AN IMPORTANT – PERFORMANCE ANALYSIS OF INTERNET OF THINGS APPLICATIONS IN HOTELS

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Abstract—Internet of Things (IoT) technology starts claiming a lofty position in tourism industry, transforming hotels to smart hotels, tourism services to smart tourism services and overall tourism industry to smart tourism industry. It could be considered the core carrier of the smart tourism information system.The acceptance ofImportance-performance analysis (IPA) as the measurement of service quality is corroborated by its extensive application in the tourism sector. Hotels must deliver high guest satisfaction iftheyare to maintain a competitive advantage and it is up to hotel managers to identify the critical IoT performance appliancesthat generate this guestsatisfaction. Guests are satisfied when the hotels' performance matches their expectations.The purpose of this research was to investigate the perceptions of hotel guests towards importance and performance of IoT appliances in hotels. It was found that IoT appliances spread over 3 quadrants. Two of them were placed in the Concentrate Here quadrant, six of them in the Keep up the Good Work quadrant and eight of them in the Low Priority quadrant.

Index Terms— Importance – Performance analysis (IPA), Internet of Things (IoT), tourism industry.

I. INTRODUCTION

Societies are characterized by an extreme pace of growth of technology. Individuals tend to replace personal computers and laptops with smartphones and tablets, as the latter ones can do almost the same daily activities, while being much smaller and easy to carry at all times. This technological evolution has led to the development of smart applications. Besides smart applications, smartification of other objects and devices has started, enabling the innovative technology diffusion of the Internet of Things (IoT), where people and 'smart' objects can exist and cooperate together by being connected to networks through IoT. [6]

In tourism industry, adopting technological innovations can be of a great importance for businesses, both for the creation and preservation of a competitive advantage. The purpose of this research is to investigate the perceptions and attitudes of guests towards IoT appliances in hotels. A questionnaire, containing some of the most popular hotels' IoT applications, was distributed to guests of smart hotels, who were asked to state their perceptions of the importance and performance of these key IoT appliances.

The first part of the research presents a literature review on the concept of IoT and on hotels' IoT, as well as a description of Importance -Performance (IPA) analysis. The second part consists of the methodology research and the analysis of the participant responses.

II. INTERNET OF THINGS - IOT

The concept of Internet of Things (IoT) refers to the environment that consists of various things/objects that through wireless and wired connections and unique addressing schemes are able to interact with each other and cooperate with other things/objects to create new applications/services and reach common goals [23]. "[…] A world where the real, digital and the virtual are converging to create smart environments that make energy, transport, cities and many other areas more intelligent." [23]

The development of open wireless technologies, such as Bluetooth, RFID, Wi-Fi and telephonic data services, with the combination of the embedded sensor and actuator nodes on the objects, have resulted in giving the current static Internet a new totally integrated dimension of the Future Internet. This Internet evolution achieved interconnection among people and objects, which led to the creation of smart environments [6].

"Smart environment is defined by Mark Weiser as the physical world that is richly and invisibly interwoven with sensors, actuators, displays and computational elements, embedded seamlessly in the everyday objects of our lives and connected through a continuous network." [6].

A. IoT in hotels

With IoTs technology, physical objects are interconnected and equipped sensors and actuators on smart objects and devices, act as means to connect them to the Internet. The widespread use of this technological innovation to many industries, inevitably lead to the development of new 'smart' applications or/and to improvement of existing ones. Examples of IoT applications for both personal ne industrial use include monitoring personal health through wearables, washing machines that enable users to pay per load instead of for the whole machine, 'smart' agriculture greenhouses, farms, and stables where the climate can be adapted according to the monitored properties of the specific crops, feeding and milking schedules to monitored properties of

individual cows and other animals of the farms and so on [3].

IoT technology starts claiming a lofty position in tourism industry, transforming hotels to smart hotels, tourism services to smart tourism services and overall tourism industry to smart tourism industry. It contributes in upgrading the whole tourism industry by informatization and intellectualization, in a wider sphere. Cloud computing and IoT technology are significant components, that smart tourism can focus on so as to "apply intelligent perception of all kinds of tourism information, like tourist resources, tourism economy, tourism activities, tourism participants, among others to realize the acquisition and adjustment of real-time tourism information through mobile Internet or Internet terminal equipment." [7]

IoT technology could be considered the core carrier of the smart tourism information system. An indicative example of using IoTs in a hotel resort is systems identifying the real-time positioning of visitors and automatically point them at the resort map can be designed, leading to an exchange of information facilitation, through alarms and messages [7].

