices, this theoretical article classifies different online tourism applications that can be accessed by mobile devices according to Angehrn's four virtual "spaces" (information, communication, distribution, and transaction). This is for the purpose of demonstrating that the majority of applications in the mobile tourism arena eventually fall within the realm of information provision and can thus be assessed according to how they perform in relation to information attributes. A model of ICDT Internet flows on mobile devices for the travel and tourism consumer is presented.

Key words: Mobile devices; Information attributes; Travel; Tourism; Model

## Introduction

As an information-intensive sector, tourism is a sector that has seen the adoption of many information and communications technology (ICT) applications over the years. More recently, the sector has been influenced by the use of mobile devices that allow tourists to access online tourism applications. While mobile technology is transforming work and social activity, little is known about how it influences how information is now accessed and used.

This theoretical article classifies different online tourism applications that can be accessed by mobile devices according to Angehrn's (1997) ICDT model, which categorizes Internet activities into four virtual "spaces": information, communication, distribution, and transaction. This is for the purpose of demonstrating that the majority of applications in the mobile tourism arena eventually fall within the realm of information provision and can thus be assessed according to how they perform in relation to their information attributes.

Address correspondence to Dr. Stephen Burgess, College of Business, Victoria University, PO Box 14428, Melbourne, Victoria, Australia, 8001. E-mail: Stephen.Burgess@vu.edu.au

Information attributes are a series of dimensions by which the delivery of information can be classified. Their general application and specific relevance to the travel and tourism arena is discussed, with a list of attributes for travel and tourism and mobile devices presented.

Finally, a model of ICDT Internet flows on mobile devices for the travel and tourism consumer is presented to exhibit the authors' contention that most of these applications provide information that can be assessed according to mobile device information attributes.

While this article examines the use of mobile devices for travel and tourism purposes, its particular focus is the use of these devices to access Internet tourism applications and services. Thus, voice or video calls made over a cellular (such as 3G) network or via voice-over-IP (such as Skype) and/or use of mobile devices for *generic* email communications are not a focus of the article. The model contributes to the literature by linking Angehrn's ICDT model with the notion of information attributes and applies this to the use of mobile technology services in the tourism arena.

## A Need for Evaluation of Mobile Tourism Services

Mobile devices have been used for some time as a way for tourists to coordinate their activities (Karanasios, Sellitto, & Burgess, 2012). Existing mobile tourism applications typically represent applications with defined content or the use of devices with networking capabilities that access tourist content via wireless network coverage (Kenteris, Gavalas, & Economou, 2009). Mobile tourism applications cover a range of tools and functionality. This has resulted in number of diverse functionalities. In order to help distinguish between tourism applications a frame of reference is required that accounts for the range of characteristics of the applications (Karanasios et al., 2012).

Karanasios et al. (2012) suggested that there is a distinction between an application that is downloaded onto a mobile device and the remote access to a website from a mobile device. There is another distinct group of tourism-related applications that has emerged, such as location-based services, travel tools such as translators, currency converters, and so forth. These are complementary mobile travel services that are distinct from tourism guides. There is a lack of understanding concerning these applications, despite their ability to transform the travel experience. There is a need to understand mobile applications per se, as they typically have different capabilities and functions with tourism operators needing to provide the benefits that mobile device users require.

Previous attempts to evaluate mobile applications have focused on mobile tourist guides and applications and investigated specific issues at the prototyping and pilot stage, such as support for maps or mobility issues, the kinds of services that were offered and how these services are delivered to the end-user. Other studies have examined the mobile device human–computer interaction or developed frameworks in order to measure usability or how mobile applications can add value to destinations and tourists alike. There is a dearth of literature considering how actual mobile device tourism applications may be evaluated based on their characteristics (Karanasios et al., 2012). This article aims to address this situation by developing a conceptual model that links the information attributes of mobile tourism services with Angehrn's (1997) virtual spaces to provide a means to evaluate the effectiveness of these services. The discussion commences with a discussion of Angehrn's (1997) virtual spaces.

## Tourism, Virtual Spaces, and the Internet

Angehrn (1997) proposed the *ICDT model* to provide a "systematic approach to the analysis and classification of business-related Internet strategies" (p. 361). The model separated different business opportunities provided by the Internet into four separate "virtual spaces":

- **The virtual information space**: where businesses can provide information about themselves and the goods that they offer.
- **The virtual communication space**: where businesses and their suppliers and customers can exchanges ideas, negotiate collaborations, create communities and so forth.
- **The virtual distribution space**: where businesses can provide their goods for distribution to

customers, probably in digital form. Angehrn provides examples such as "electronic books," pictures, and digital music that would be suitable for such a purpose.

- **The virtual transaction space***:* where formal business transactions such as ordering, invoicing and payment can occur.

A simplified version of the ICDT model is presented in Figure 1.

The ICDT model has been employed in a number of research projects. More recently, Hsu, Chiu, Su, Wu, and Yang (2007) used the four spaces to categorize the architecture of online gaming websites and Breen and Burgess (2011) analyzed the websites of Australian accounting practices according to the information, communication, and transaction spaces.

Tourism is a sector that has been regarded for a long period as being information intensive, thus being suited to ICT-based applications. From a tourism perspective, information quality has been documented as a key evaluation approach (Park & Gretzel, 2007) with respect to website content and for improving the overall nature of travel (Schwabe, 2005). P. O'Brien (1998) provided an illustration of how the ICDT model might apply in the travel industry (see Fig. 2) noting typical travel content/activities that may occur over the Internet.

The discussion now moves on to examine each of the spaces.

