Architecture of Hotel Digital Services

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Abstract— The architecture of a digital hotel supports a new classes of hotel digital services for the purpose of enhancing hotel's guests staying experience. The new digital services are: (1) Hotel Digital Space: a service to expand hotel space to include vicinity & city point of interests and also a new business model that enables the hotel to provide extended services while generating non-room revenue. (2) The Digital Social Engagement: a service for of guests to guest communication but can be extended beyond the hotel boundaries providing guests with a safe and ease of mind staying. visiting, and shopping experience, and (3) Digital Concierge Services: a comprehensive mobile service application for guests to receive context-aware services based on the guest's life cycle. The architectural components, the new services and the non-room revenue generation services, were evaluated using a prototype, and questionnaires which were answered by a sample of 80 technical respondents.

Keywords - digital hotel; hotel digital space; guest to guest communication; guest to neighbors; guest to city POI; digital concierge; e-commerce; guest life cycle

I. INTRODUCTION

The traditional information systems of a hotel is comprised of the following major functions: 1) Reservation 2) Cancellation 3) Change of room 4) Deposit 5) Check-in and Check-out 6) Room keycard 7) Room services 8) Hotel Services 9) Payment and 10) Hotel ERP and CRM. These are typical hotel operations and are supported by numerous commercially available software programs. Little progress has been accomplished in providing new digital services for guests. However, a new innovation can be developed to expanded services for hotel guests. This will be the main focus of this research.

First of all, at present, no system takes the life cycle of a guest into account in the context of providing services to guests. The life cycle of a guest includes, guest arrival to register, guest check in to stay, guest visiting places, and guest leaving as depicted in Figure 1. The activity before the guest's arrival can be the reservation activity. It should be noted that many guests are also walk-in type or are booked through OTA.

In this paper, we proposed three new digital services, two of which have never been proposed and implemented commercially, and one which is partially available with limited feature, commercially. Specifically, the three new services are Hotel Digital Space, Digital Social Engagement, Digital Concierge Services [4]. These three new digital services are hotel digital service innovations that will be presented in this paper including the discussion of the experiment and the validation of these concepts.

Tourism is an industry that generates extensive revenue for Thailand [1,3]. In this decade, it is still a growing industry due to the tourists from China visiting Thailand, and from CMLV countries. The new generation of tourists are all mobile savvy, and most can travel independently. As for the hotel innovations in the past, all were physical implementations of new products or services [5-13]. Hence, it is critically important to innovate by developing a new class of hotel services which supplement traditional hotel operation system. Three digital service innovations, most of which have not been realized and relatively unknown among the hotel operators, will be proposed in Section 2 and validation of these innovations will be described in Sections 3 and 4. Consequently, the result of these innovations can be the foundation of creating a commercially strength add-on system for proving expanded hotel services.

II. ARCHITECTURE OF THE DIGITAL HOTEL

To innovate the new services, we use the new paradigm of digital twin [15]. On the digital side of a hotel, the digital twin of the hotel with extended smart services and smart spaces for the guests will be formulated. In this paradigm, there are four major components of the digital twin of a hotel as shown in Figure 1. These are Hotel Digital Spaces, Hotel Digital Social Engagement, Hotel Digital Concierge and Digital Hotel Operations. All of these digital capabilities are to support the operations functions of a hotel such as

reservation, check-in, check-out, payment, guest services, access to hotel information, and services.
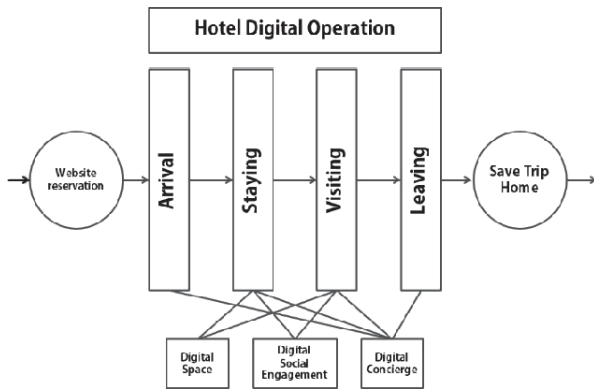

Figure 1. The main functions of a Digital Hotel supporting the life cycle of a guest from making reservation, arrival, staying, visiting and leaving, and safe trip home farewell.