An innovative firm can create an entirely new market or provide an entirely new product or service to a current market, were benefits arise for both the firm and the potential customers, in terms of profit and convenience. When innovation concerns the service sector there are four dimensions of novelty: service concept, that refers to a service new to its particular market; client interface, where the changes occur in customers involved in service design, production and consumption; service delivery system, which entails changes in the ways services providers perform while delivering service; technology, that is used in processing and delivering innovation [8].

Since hospitality industry is a highly competitive market, hotel companies tend to implement ICT innovations to improve their image, their customer perceived quality and consequently to achieve brand loyalty. It is essential for hotels to pay much attention to their customer-based brand equity in order to remain competitive in their market [17].

'Smart' tourism needs to proceed to systematic and intensified transformation in order to keep up to personalized tourists' needs, to improve tourist experience and increase satisfaction, as well as to share and effectively utilize the tourism resources combining with the social ones [18].

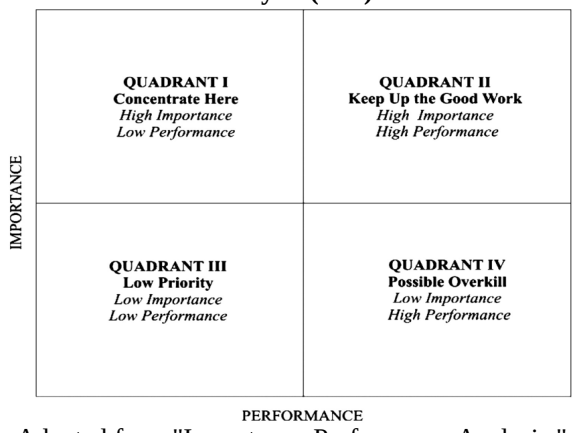
III. IMPORTANCE-PERFORMANCE ANALYSIS (IPA) CONCEPT

Importance-performance analysis (IPA) is a widely accepted method for measuring service quality that is well known of its simplicity. The concept of IPA was introduced in 1977 by Martilla and James [10]. Essentially, the idea of IPA comes from the theory of customer satisfaction as a function of the expectation on important attribute and the judgment of attribute performance [10]. The underlying assumption in IPA is the relationship between importance attribute and attribute performance toward customer satisfaction is linear and symmetric [10]. Thus, IPA investigates the gap between customer expectation on the importance and assessment of the performance of services. The objective is to identify which attributes or its combination gives more impact toward customer satisfaction and leads to the repetitive customer purchase behavior [11].

The IPA consists of a pair of coordinate axis where the 'importance' (y-axis) and the 'performance' (x-axis) of the different elements involved in the service are compared (Fig. 1). Each of the quadrants combines the importance and the performance assigned by the customers/user given element of the service and possesses a different value in terms of management and the respective mean of self-stated raw importance and attribute performance data is the original point of this IPA matrix [10], [5], [1], [11], [12], [25], [16], [20]. Each quadrant suggests a different marketing strategy.

The acceptance of IPA as the measurement of service quality is corroborated by extensive application of IPA, largely in the tourism sector [9], [13], followed by banking sector [19], education sector [11, [2], [14], [15], electric and electronic sector [15], automotive sector [10], and many other. It provides indication that the customer is either satisfied or dissatisfied on the attributes of service consumed [10].

Figure 1. Quadrants of importance-performance analysis (IPA)



Adapted from "Importance-Performance Analysis," by J. A. Martilla and J. C. James, 1977, [10]

The four quadrants in importance-performance analysis are characterized as [10] : "- A. Concentrate here - high importance, low performance: requires immediate attention for improvement and are major weaknesses; - B. Keep up with the good work - high importance, high performance: indicate opportunities for achieving or maintaining competitive advantage and are major strengths; - C. Low priority - low importance, low performance: are minor weaknesses and do not require additional effort; - D. Possible overkill - low importance, high performance: indicate

that business resources committed to these attributes would be overkill and should be deployed elsewhere".