## The Virtual Information Space: Information and its Attributes

Information is often considered to consist of "raw" data items that have some context. Turban, McLean, Wetherbe, Bolloju, and Davison (2002) suggest that such data items represent the "elementary description of things, events, activities and transactions that are recorded, classified, and stored, but not organized to convey any specific meaning" (p. 48). Data itself can be multiform, being a combination of numbers, alphanumeric

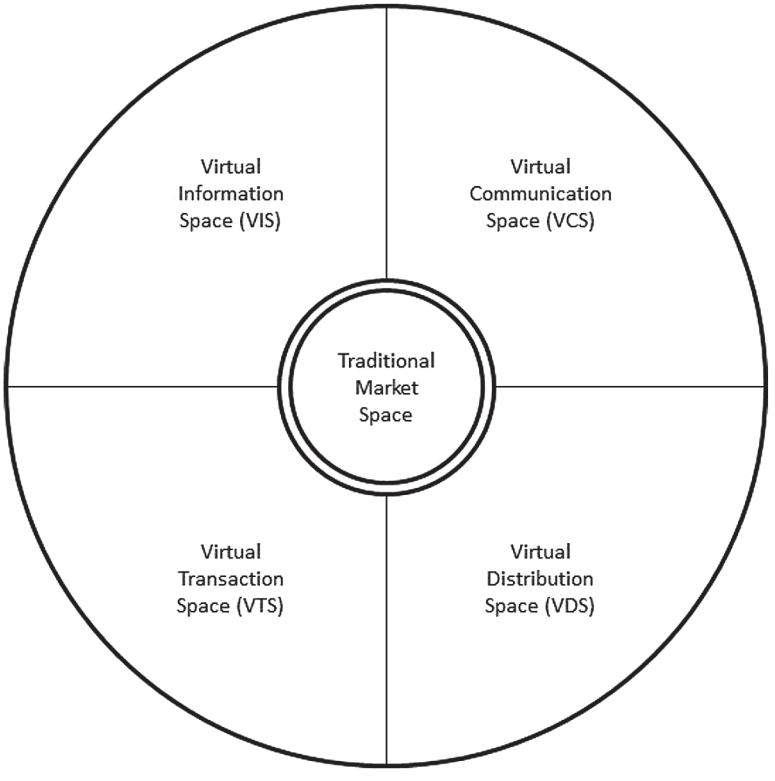


*Figure 1.* The ICDT model (adapted from Angehrn, 1997, Fig. 1, p. 362).

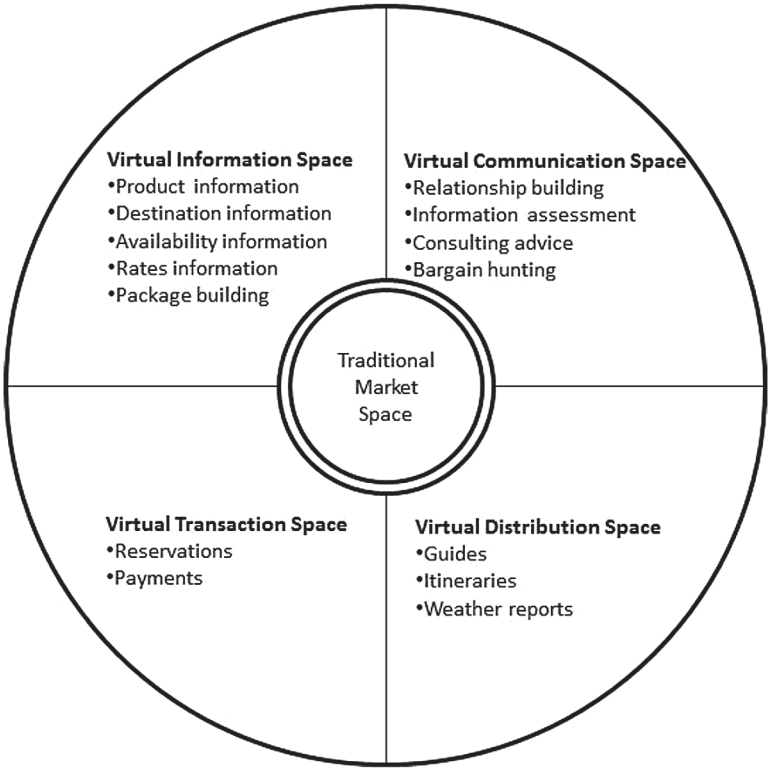


*Figure 2.* The travel industry ICDT model (adapted from P. O'Brien, 1998, Fig. 2, p. 72).

characters, figures, sounds, or images. Rowley (2007) describes the *elementary* aspect of data as "symbols that represent properties of objects, events and their environment" (p. 166) and suggests that data are invariably observed as the primary value of a measure or phenomenon. For instance, a combination of characters such as "A," "4," "2," and "5" could be considered to be data items.

As information can be considered to consist of data items, it can be useful to contextualize information as being a by-product of data that has undergone some transformation process. For instance, the code "A425" from the previous example might be interpreted to be a means of classifying rooms in a series of buildings, and could refer to the 25th room on the 4th level of Building "A" at a university campus.

Thus, data are noted as lacking meaning or value, tending not to be organized. In contrast, information has elements of meaningful organization that is of value to a recipient—information is directly inferred and derived from organized data. In the previous example, the data items "A," "4," "2," and "5" have been organized in such a way as to convey meaning to any person understanding the room classification scheme.

Frické (2009) proposes that the relationship between data and information is functional, where information for the user is "relevant, or usable, or significant, or meaningful" (p. 133). Access to and availability of information can fundamentally underpin decision-making activities, be it at the business level by managers or within the consumer domain. Indeed, the manner in which individuals engage in making decisions is based on the *context* in which data are made available and the manner in which the data is interpreted and used to make decisions (Sellitto, Burgess, & Hawking, 2007). The authors also indicate that an appropriate approach to examining the value of information for decision-making purposes is to focus on the quality of the information and, in turn, attributes of the information that lead to a determination of quality.

There are various opinions as to what constitutes information quality and the defining attributes that might be affiliated with such information. Ballou, Madnick, and Wang (2004) suggested that ideal or perfect information can be difficult to achieve. They argue that the value of information tends to be shaped by the user environment in which the information is being applied—hence, user perceptions govern the attributes of the information. The authors identify information attributes such as the accuracy of the information, completeness of the information, timeliness in the delivery of information, and consistency in its presentation as reflecting different quality dimensions. Lee and Strong (2003) investigated the association between knowledge and work performance by focusing on information quality. The information attributes that had a quality dimension were accessibility, which directly reflected data availability; relevancy, which was noted as how the information is applied to a specific task; timeliness, which reflected a point of data creation or access and accuracy, which represented information that was correct and complete. Miller (1996) referred to quality information as embodying attributes such as the relevance of the information to the user, the accessibility of the information, the level of accuracy of the information, the level of understandability of the information, and timeliness—these elements tending to be intuitively interpreted by people when used for decision making.