A. Hotel Digital Space:

The term digital space of a guest represents the physical areas, inside and outside of the hotel, that are frequent by a guest when staying in a hotel. The digital footprint of the guest, as related to the activities of the guest, has significant impact on building the next generation digital hotel service platform. The digital space can be divided into three group of digital spaces including.

- Digital space within the hotel: Guest Room, Lobby, Bar, Hotel Shops, Massage Rooms, Swimming Pool, Joking Track, Business Center (or Co-Working Space), Restaurants, and others,

- Digital space between hotel and the neighbors: This space will bring the neighbors into being a part of the guest's ecosystem.

- Digital Space between the hotel and the city: The guest will venture out to visit many places or conduct some personal business affairs in the city. The City-POI will be registered and become part of the guests' extended space.

Each space is connected through several functions. The realization of the hotel digital space is through the Digital Space Services comprising the following.

1) The Digital Space App that provide footprint functions for tracing back of traveled routes, short trip planning inside the connected digital spaces, and recording of events (live and recording).

2) The Alert & Warning and Emergency functions.

3) The E-Commerce functions for Hotel e-commerce, Neighbor e-commerce, and City POI e-commerce. All shops and services must be pre-registered with the Hotel *Server. Figure 2 shows the diagram of The Hotel Digital Space Services.*

B. Digital Social Engagement

Traveling for pleasure or business creates opportunities for finding friends for more personal socialization and guest to guest connection. Here, will have three categories of social and business engagements as the following:

- G2G or Guest to Guest connection on a permission-based system.

- G2N or Guest to Neighbor connection for local food and service experience.

- G2C or Guest to City engagement for providing connection to the person representing the city POIs.

The realization of the Digital Social Engagement is through the architecture shown in Figure 3. The basic components are three chat spaces, one for hotel guests, one for neighbor establishments, and one for the city establishments. All establishments must be registered with the Digital Hotel Servers.

C. Digital Concierge

The third component of a digital hotel is to provide concierge services though the digital space. The service amenity is provided by not only the physical concierge, but also by the digital concierge that can be accessed by guests anytime and anywhere to provide assistance as needed. Most are information requests, and provides a channel to handle the physical requirements such as booking transportation to the airport.

The concierge services can vary, but most of which will deal with the following issues categorized as follows figuer 4.

As for the implementation aspects of the system, it should be noted that any new services must be integrated into the overall workflow that will provide experience to the guests in a seamless manner. Moreover, mobile devices must be the central tool for guests to access any service or to refuse any service, and the interaction between the mobile device and the front-end system must be smooth and intuitive. Many technologies might have to integrate in such system that would not create any weakness in security. The protection of the privacy and provision of security for the guests is the utmost important of the new innovative digital services of the hotel.

III. Experiment and Validation

In order to experiment and validate the merit of the proposed new digital services, a study was conducted based on a mix-method design. Quantitative data from a questionnaire and qualitative data from in-dept-interviews were used for assessing the effectiveness of a new class of digital hotel services. The population in this study was the

official staff of Universal Matrix Technology, and the sample size in this study was 80 respondents. This group members was selected for their knowledge, understanding, and work which are directly related the use of technology in modern business. The instruments for data elicitation in this study is a questionnaire- namely The Digital Hotel Services Questionnaire, and an in-depth interview. The quantitative data from the questionnaires were analyzed by descriptive statistics, and the qualitative data from the interview were qualitatively analyzed and presented in categories. The results of the study were presented according to research questions.