IV. METHODOLOGY RESEARCH

IPA was used for assessing guests' perceptions of smart hotels. The selection of the IoT appliances in hotel businesses, referring to services of hotel's main operations like front-desk and reception, billing, in-room, F&B, guest relations, conferences and group, as well as marketing services like surveys, were based on previous literature, deciding to focus on the following attributes:

1. Mobile Check-in/out (through hotel's mobile application)
2. Smartphone as Room Key (e.g. after checking in, guests can approach their smartphone to the door of the room, where a sensor "recognizes" the specific guest and the door opens automatically)
3. Auto Billing (e.g. whatever guests can purchase at the hotel is added to their bill through their smartphone)
4. Auto Bill Check (e.g. guests will be able to control their bill, during their stay, through hotel' s mobile application)
5. "Smart" Rooms (e.g. guests can enjoy the preferable conditions of the room environment, such as temperature, humidity, lighting, music, as "smart" devices in the room can be programmed according to guests' standards throughout their stay)
6. "Smart" Mini-Bars (e.g. sensors in mini bars can inform hotel staff about the appropriate and timely refilling according to guests' consumption and needs)
7. Auto Restaurant Reservations (e.g. guests can make restaurant reservations at the hotel through their smartphone)
8. Auto Tracking and Ordering (e.g. through their smartphones, when guests are around hotel's bars or restaurants area, they can be informed about any available seats and if so, they can be sent the menu and order online)
9. Target Promotions (e.g. special offers and promotions can be sent to guests through the hotel's smartphone application according to their consumption history)
10. Auto Last - Minute Booking (e.g. if guests want to book a room in hotel the last moment they arrive at specific place, they can search about any availability and proceed with the booking through hotel's mobile application)
11. Late Arrival services (e.g. if guests arrive late at night at hotel, the hotel can be informed through the application)
12. Daily Activities Schedule (e.g.every day guests can be informed about possible activities that are going to take place at the hotel or around it, regarding their interests)
13. Social Networks (e.g. guests can rate and share their stay experience of the hotel and its services, while possible new guests can find out what to expect)
14. Event Alarm and Location (e.g. alarm is sent to speakers and attendants of a conference, meeting or event, reminding of the specific time and directions to place they should attend)
15. Group Tracking (e.g. everyone in a group is warned about the schedule of activities or events they have to participate)
16. Service surveys (e.g. surveys are sent through hotel's smartphone application allowing guests to rate a service provided by hotel staff)

The survey was conducted during May and September of 2018 in Greece. A total of 372 valid questionnaires were received, using a non-probability convenience sample. No incentive was offered to encourage participations. Respondents were instructed to identify the levels of importance they associated with 16 items related to key hotel IoT appliances. The response set for each item was a 5-point Likert-type scale, with possible response options ranging from 1 (*not at all important*) to 5 (*extremely important*). Respondents also were instructed to identify the levels of performance they associated with the same set of 16 items. The response set for each item was a 5-point Likert-type scale, with possible response options ranging from 1 (*not at all performed*) to 5 (*extremely performed*).

V. RESULTS

In order to approach the importance that guests assign to different IoT appliances of the hotel, as well as know the value of performance, means and standard deviations for the aggregated data were calculated. The overall importance means ranged from 2.67 to 4.92 and the overall performance means ranged from 3.16 to 4.92 (Table 1). The overall grand means for importance and satisfaction were 3.85 and 3.90, respectively. The position of the grid is determined by these two overall mean values for attribute importance and attribute importance (Fig. 1).

According to Table 1, the IoT appliances that guests mentioned as the most important were: Mobile Check-in/out, Auto Billing, Auto Bill Check, "Smart" Rooms, Late Arrival services, Daily Activities Schedule, Social Networks, Event Alarm and Location. On the other hand, IoT appliances that guests mentioned as less important were Smartphone as Room Key, "Smart" Mini-Bars, Auto Restaurant Reservations, Auto Tracking and Ordering, Target Promotions, Auto Last - Minute Booking, Group Tracking, Service surveys.

In evaluating the performance IoT appliances, the

Event Alarm and Location was the highest (4.92), followed by the Mobile Check-in/out (4.72), Daily Activities Schedule(4.61), Social Networks(4.18) and Smart Rooms (4.02). The rest were evaluated as low performance IoT appliances, with Smart" Mini-Bars(3.16) beingthe lowest-rated performance attribute.

The values obtained for the standard deviation (SD) are considered low, indicating that the variations of the responses are low. This measure reflects the variation of dispersion of a set of data around the mean, i.e., the greater or less variability of results.