Lichtenstein and Parker (2009) examined the notion of Wikipedia as a model for collective intelligence, noting that some of the core attributes associated with information quality were authority (of the source that provided the information), credibility (of the source), accuracy, coverage, and accessibility. The authors further suggested that in the online environment the attributes of accuracy and credibility are perceived by information searchers as the key indicators of quality. Information accuracy tends to be assessed through verifiable independent sources—being closely allied to the authority of the source, how the information is presented, and how plausible it might be. Information credibility reflects the "believability" of the information. These attributes tend to be interchangeable. The perceptions associated with credibility among online information seekers tends to be governed by the reputation and credentials of the individuals or body from which the information originates.

Taylor (2009) documented a comprehensive number of information attributes associated with the stages of the information search process. Many of the attributes assembled by Taylor have been noted by previous authors; however, some can be considered relatively novel. The *dynamic* information attribute refers to how information can be practically manipulated within a source, while the attribute of *information geography* is location based and infers the notion of geographic proximity to a point in time and place.

### *Classifying Information Attributes*

Information attributes can be classified into different groupings. For instance, Lee, Strong, Kahn, and Wang (2002) addressed the issue of information quality by grouping attributes into the categories of intrinsic, contextual, representational, and accessibility. Time-related attributes associated with information quality have been noted to reflect accuracy and completeness (Cappiello, Francalanci, & Pernici, 2003). Attributes reflecting business information value have been suggested by Pipino, Lee, and Wang (2002) and include descriptors such as accessibility, believability, completeness, relevancy, and timeliness.

J. A. O'Brien (2001) suggested that information quality elements embrace dimensions that are collectively related to content, form, and time. The content dimension is notable for attributes such as accuracy, relevance, and completeness. The time dimension includes attributes such as timeliness. The form dimension reflects attributes that the presentation of the information. Henceforth, J. A. O'Brien's categories are used in this article.

### *Information Attributes in Travel and Tourism*

Within the tourism domain the value and importance of information quality has been noted. Schawabe (2005) proposed a framework for information quality asserting that information quality directly influences travel and affiliated activities. They identify four individual quality factors: timeliness, completeness, structure, and personalization. The timeliness attribute is one of the more important attributes and represents information that

is up to date, allowing travelers to make decisions to participate in activities and destination events. The completeness attribute addresses traveler requirements at a particular point in time—the authors making a close link between the attributes of timeliness and completeness. The information structure attribute is similar to J. A. O'Brien's (2001) form dimension and is related to the presentation of the information. The personalization attribute has an information specificity component that is relevant to an individual and can be used in the context of different travel situations. This can be related to Miller's (1996) notion that information attributes can be intuitively interpreted when used for decision making.

Park and Gretzel (2007) described a set of key evaluation factors applicable to information content associated with tourism destination organizations that addressed the issue of online information quality. The attributes associated with information quality included descriptors such as authority, reliability, accuracy, and currency. Aschoff, Prestipino, and Schwabe (2007), drawing from the work of Schawabe (2005), noted that the timeliness attribute also relates to frequency of change of information and the currency of information—a set of attributes that informs the prospective traveler.

Table 1 provides a set of information attributes compiled by the authors from previous work described in this article. It is based on J. A. O'Brien's (2001) classification of information quality attributes (into content, time, and form) and contain "classic" information attributes and a set of additional "tourism"-based attributes for that sector.

The classic attributes of relevance, completeness, and accuracy have been listed under *content*, with *time*-related aspects being listed under that category. It could be argued that the additional attributes listed as *tourism attributes* could be classified under the relevance attribute—but this is problematical. For instance, information that is personalized (tailored) for a particular tourist may not necessarily be relevant. Similarly, the specific location of a traveler, or his/her desired destination(s), can provide information that may or may not be relevant.

In the next section the discussion moves to the use of mobile devices in the tourism sector. This will then be linked to the previous discussion on information attributes.

## Mobile Devices in Tourism

In recent times, mobile devices such as digital assistants and smartphones have advanced in technological utility to the point where they are changing the tourism landscape, altering the modus operandi for accessing travel information (Karanasios et al., 2012). Indeed, the nature of tourism as an inherently nomadic activity aligns well with the utility provided by mobile devices that are relatively small, portable, and offer a high degree of flexibility for the traveler (Oh, Lehto, & Park, 2009). It has been observed that the tourist experience can be enhanced through the delivery of various information services using mobile devices such as the smartphone—an activity that has the potential to change traveler behavior (Wang, Park, & Fesenmaier, 2011). Recent technological developments have seen the functionality of many mobile devices improve significantly, being constantly Internet connected and more user-friendly (Canadi, Francalanci, & Pernici, 2010). Such advancements in mobile device design are arguably contributing to potential paradigm shifts associated with the different ways people might access, search for, and use travel information. Furthermore, the literature identifies the growing adoption of mobile device use for tourism purposes that is reflected in many tourism applications, such as mobile cultural guides (Alfaro, Nardon, Pianesi, Stock, & Zancanaro, 2005), the use of mobile information systems at sporting events (Peters, Paixolo, Köster, & Promberger, 2010), flight check-in through mobile devices (Mamaghani, 2009), and the use of mobile positioning data to track tourists' movements (Ahas, Aasa, Roose, Mark, & Silm, 2008).

Rusu and Cureteanu (2009) allude to the contribution that smartphone devices have made to tourism in recent times. They propose that mobile applications have the propensity to provide increased traveler flexibility and high levels of convenience through the access of personalized and real-time information. Furthermore, they note that the smartphone is an important device for the business traveler, enabling access to high-quality video that has become an important and integral communication form.

Wang et al. (2011) alluded to a broad range of information services that were readily accessible

Table 1
A Set of Information Attributes for the Tourism Sector

| Content | Time | Form |
|---|---|---|
| **Classic attributes** | **Classic attributes** | **Classic attribute** |
| Relevance | Accessibility | Presentation |
| Completeness | Timeliness | |
| Accuracy | Currency | |
| **Authority** | Frequency | |
| Authentication of source | | |
| Objectiveness of source | | |
| **Tourism attributes** | | |
| Personalized information | | |
| Current location of traveler | | |
| Location of destination | | |

via the smartphone that provided notable benefits for travelers:

- Services that assisted the traveler while they already were on vacation. These benefits were associated with activities such as accessing navigation services for finding areas of interest, using the device for foreign language translations, recommending tourist activities, and finding eateries/cafés. From an informational perspective, the use of navigation mobile applications (apps) intrinsically reflects location-based attributes, while the use of language translators embody attributes that reflect accessibility and relevancy to the particular individual. Apps that recommend activities or identify eateries arguably reflect information attributes that are geographical and timely in nature, as well as provide a complete and up-to-date (current) overview of offerings to the traveler.
- Providing the traveler with relevant information depending on a previously recorded personal profile—with information being up to date and accessible at any time of the day. This type of mobile device information facilitates benefits that support traveler "micromoments" such as assisting them to locate nearby amenities such restrooms, fuel stations, parking lots, and WiFi "hotspots"—all being accessed in real time.