A. The Results of Research Questions

a) Research question 1: What new innovation that can provide the guest with a safe and ease of mind staying experience ?

b) Research question 2: What is a new business model that enables the hotel to provide extended services while generating non-room-based revenue ?

c) Research question 3: What are the exclusive services among the guest and between the guests, and what will the attraction look like in providing the new innovative services to the guest ?

d) Research question 4: What kind of context the hotel system should be aware of in order to provide a more precise service to the guest ?

The results drawn from the questionnaire, Digital Hotel Services and Questionnaire were divided into two parts: Part 1 General information of respondents, and Part 2 Opinions concerning hotel services. The information from Part 2 and together with the in-dept interviews was used to answer the research questions

B. Part 1 General Information of Respondents

The demographic data of the respondents were summarized as follows.

There are 80 respondents in the study. Regarding the the respondents of the questionnaire, (53.00%) were male, while the rest (47.00%) were female, which indicated that there was not much difference in the breakdown of gender of the respondents.

The ages of the respondents were ranked from the highest to the lowest as follows: 21-40 years old (60%), 41-60 years old (32.5%), more than 60 years old (0.0%), and less than 21 years old (7.5%) respectively. This indicated that the majority of the respondents (92.5%) were between 21 and 60 years old. Also, the majority of the respondents (97.5%) were highly educated. Hence, they are well equipped to answer or express their opinions regarding these hotel new digital services for guests.

C. Part 2 Opinions of the Merit of New Digital Services

Opinions of respondents for the hotel new digital services show in Table I.

TABLE I.   OPINIONS OF RESPONDENTS FOR THE HOTEL NEW DIGITAL SERVICES

New Digital Services Satisfaction	Levels of Opinions				
	5	4	3	2	1
1. Besides standard hotel services, the services provided through mobile devices will be more convenient and provide more satisfaction to the user.	58.75% (47)	31.25% (25)	10% (8)	0% (0)	0% (0)
2. Hotel Digital Space Services is a new service that expand the effective guest space to cover, not only space inside the hotel, but the neighbor shops, and also the POIs in the city that are registered with the hotel. The hotel digital space services provide a number of functions such as footprint to track location of guests for safety and ease of mind, e-Commerce for the guests, Alert & Warning, Emergency activation at any time which will provide guest with ease of mind staying experience in and out of hotel.	43.75% (34)	42.5% (30)	13.75% (11)	6.25% (5)	0% (0)
3. Any specific interest of the guest can be answered or assisted by the Digital Concierge.	55% (44)	35% (28)	10% (8)	0% (0)	0% (0)
4. The Hotel E-Commerce shows all the merchandise in the Hotel Shops, and also all the special services offered by the hotel for a fee. The guests can obtain the products and services through the Hotel E-Commerce System. The registered guest has the privilege to access this portal even if after they depart from the hotel. The Hotel E-Commerce can generate substantial income for the Hotel.	42.5% (34)	37.5% (30)	13.75% (11)	6.25% (5)	0% (0)
5. The extra revenue of hotels will be from Neighbor e-commerce Stores, and the City POI e-Commerce Stores registered with the Hotel in which the guests are the e-Commerce customers.	46.25% (37)	45% (36)	8.75% (7)	0% (0)	0% (0)
6. The Hotel E-Commerce System implements the just-in-time logistic to ensure the guests get the merchandise in time before leaving and also provides shipment to the guest's home country.	46.25% (37)	45% (36)	8.75% (7)	0% (0)	0% (0)