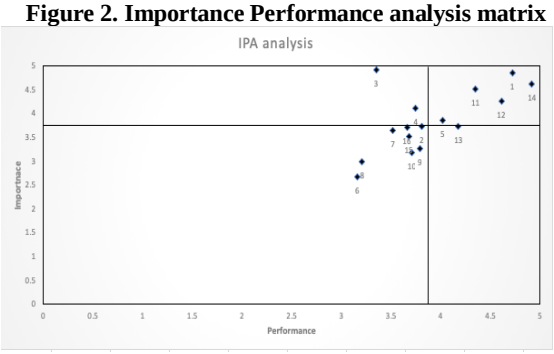
Table 1. Importance - Performance ratings

	Correspondi ng Number	Importance		Performance		Gap	Quadrant
		Mean	SD	Mean.	SD		
Mobile Check-in/out	1	4,86	0,58	4,72	0,68	0,14	2
Smartphone as Room Key	2	3,72	0,72	3,81	0,83	-0,09	3
Auto Billing	3	4,92	0,57	3,35	1,21	1,57	1
Auto Bill Check	4	4,12	1,15	3,75	1,03	0,37	1
"Smart" Rooms	5	3,86	0,91	4,02	0,92	-0,16	2
"Smart" Mini-Bars	6	2,67	0,96	3,16	0,67	-0,49	3
Auto Restaurant Reservations	7	3,64	0,47	3,52	0,49	0,12	3
Auto Tracking and Ordering	8	2,99	1,24	3,21	0,51	-0,22	3
Target Promotions	9	3,27	0,72	3,79	0,83	-0,52	3
Auto Last Minute Booking	10	3,17	0,86	3,71	1,26	-0,54	3
Late Arrival services	11	4,52	1,31	4,35	0,86	0,17	2
Daily Activities Schedule	12	4,25	0,49	4,61	0,74	-0,36	2
Social Networks	13	3,72	0,81	4,18	0,91	-0,46	2
Event Alarm and Location	14	4,61	0,74	4,92	1,17	-0,31	2
Group Tracking	15	3,52	1,02	3,68	0,63	-0,16	3
Service surveys	16	3,71	0,87	3,66	0,54	0,05	3
		3,85		3,90			

Importance-Performance matrix is represented in Fig. 2. The results are spread over 3 quadrants. In Quadrant A there were 2 IoT appliances: Auto Billing and Auto Bill Check. Quadrant B shows hotels' weaknesses.Guests valued these attributes but showed low satisfaction with thehotels' performance. Hotels should focus on them immediately, in order to improve guests satisfaction. In Quadrant B were the Mobile Check-in/out, "Smart" Rooms, Late Arrival services, Daily Activities Schedule, Social Networks, Event Alarm and Location. These IoT appliances are of the highest importance for guests and of high satisfaction, judging from the good performance evaluations. Hotels should keep up the good work here and continue to meet the needs of their guests.

IoT appliances included in Quadrant C, are of low priority and need no additional action. Guests neither evaluated them as important nor rated them as of high performance. Eight appliances are included: Smartphone as Room Key, Smart" Mini-Bars, Auto Restaurant Reservations, Auto Tracking and Ordering, Target Promotions and Auto - Last Minute Booking. In Quadrant D,no IoT appliances appeared.

Figure 2. Importance Performance analysis matrix



CONCLUSIONS

Importance-Performance Analysis (IPA) is a simple and useful technique that can help managers identify which attributes should be improved to increase overall customer satisfaction and offers a number of advantages when it comes toassessing guest'sacceptance of hotels' IoT appliances.It is an easily applied technique and can be used to identify a hotel's strengths and weaknesses. This research supports the adoption of the IPA as a framework for evaluating guests' satisfaction. Such framework can be used in further research on guests' satisfaction.

Hotels must deliver high guest satisfaction iftheyare to maintain a competitive advantage and it is up to hotel managers to identify the critical IoT performance appliancesthat generate this guestsatisfaction. Guests are satisfied when the hotels' performance matches their expectations. However, many studies have evaluated either guests' expectations or actual IoT appliances performance only, rather than both. The lack of systematic study intoguests' expectations and hotels performance is making it more difficult for hotel professionals to develop a sound marketing strategy.

The generalization of these results should not, however, be overstated. It would be interesting to look at the decisive factors that influence hotel guests' loyalty and how this technique can help hotels allocate their resources with more confidence

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