Law, Leung, and Buhalis (2009) offered a synopsis on the increasing use of mobile devices in tourism at destinations. The authors provided salient examples of the use of mobile devices at festivals and cultural sites where information exchanges have contributed to a deeper traveler interest and understanding in the tourism activities undertaken. Furthermore, such devices were noted to facilitate real-time access and interaction with a diverse number of tourism service providers. Portolan, Miličevićand Žubrinić (2011) proposed that mobile devices have a propensity to allow the traveler to access aggregated and/or synthesized information, providing them with personalized content that has been filtered based on predefined rules or protocols. They noted that the traveler would potentially be able to access generally available Internet-based information that had been personalized (such as tourist attractions, guides, and means of transport), or specific information that might be sourced uniquely from travel partners and marketers. Oh et al. (2009) explored traveler intentions for using mobile devices while on a trip and identified the main benefits that might be realized are the device being used as an organizer, how it facilitated Internet access, and its use as a communication tool. Such benefits were noted to be for personalized use that allowed information exchanges to be enacted in real time, from any location, and with particular relevance to the traveler.

Goossen, Lammeren, and Ligtenberg (2010) examined the use of mobile devices to record the location-based activities of a set of adventurers as they hiked or cycled through specific areas of the Netherlands. Users found the devices were important in being able to record and note what they perceived to be points of interest (parlance points) that could be shared with other adventurers. Although some technical issues were noted with the use of mobile device in remote areas, the adventurers

found that the value of the devices rated relatively highly due to the different types of media that could be captured. Furthermore, it was noted that the PDA provided an alternative for paper-based directional guides, maps, or physical information panels. The top three benefits adventurers reported in using the devices were:

- The ability to retrieve information at any particular location in the hiking area—content that reflected the attributes of information accessibility and geography.
- Being aware of where they were at all times (not getting lost or losing their way)—reflecting directional capabilities of the device and information attributes based on deriving geographic or location based coordinates.
- The ability to capture and record personal content that allowed parlance points about the area and landscape to be shared with other adventurers. Such content tended to be sounds, photographs, videos, or images reflecting attributes associated with different information forms.

Karanasios et al. (2012) suggested that the use of mobile devices embraced elements that allow the traveler to experience the benefits associated with ubiquity, personalization, localization, interaction, and convenience. The benefits of mobile technologies to businesses can be summarized as (Sheng, Nah, & Siau, 2005; Turban, Leidner, McLean, & Wetherbe, 2006):

- **Ubiquity**: mobile technologies can be available at any location at any time.
- **Convenience**: mobile technologies are the preferred option for accessing many forms of information due to their size and mobility.
- **Interactivity**: mobile devices can allow transactions, communications and service provision that are immediate and interactive.
- **Personalization**: as mobile devices are predominantly used by a single individual the delivery of information and other services can be tailored to meet individual needs.

Table 2 brings the discussion back to information attributes by providing an indication of altered information attributes provided by mobile devices when compared with traditional desktop technologies used to access tourism information online. *Interactivity* in the table is not considered, as that particular mobile feature has more to do with the virtual communication and virtual transaction spaces rather than the virtual information space. In relation to *ubiquity*, the use of mobile devices can provide additional benefits in relation to time attributes—including the ability to access information faster and on a more frequent basis. In relation to *convenience*, as a preferred choice of device for accessing information, mobile devices provide enhanced accessibility to that information. However, there can also be a price to pay for this convenience. Often mobile devices are equipped with screens that cannot provide the quality of information that can be accessed on, say, the monitor of a desktop computer and thus the user is sometimes limited in relation to information delivery. Information delivery systems need to be modified with trade-offs in order to cope with the depth and breadth of the screens (Chae & Kim, 2004) as many of these systems are adapted from desktop applications. Other limitations may relate to the limited speed of communication networks (Church, Neumann, Cherubini, & Oliver, 2010). This is reflected in Table 2 by noting the level of completeness of information and the timeliness in which it is delivered. Note that the authors have identified two potential effects of mobile devices in regards to timeliness: a potential enhancement of service by being able to access services due to the ubiquitous nature of mobile devices, but also a potential inhibition in regards to the information not being received to due slow communication networks. Additionally, the presentation of information may be compromised due to the screen limitations of many mobile devices. Finally, in regards to *personalization*, the enhanced ability of mobile devices to provide personalized information to the user (including information such as the current location of a traveler) can lead to the provision of information that is more relevant for that particular user.

Despite the range of services accessible to mobile devices spanning the virtual information, communication, distribution, and transaction spaces, the authors will later argue that the *information* attributes listed in Table 2 can be used as a cornerstone for assessing the usefulness of the majority of

Table 2
Information Attributes Provided by Mobile Devices (in Addition to Those Previously Available)

| Tourism Information Attributes Information attributes | Mobile Device Effect | | |
|---|---|---|---|
| | Ubiquity | Convenience | Personalization |
| **Content** | | | |
| Classic | | | |
| Relevance | | | X |
| Completeness | | O | |
| Accuracy | | | |
| Authority | | | |
| Authentication | | | |
| Objectiveness | | | |
| Tourism | | | |
| Personalized information | | | X |
| Current location of traveler | | | X |
| Location of destination | | | |
| **Time** | | | |
| Classic | | | |
| Accessibility | | X | |
| Timeliness | X | O | |
| Currency | | | |
| Frequency | X | | |
| **Form** | | | |
| Classic | | | |
| Presentation | | O | |

X: potentially enhanced; O: potentially inhibited.

mobile device travel and tourism-based applications and services.

The discussion now moves on to the virtual communication space.