New Digital Services Satisfaction	Levels of Opinions				
	5	4	3	2	1
7.The Hotel E-Commerce, the Neighbor E-Commerce and the City POI e-Commerce are offered exclusively for hotel guests only under the Hotel Digital Space Services.	33.75% (27)	50% (40)	16.25% (13)	0% (0)	0% (0)
8. The hotel special service called Hotel Social Engagement will provide a mechanism by which hotel guests can know each other or a permission-based system so as to expand the business and personal networking.	21.25% (17)	60% (48)	10% (10)	7.5% (6)	1.25% (1)
9. The Hotel Digital Concierge System will provide information request assistance and perform certain task as requested by the guests under the context of guest life cycle and time context to increase the degree of satisfaction.	43.75% (35)	41.25% (33)	33.75% (27)	6.25% (5)	0% (0)
10. The top layer guest workflow or life cycle in this system follows 4 steps: Arrival and check-in, staying in hotel, traveling and sight-seeing, and the check-out and departure. The services can be offered to provide the more targeted services to the guests in each of the stage of the guest's life cycle.	40% (32)	50% (40)	10% (8)	0% (0)	0% (0)
11. The time context is used to provide context-aware services, such as breakfast in the morning, spa and relaxation in the afternoon, or making a local trip to some POI and Special dinner program in the evening.	22.5% (18)	61.25% (49)	16.25% (13)	0% (0)	0% (0)
12. In your opinion, rank the Hotel Digital Space Services with 5 as the highest ranking	51.25% (41)	20% (16)	28.75% (23)	0% (0)	0% (0)
13. In your opinion, rank the Hotel Social Engagement Services with 5 as the highest ranking	11.25% (9)	55% (44)	33.75% (27)	0% (0)	0% (0)
14. In your opinion, rank the Hotel Digital Concierge Services with 5 as the highest ranking	37.5% (30)	25% (20)	37.5% (30)	0% (0)	0% (0)

IV. ANALYSIS

Table I shows that opinions concerning hotel's new digital services. In particular, we will examine the results to see if the new services can provide guests with a safe and ease of mind staying experience? The respondents' opinions about the function of the Hotel Digital Space services with footprint to track the location of guests outside the hotel, the alert and warning, and the emergency functions also were ranked as follows: strongly agree (43.75%, n = 34), agree (42.5%, n = 30), neutral (13.75%, n = 11),), and disagree (6.25%, n = 5) , respectively. The disagreement was minimal (6.2.5%, n = 5), which indicated that the majority of the respondents (86.25%, n = 64) agreed that the digital space functions would be able to provide ease of mind and a safe experience. Moreover, ease of mind is also provided by the Hotel Digital Concierge functions (questionnaires #3) in which the respondents' opinions that "the guest will have ease of mind experience" by getting the answer for question asks, and getting the service that is requested digitally, were ranked as follows: strongly agree (55%, n = 44), agree (35%, n = 28), neutral (10%, n = 8), and disagree (0%, n = 0) respectively. There was no disagreement, which indicated that the majority of the respondents (90%, n = 72) agreed that the guests can have ease of mind experience since any question or request can be serviced by the Digital Concierge.

As for Research Question 2: What is new business model that enables the hotel to provide extended services while generating non-room-based revenue? The respondents' opinions that, "The e-commerce components can generate income for the hotel", were expressed in question # 4 and #5. For the Hotel E-Commerce revenue generation, the respondents answers were ranked as follows: strongly agree (42.5%, n = 34) agree (37.5%, n = 30), neutral (13.75%, n = 11), and disagree (6.25%, n = 5) respectively. The disagreement was minimal (6.25%, n = 5), which indicated that the majority of the respondents (80%, n = 64) agreed that the e-Commerce is a source of extra income for the hotel. Likewise, the extra income for Neighbor e-Commerce and City POI e-commerce, the respondents' opinions that "the source of non-room revenue can be provided by the Neighbor and City POI e-commerce " were ranked as follows: strongly agree (46.25%, n = 37), agree (45%, n = 36), , neutral (8.75%, n = 7), and disagree (0%, n = 0) respectively. There was no disagreement, which indicated that the majority of the respondents (91.25%, n=73) agreed that the hotel should develop all the e-commerce system so as to generate non-room revenue.

For Research Question 3: What are the exclusive services among the guest and between the guests and the attraction look like in providing the new innovative services to the guest ? To answer this question, the data

was provided by the respondents' opinion in questions #6, #7, and #8 in Table 5.4 which shows that opinions regarding the unique services provided by the Hotel in the areas of e-commerce and social engagement. The respondents' opinions about just in time logistic, shipment to home country, exclusive e-commerce for guest, and life-time membership for e-commerce were ranked as follows: For question #6, strongly agree (46.25%, n = 37), agree (45%, n = 36), neutral (8.75%, n = 7), and disagree (0%, n = 0) respectively.