## The Virtual Communication Space

This section examines the use of mobile devices to access the Internet for tourism and travel purposes. Apart from the use of email, a popular Internet application in relation to tourism is the online posting of reviews of tourism services and destinations. While traveler reviews are often posted on well-known popular travel websites (Bingley, Burgess, Sellitto, Buultjens, & Cox, 2010), Kenteris, Gavalas, and Economou (2011) noted that some mobile tourist guides allow the recording of traveler comments. Users are able to log comments associated with the sites they may have visited, or comment on aspects of tourism destinations and/or services. The recording of comments is arguably an important aspect of these mobile applications, allowing users to gather personal, relevant information that they have found to be valuable at different tour location points.

Bingley et al. (2010) examined weblog (blog) comments posted on tourism-related websites, identifying that the majority of comments fell into one of three categories: *Website content* (placed by website operators), *UGC Blog* [placed by travelers as user-generated content (or UGC)], and *Affirmations* (where users posted confirming or finalizing comments, such as "That's good" or "Thanks very much"). The authors also examined UGC blogs and found that most comments that were posted expressed an opinion and/or updated others in relation to travel experiences. A small number of comments actually requested information from blog participants seeking opinions or feedback. Other postings reflected a comment that released emotional tension or allowed them to "think by writing" (a type of posting suggested by Nardi, Sherman, & Mansfield, 2004).

## The Virtual Transaction Space

According to P. O'Brien (1998), activities in the virtual transaction space are those that relate to reservations and payments. Angehrn (1997) extended

this to online ordering and invoicing. Notably the virtual distribution space takes the advantage of the *interactivity* features offered by mobile devices.

The purchasing of travel products can be enacted through mobile devices—a behavior that has transposed what was a desktop activity to the mobile environment (Rusu & Cureteanu, 2009). Wang et al. (2011) suggested that smartphones offered users the opportunity to manage flight, car, or accommodation requirements while on the way to a destination—an activity that was previously reliant on desktop computer activity. Such benefits reflect the attributes associated with being able to access information on the road in real time—information needing to be accurate and complete to enable the transactions of bookings to be successful.

Belopotosky (2011) suggested that travel bookings will be completed via a mobile device in the future. The author alludes to web-based travel providers who have already developed apps allowing users to book flights and make room reservations via their mobile phones. As suggested earlier, desktop-dependent travel activities are being migrated to the mobile environment—concurring with the observation of Wang et al. (2011), who noted that access to traditional online travel services was up until recently a purely desktop activity.

While online bookings and payments fall within the realm of the virtual transaction space, it could be argued that the apps that are stored on mobile phones that allow automatic access to these features are part of the virtual distribution space as they are typically downloaded to the mobile device. These are discussed in the next section.

## The Virtual Distribution Space

Angehrn (1997) suggests that this virtual space allows goods to be distributed online, typically in digital form. Some authors have argued that the distribution space can be ignored in the travel context as there are few physical products to distribute (Karanasios & Burgess, 2006). However, P. O'Brien (1998) suggests goods can take the form of guides, itineraries, and weather reports. These can be distributed as online services among other forms of information that may be relevant to a consumer.

The use of smartphone devices can also be an important method for promoting and marketing hotels—potentially enhancing brand awareness and loyalty (Kim & Adler, 2011). The authors note that by making available a smartphone application, hotels allow their offerings to be easily accessible anywhere and anytime, affording convenience to their clients. Furthermore, mobile applications afford users the opportunity to initiate and/or complete reservations (check in/out) relatively quickly in a real-time environment. This also has a geographic information attribute that reflects the current location of users and their proximity to the hotel of interest.

The authors also outline various examples of tourism smartphone applications such as mobile-enabled travel journals—an application that allows the traveler to capture pictures, location coordinates, create an itinerary, and complete notes about their trip as it happens.

The advent of travel-guide apps have all but replaced the traditional tourist guidebook with an equivalent electronic form that embodies elements of being always up to date and relatively light to carry (Hill, 2010). Hill further notes that the more useful smartphone apps are associated with enabling a person to collate their bookings (flights, accommodation, and so forth) in one organized access point—providing a complete overview of their itinerary. Another smartphone app noted by Hill (2010) relates to restaurant guides that identify eateries located within close proximity to the traveler, providing them with contact, address, and menu details. Such apps tend to also include access to third-party reviews and ratings of the restaurant that assists with traveler decision-making regarding restaurant selection.

Economou, Gavalas, Kenteris, and Tsekouras (2008) examined the application of mobile devices in a museum setting to provide cultural relevant tourism information, allowing visitors to connect various visual displays to textual narratives delivered via the mobile device. The device allowed museum management to deliver a rich array of information to visitors that enhanced their understanding of artifacts while not encroaching on gallery space. Visitors benefited from using the technology by being able to connect different information threads to gain a comprehensive picture of displays as well being able to "drill down" and focus on specific interests.

Kenteris et al. (2009) evaluated a mobile electronic tourist guide (myMytileneCity), finding that improvements to the electronic guide could be made. The user-suggested improvements related to increasing the number of available mobile device services for the traveler and tourist. These improvements included:

- A provision for multidisplay and communication conduits that include 3D mapping and synthetic speech abilities (information form).
- Opportunities to create tourism itineraries that would be based on where the traveler might be located, the weather, and individual interests (relevance).
- The mapping of emergency contacts such as hospitals, clinics, doctors, and police authorities. Such an information service would use location-based abilities to identify the nearest contact (location based, relevance accuracy).
- A feature that allowed an exchange of tourist-related impressions, reviews, and suggested activities of the immediate local area (location based, relevance, accessibility).

The key aspect of these apps is that although the benefit of their use may not be provided at the time of download, their subsequent use can provide information that exhibits many of the attributes listed in Table 2.

Up until now the discussion has centered on the types of applications that provide information after an action has been initiated by the travel consumer. However, there are instances, known as *push* services (Grün, Werthner, Proll, Retschitzegger, & Schwinger, 2008), where information provision or updates to services are not initiated by the user. This would include the scenario when travel booking circumstances change—for instance, when the departure time of a flight alters and customers booked on that flight are automatically notified.

## A Model Representing ICDT Internet Flows on Mobile Devices

The authors contend that the vast majority of online travel and tourism services accessed by tourism consumers via mobile devices result in information flows whose "performance" can be assessed against the information attributes associated with these flows. Figure 3 represents a model that segments the mobile tourism applications discussed in this article across Angehrn's (1997) four virtual spaces into six categories of flows. These are discussed below, with the number of the flow corresponding with the equivalent number in Figure 3. The *mobile traveler* is represented at each end of the diagram as the initiator of most flows (left side), as well as the subsequent receiver of information, apps, or other services (right side). Note that the model takes the viewpoint of the travel consumer in that the activities of suppliers and intermediaries (as described in Datta & Chatterjee, 2008, in their discussion of intermediaries in electronic markets) and even other travel consumers are treated as "the suppliers" of online information and services.

1. **Information search:** The simplest flow occurs when a travel consumer conducts a general search for travel information, such as a search for information using a search engine or a more specific search on a travel provider's website. This search falls within the virtual information space.
   a. **Information received:** The corresponding information is received through the browser that the consumer is using for the search. The travel consumer will then judge the usefulness of the information received according to its accuracy, currency, and so forth.
2. **Information request:** This type of flow involves a request *to others* for travel information, such as requests to members of a travel blog via a browser or even to a travel product supplier via email. This request falls within the virtual communication space.
   a. **Information provided:** The information will typically be received back via the blog or through a return email sent by the travel provider. While the other information attributes apply, it is more likely that timeliness will be become an issue if responses are not received immediately. Note that although the request for information and response fall within the virtual communication space, the supplied information still has particular information attributes that can be assessed.

3. **Information provision:** This type of flow involves the *provision* of information, an expression of opinion, and/or release of emotional tension (as described earlier), typically to a blog. No response is expected and thus information attributes do not apply.
4. **Initiate online transaction:** This type of flow falls within the virtual transaction space, and could take the form of an automated database request (e.g., checking if rooms are available in a particular hotel); an online real-time booking, reservation, or order; or a real-time payment. The key to the virtual transaction space is that these transactions can occur without manual intervention from an individual at the "supplier" end.
   a. **Transaction confirmation/ information:** Usually, a transaction of this type will result in an automated confirmation of the transaction and/or some useful information (such as the types of hotel rooms available, room rates and so forth). This information will have attributes that will affect its usefulness to the mobile tourism consumer.
   b. **Online distribution triggered:** In a number of instances the initiation of an online transaction (as per flow 5) may trigger an automated download of digital goods (virtual distribution space). These may take two forms: i) **Information distributed:** An example of this would be a digital travel guide, automatically sent to the user. Again, the information in such a download will have attributes that affect its usefulness to the consumer. ii) **App/service downloaded:** A typical example of this flow would be when an app is downloaded to the user's mobile device. A number of examples of these are provided earlier. These allow some processing to occur on the mobile device, which may even involve automatic access to the Internet at a later date to update information—which would have different information value to the traveler. Note that the model does not direct this flow through the "information attributes" section as useful information may not be accessed directly at the time of the download. It is likely that this would occur when the app is eventually used.
5. **Initiate offline action:** This action might be triggered as part of a consumer request (flow 5) or perhaps as part of an automated order and/or payment action (flow 4). Either way, digital goods are distributed to the consumer "manually," perhaps via email. For instance, a digital travel guide that has been purchased could be distributed as an email attachment to the customer. While this involves the transfer of digital goods, it is not automatic and not in the virtual distribution space. Instead, it occurs in the virtual communication space.
   a. **Offline action confirmation:** Transaction confirmation will typically occur via the browser, but may instead occur (or be supplemented) via messages sent using email (or even SMS messages) to the travel consumer.
   b. **App/service delivered via email:** This is less likely to occur as an "app" to be installed—more likely as a digital information product (such as a travel guide). As with the online distribution of an app, this may not directly result in information being accessed at the time of the flow so there is no link through information attributes (at that stage).
6. **Push notification:** This will usually occur via email (or perhaps even SMS) notification and typically occurs after an online transaction (flow 4) or offline action (flow 5) has occurred. Such notifications could involve changes to itineraries, cancellations, and so forth—information that could be vital to the mobile tourism consumer.

## Model Application

There have been a number of studies conducted on the use of mobile devices in tourism. This article has examined many of these from the viewpoint of how the use of mobile devices for different tourism applications spans Angehrn's (1997) four virtual spaces. Even though the article found a number of applications across each of the spaces, many of them enable the provision of information that can be assessed using a set of information attributes that have been modified to include applications for tourism and the benefits and limitations of mobile device usage. The authors contend that these attributes can be used as a means of evaluating the