The respondents' opinions about exclusivity of service is especially vital for the hotel service branding and were ranked as follows: strongly agree (33.75%, n = 27) agree (50%, n = 40), neutral (16.25%, n = 13), and disagree (0%, n = 0) respectively. There was no disagreement which indicated that the majority of the respondents (83.75%, n = 67) agreed that the exclusive service is especially vital for branding of hotel services.

Another answer to Research Question 3 was the unique offering of Social Engagement for guest to guest communication, guest to neighbor shop communication, and guest to City POI shop communication. The respondents' opinions that "Hotel Social Engagement can draw the attention of potential guests considering the selection of a hotel" were ranked as follows: strongly agree (21.25%, n = 17), agree (60%, n = 48), , neutral (10%, n = 10), and disagree (7.5%, n = 6) strongly disagree (1.25%, n=1), respectively. The disagreement was noticeable (8.75%, n = 7), which indicated that even more than the majority of the respondents (81.25%, n = 65) agreed that Social Engagement is an innovative service, but 8.75% disagreed with providing such a facility. However, from our in-depth interview, we discovered that the major concern was about the security, anonymity, and personal privacy.

As for Research Question 4: What kind of context, the hotel system should be aware of in order to provide a more precise service to the guest? The answer to this question lies in the partition of services correspond to each phase in the guest's life cycle consisting of the arrival phase, the staying phase, the sight-seeing phase and the departure phase. The respondents' opinions about use of guest life-cycle to provide the primary needed functions for the guests and the use of time context to determine the appropriate services the guest desires to acquire. Questionnaire #10" responses were ranked as follows: strongly agree (40%, n = 32), agree (50%, n = 40), and neutral (10%, n = 8), respectively. There was no disagreement, which indicated that the majority of the respondents (90%, n = 72) agreed with the idea that the life cycle of a guest can be used to determine the primary service function needed for a particular phase. For the use of time context to provide the right service suggestion for the guest, the respondents' opinions that the system could "increase the guest satisfaction by using the time context to suggest the right service" were ranked as follows:

strongly agree (22.5%, n = 18), agree (61.25%, n = 49), neutral (16.25%, n = 13), and disagree (0%, n = 0), respectively. There was no disagreement, which indicated that the majority of the respondents (83.75%, n = 67) agreed that the guests would benefit from providing time-context aware services.

Finally, the respondents rank the three group of hotel new digital services in the following order

- Hotel Digital Space Services ranks No. 1 (51.25%)
- Hotel Digital Concierge ranks No. 2 (37.5%)
- Hotel Social Engagement ranks No. 3 (11.25%)

V. THE RESULTS OF THE VALIDATION

Hence, from the research data as analyzed, the three innovative new services for the hotel were well accepted by the respondents who are well-versed in using digital technology in every aspect of living. The Digital Space Services ranked number 1 since the functions provided are very useful giving peace of mind and safety to the guests. Also, the e-commerce functions, be it the hotel e-commerce, the neighbor e-commerce, or the city e-commerce are all revenue generating channel to supplement the room-based revenue. The notion that once a guest is using the e-commerce, they are the life time member, and can continue access the system, and buy merchandises, or services from any location in the world was viewed favorably.

The social engagement is a vehicle to expand the guests' network, personal or business. The utmost concern from the expert discussion is the privacy issues. However, the system is designed as permission based social engagement, the privacy issue can be well managed within the boundary of engagement rules.

Finally, the Digital Concierge was well received by the respondents which indicate the usefulness of this type of services to the guests, and hence, ranks number two among the respondents. All in all, these three group of new services for the hotel guests would be able to bring in more guests if the services are implemented.