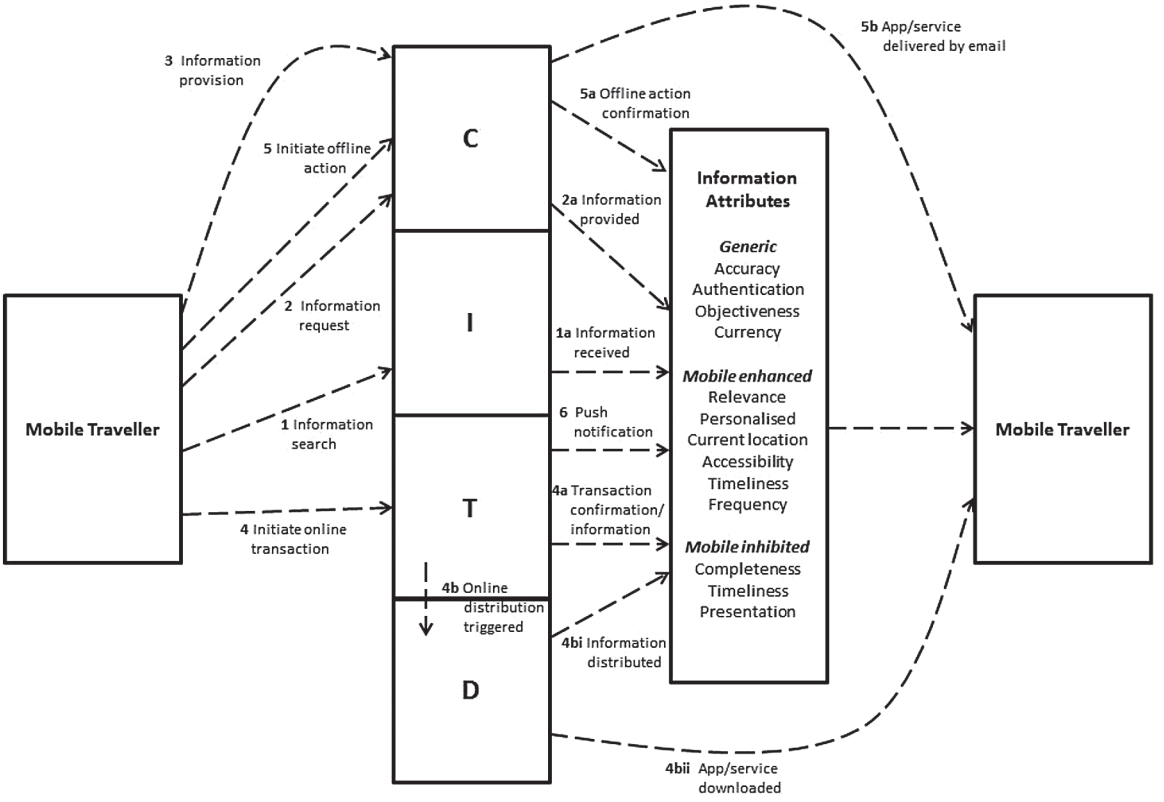


*Figure 3.* A model of ICDT Internet flows on mobile devices for the travel and tourism consumer.

travel and tourism information gathered using mobile devices and that the use of mobile devices can enhance and inhibit some of these attributes.

The model identified six different types of information flows that may occur in the mobile tourism device usage domain. Further research that examines the effectiveness of mobile device applications for tourism could examine the model's usefulness though the lens of the specific information attributes that have been identified and could separate the activities and features of the services provided by the six major flows in the model.

When examining the attributes it is important to remember the "individual" nature of both mobile devices and information attributes that have been discussed in this article. One of the key attributes of mobile devices is that they are predominantly used by individuals and that in many instances travel and tourism information can be tailored to meet individual needs. When combined with the notion that information attributes such as *relevance* can often be a matter of personal opinion, researchers will need to consider that *individual* consumers might be best placed to assess the performance of mobile travel and tourism applications. They should also consider that these applications can now typically be accessed on different mobile devices and that the capabilities of the devices themselves could influence the delivery of information to the mobile travel consumer.

The conceptual model that has been proposed is unique in that it extends Angehrn's (1997) ICDT virtual spaces into the mobile tourism services arena and matches the specific services with associated information attributes. The traditional list of information attributes has been further classified to identify information attributes that may be "mobile enhanced" or "mobile inhibited." This provides a means for academics and practitioners to classify mobile tourism services according to their performance along the spectrum of information attributes.

## Conclusion

With its information-intensive nature, the tourism sector has adopted information and communications technologies, especially via Internet and mobile devices, extensively. This article has described many travel and tourism applications that have been accessed via mobile devices over the Internet. In many ways, mobile devices have changed that manner in which information is accessed by travel and tourism consumers. The authors have developed a model that they contend links the types of information sought by travel and tourism consumers with a specific set of information attributes that are enhanced or inhibited by mobile device access. The model is not meant to provide a specific framework for the purposes of evaluating mobile applications for the travel and tourism consumer. Rather, it has developed a model that has tracked the flows of typical Internet flows on mobile devices for the travel and tourism consumer and demonstrated how the majority of the flows can be assessed through the use of a set of information attributes that have been developed for the travel and tourism sector and refined for their access by mobile devices. Researchers can use these modified information attributes as one means to assess the performance of mobile travel and tourism applications.

## References


Ahas, R., Aasa, A., Roose, A., Mark, Ü., & Silm, S. (2008). Evaluating passive mobile positioning data for tourism surveys: An Estonian case study. *Tourism Management, 29*(3), 469–486.

Alfaro, I., Nardon, M., Pianesi, F., Stock, O., & Zancanaro, M. (2005). Using cinematic techniques on mobile devices for cultural tourism. *Information Technology & Tourism, 7*(2), 61–71.

Angehrn, A. (1997). Designing mature internet business strategies: The ICDT model. *European Management Journal, 15*(4), 361–369.

Aschoff, F. R., Prestipino, M., & Schwabe, G. (2007). Cooperation technology and timeliness of information: Comparing travelbooks, wikis and online communities. *15th European Conference on Information Systems,* Switzerland.

Ballou, D., Madnick, S., & Wang, R. (2004). Special section: Assuring information quality. *Journal of Management Information Systems, 20*(3), 9–11.

Belopotosky, D. (2007, May 4). Mobile booking apps are only just starting to deliver. *New York Times,* p. 7.

Bingley, S., Burgess, S., Sellitto, C., Buultjens, J., & Cox, C. (2010). A classification scheme for analysing Web 2.0 tourism websites. *Journal of Electronic Commerce Research, 11*(4), 281–298.

Breen, J., & Burgess, S. (2011). E-services and Australian accounting practices. In A. Scupola (Ed.), *Developing technologies in E-services, self-services, and mobile communications: New concepts* (pp. 51–65). Hershey, PA: IGI Global.

Canadi, M., Höpken, W., & Fuchs, M. (2010). Application of QR codes in online travel distribution. In U. Gretzel, R. Law, & M. Fuchs (Eds.), *Information and communication technologies in tourism 2010* (pp. 137–148). Vienna: Springer-Verlag.

Cappiello, C., Francalanci, C., & Pernici, B. (2003). Time-related factors of data quality in multichannel information systems. *Journal of Management Information Systems, 20*(3), 71–92.

Chae, M., & Kim, J. (2004). Do size and structure matter to mobile users? An empirical study of the effects of screen size, information structure, and task complexity on user activities with standard web phones. *Behaviour & Information Technology, 23*(3), 165–181.

Church, K., Neumann, J., Cherubini, M., & Oliver, N. (2010). SocialSearchBrowser: A novel mobile search and information discovery tool. *Proceedings of the 15th International Conference on Intelligent User Interfaces* (pp. 101–110), Hong Kong, China.

Datta, P., & Chatterjee, S. (2008). The economics and psychology of consumer trust in intermediaries in electronic markets: The EM-trust framework. *European Journal of Information Systems, 17*(1), 12–28.

Economou, D., Gavalas, D., Kenteris, M., & Tsekouras, G. E. (2008). Cultural applications for mobile devices: Issues and requirements for authoring tools and development platforms. *ACM SIGMOBILE Mobile Computing and Communications Review, 12*(3), 18–33.