VI. CONCLUSION

This paper has attempted to answer three important four research questions by proposing three group of digital services and one non-room revenue generation by e-commerce. The result was validated by a quantitative and equalization means as described in Sections 3 and 4. Here, the main results can be briefly summarized as follows.

A. New Services

In this research, three new digital services are proposed.

1) The Digital Social Engagement. The digital social engagement for guests so that guest and guest can know

each other based on mutual approval. The guest to guest social engagement is one of the concepts mentioned in the report "The Next Generation Hotel" by Deloitte [14]. In our work, we extend this concept to allow guest to communicate with neighbor business entities, and extending the space coverage to include the guest to city's POI communication.

2) The Digital Hotel Space. The second group of service is the Hotel Digital Space. Normally, the space occupied by a guest is the room, the lobby, the hotel service areas such as restaurant, business center, swimming pool. In general, most of the open space is in the hotel. Our new service concept is to extend the coverage to the neighbor space and the POI space in the city. The connectivity and transition from one space to another space is managed via the following applications: The Digital Footprint, The Alert and Waring, Emergency, The e-commerce applications, and The Graphic Map services

3) Digital Concierge. The digital concierge will provide assistance to hotel guests whenever and where-ever, they have certain questions to find answer, be it the services needed, or be it certain tasks that need to be performed by the concierge.

B. New Business Model

From the validation of this new services, the survey of 80 representative hotel users gave highest favorable rating of the new services in the range of 99%-100%. The hotel service innovations were mostly in the form of physical services. Over many decades, the hotel still concentrates on traditional hotel operations. Even the traditional hotel operations can be re-designed. For example, the business center can be remodeled as the co-working space to accommodate outside users.

The three E-commerce systems can be implemented to support the online experience in shopping souvenir and personal needs. The hotel e-commerce targets the guests to by certain products or services that sell by the hotel shops. While the neighbor e-commerce will expand the shopping experience to certain shops in the neighborhood in which the guest can have seen the merchandise before making the purchase decision online. The hotel can have a margin for all the transactions between guest and a neighbor shop. Likewise, for the city e-commerce linking with POI, including certain department stores, specialty shops, the hotel will have a cut on each transaction.

REFERENCES

[1] National Statistical Office. (2015). Survey of hotel and guest house business operation, 2014.

[2] Grant Thornton. (2016). Thailand: Hotel Survey 2016.

[3] Ministry of Tourism and Sports. (2017). Statistics of foreign tourists traveling to Thailand in 2017. R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press.

[4] Galayapha Lekvanijthamvita, Architecture of Digital Hotel Services, Dissertation, SIU, 2020.

[5] Gyurácz-Németh, P., Friedrich, N., & Clarke, A. (2013). Innovation in special hotels - as a key to success. In Zadar Croatia International Conference.

[6] İplik, FN, Topsakal, Y., & Doğan, O. (2014). Strategic innovation: An operation in the Antalya region. Advances in Hospitality and Tourism Research (AHTR), 2 (1), 16-29.

[7] Ilyenkova, SD., Kuznetsov, VI (2009). Innovation Management. Moscow, Eurasian Open Institute, p.183.

[8] Orlova, LN (2016). Approaches Tto Management of The Principles And the underlying on Sustainable Development Innovation of Economic systems's. Management in Russia and abroad, 3, pp. 3-9. use of AR is also possible to make the stay more enjoyable and challenging.

[9] Balan, P., & Lindsay, NJ, (2010). Capability Innovation With, Entrepreneurial Orientation and Performance In the Australian friendlys: in An Empirical Study, the Library Of Australia The to National Cataloging-In-Publication New Entry The, For the CRC of Sustainable pty. Ltd, the Tourism.

[10] Andrea, NAGY (2012). Review of Tourism and Hospitality Innovation Research, Annals of Faculty of Economics, 1 (2), 364-370.

[11] Pivčević, S., & Garbin Praničević, D., (2012). The Hotel-Sector Activity In The Innovation With Used case Of Croatia Croatian, the Economic Research, - Ekonomska Istrazivanja Vol.25, SE1, pp. 337 - 363.

[12] Carvalho, L., & Costa, T., (2011). Tourism Innovation - A Literature Review Complemented by Case Study Research, Book of Proceedings Vol.1-International conference on tourism and management studies, pp. 23 - 33.

[13] Dzhandzhugazova, E.A., Blinova, E.A, Orlova, L.N., & Romanova, M.M. (2016). Innovations in Hospitality Industry. International Journal of Environmental and Science Education, 11 (17).

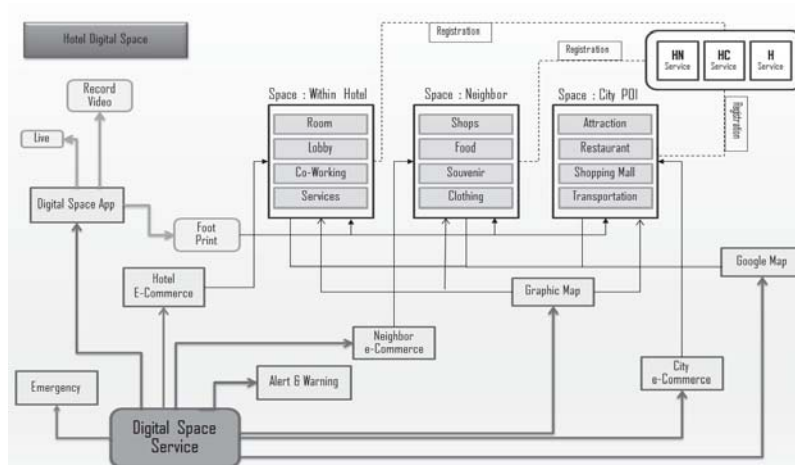[14] Deloitte Consulting, The Hotel of the Future, Doblin, 2016

Figure 2. The diagram of the Digital Space showing the digital footprint, e-commerce, alert and warning.
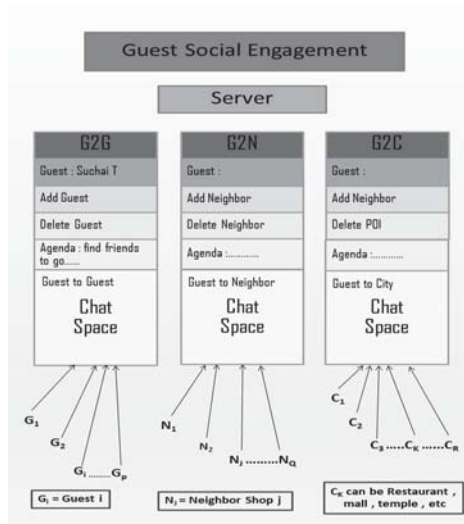

Figure 3. The Guest Social Engagement Diagram, showing the chat space and the connected e-commerce for each engagement.
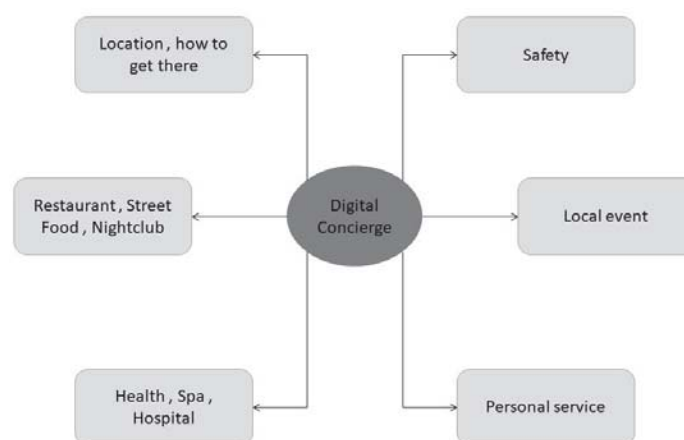

Figure 4.   The Digital Concierge provides assistance to guests in six basic areas.