Frické, M. (2009). The knowledge pyramid: A critique of the DIKW hierarchy. *Journal of Information Science, 35*(2), 131–142.

Goossen, M., Lammeren, R., & Ligtenberg, A. (2010). The pro's and contra's of an interactive location based service using UMTS transmission. In U. Gretzel, R. Law, & M. Fuchs (Eds.), *Information and communication technologies in tourism 2010* (pp. 111–123). Vienna: Springer-Verlag.

Grün, C., Werthner, H., Proll, B., Retschitzegger, W. & Schwinger, W. (2008). Assisting tourists on the move—an evaluation of mobile tourist guides. *7th International Conference on Mobile Business* (pp. 171–180), July, 7–8.

Hill, K. (2010, August 26). App happy. *Australian Financial Review (AFR.Boss)*, p. 73.

Hsu, C. I., Chiu, C., Su, C., Wu, P. J., & Yang, Y. (2007). Function interfaces assessment of online game websites in great China area using content analysis. *Symposium on Human Interface* (pp. 337–346), Beijing, China.

Karanasios, S., & Burgess, S. (2006). Exploring the Internet use of small tourism enterprises: Evidence from a

developing country, *Electronic Journal of Information Systems in Developing Countries, 27*(3), 1–21.

Karanasios, S., Sellitto, C., & Burgess, S. (2012). A classification of mobile tourism applications. In P. Ordonez de Pablos, R. Tennyson, & J. Zhao (Eds.), *Global hospitality and tourism management technologies* (pp. 165–177). Hershey, PA: IGI Global.

Kenteris, M., Gavalas, D., & Economou, D. (2009). An innovative mobile electronic tourist guide application. *Personal and Ubiquitous Computing, 13*(2), 103–118.

Kenteris, M., Gavalas, D., & Economou, D. (2011). Electronic mobile guides: A survey. *Personal and Ubiquitous Computing, 15*(1), 97–111.

Kim, D., & Adler, H. (2011). Student's use of hotel mobile apps: Their effect on brand loyalty. *16th Annual Graduate Student Research Conference in Hospitality and Tourism,* Houston, Texas.

Law, R., Leung, R., & Buhalis, D. (2009). Information technology applications in hospitality and tourism: A review of publications from 2005 to 2007. *Journal of Travel & Tourism Marketing, 26*(5–6), 599–623.

Lee, Y. W., & Strong, D. M. (2003). Knowing-why about data processes and data quality. *Journal of Management Information Systems, 20*(3), 13–39.

Lee, Y. W., Strong, D. M., Kahn, B. K., & Wang, R. Y. (2002). AIMQ: A methodology for information quality assessment. *Information & Management, 40*(2), 133–146.

Lichtenstein, S., & Parker, C. M. (2009). Wikipedia model for collective intelligence: A review of information quality. *International Journal of Knowledge and Learning, 5*(3), 254–272.

Mamaghani, F. (2009). Impact of e-commerce on travel and tourism: An historical analysis. *International Journal of Management, 26*(3), 365–376.

Miller, H. (1996). The multiple dimensions of information quality. *Information Systems Management, 13*(2), 79–82.

Nardi, B. A., Sherman, J. D., & Mansfield, E. R. (2004). Blogging as social activity, or, would you let 900 people read your diary? *2004 ACM Conference on Computer Supported Cooperative Work* (pp. 222–231)*,* Chicago, IL.

O'Brien, J. A. (2001). *Management information systems: Managing information technology in the internetworked enterprise* (5th ed.). Boston: Irwin/McGraw-Hill.

O'Brien, P. (1998). Electronic commerce, the Internet and travel cybermediaries. *Australasian Journal of Information Systems, 6*(1), 70–78.

Oh, S., Lehto, X. Y., & Park, J. (2009). Travelers' intent to use mobile technologies as a function of effort and performance expectancy. *Journal of Hospitality Marketing & Management, 18*(8), 765–781.

Park, Y. A., & Gretzel, U. (2007). Success factors for destination marketing web sites: A qualitative meta-analysis. *Journal of Travel Research, 46*(1), 46–63.

Peters, M., Piazolo, F., Köster, L., & Promberger, K. (2010). The deployment of intelligent local-based information systems (ilbi): A case study of the European Football Championship 2008. *Journal of Convention & Event Tourism, 11*(1), 18–41.

Pipino, L. L., Lee, Y. W., & Wang, R. Y. (2002). Data quality assessment. *Communications of the ACM, 45*(4), 211–218.

Portolan, A., Miličević, M., & Žubrinić, K. (2011). Concept of mobile device integration in current travel and tourism industry. *10th WSEAS International Conference on Applied Computer and Applied Computational Science,* Venice, Italy.

Rowley, J. (2007). The wisdom hierarchy: Representations of the DIKW hierarchy. *Journal of Information Science, 33*(2), 163–180.

Rusu, S., & Cureteanu, R. (2009). International tourism evolution and smartphone impact on tourism. *Journal of Economics and Business Research, XV*(2), 64–68.

Schwabe, G. (2005). How tourism communities can change travel information quality. *Proceedings of the Thirteenth European Conference on Information Systems,* Germany.

Sellitto, C., Burgess, S., & Hawking, P. (2007). Information quality attributes associated with RFID supply chain benefits. *International Journal of Retail & Distribution Management, 35*(1), 69–87.

Sheng, H., Nah, F. F. H., & Siau, K. (2005). Strategic implications of mobile technology: A case study using value-focused thinking. *Journal of Strategic Information Systems, 14*(3), 269–290.

Taylor, A. (2009). Gen M and the information search process. In V. B. Cveklokic & R. J. Lackie (Eds.), *Teaching generation M: A handbook for librarians and educators* (3rd ed., pp. 71–95). New York: John Wiley & Sons.

Turban, E., Leidner, D., McLean, E., & Wetherbe, J. (2006). *Information technology management: Transforming organisations in the digital economy* (5th ed.). New York: John Wiley & Sons.

Turban, E., McLean, E., Wetherbe, J., Bolloju, N., & Davison, R. (2002). *Information technology for management: Transforming business in the digital economy*. New York: John Wiley & Sons.

Wang, D., Park, S., & Fesenmaier, D. (2011). An examination of information services and smartphone applications. *16th Annual Graduate Student Research Conference in Hospitality and Tourism,* Houston, Texas.