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Implementation of Internet of things in Egypt airports and hotels: An Exploratory Study

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Abstract

The subject of considerations is the use of Internet of Things technology in air transport and accommodation. Interesting the Internet of Things solutions have grown more and more for several years, especially since it is seen as another technological revolution comparable with the dissemination of mobile technologies or social networks. The goal of work is determining the usage possibility of IoT and identifying solutions implemented in the modernized infrastructure of Egypt airports and hotels.
In the theoretical part, Polish and English-language literature was queried devoted to issue of the Internet of Things. Accomplishing the research goals required using interview method. The results allow conclusion to be drawn regarding the future of Egypt airports and hotels, then indicate the potential areas for future pass of IoT solutions.

Keywords: IoT, Intelligent Airport, Intelligent Hotel, IoT Products.

1. Introduction

The term "Internet of Things" (IoT) was first used in 1999 by British technology pioneer Kevin Ashton to describe a system in which objects in the physical world could be connected to the Internet by sensors (Rose et al., 2015).

Ashton invented the term to illuminate the power of connecting Radio-Frequency Identification (RFID) Tags used in mutual supply chains to the Internet to count and track goods without the need for human involvement (Wikipedia, 2015).
Today, the Internet of Things becomes a common term for revealing scenarios in which Internet connectivity and computing proficiency extend to a diversity of objects, devices, sensors, and daily items (Rudnicki, Borodako, 2017).
Internet of things (IoT) is considered a peculiar ecosystem in which objects equipped with sensors communicate with computers. It is a technology dynamically expands network applications and uses different devices without human interference. The internet of things is directly related to the technological revolution in information technology and telecommunications, which currently affects government, non-profit business sector, and private life (Senkus et al., 2014).
The Internet of Things involves networking of almost all types of devices. The concept is based on three concepts: always (anytime), everywhere (anyplace), with everything (anything). The potential lies in this technology makes the Internet Things are also referred to as the Internet of everything (Schatten et al., 2016).

In this approach, the system is created not only by objects, but also processes, data, people and even animals or atmospheric phenomena, in other words: everything that can be treated as a variable (Kokot, Kolenda, 2015).

Internet things are therefore a combination of two worlds: digital devices and physical world. Today, according to the classification adopted by O. Vermesan and P. Friess, among potential areas conducted, where Internet of Things can be implemented, numerous scientific studies are mentioned (Vermesan, Friess, 2014):

• Intelligent environment (Zhang et al., 2016).

• Intelligent water management (Wong, Kerkez, 2016).

• Intelligent industry (Laudien, Daxböck, 2016).

• Intelligent production (Qu et al., 2016).

• Intelligent transport (Vermesan et al., 2011).

• Intelligent energy (Yun, Yuxin, 2010).

• Smart cities (Vlacheas et al., 2013).

• Intelligent buildings (Schatten, 2014).

• Intelligent home (Lee et al., 2016).

• Intelligent health (Bui, Zorzi, 2011; Moosavi, 2016).

The classification presented above clearly shows the variety of applications The Internet of Things recognizes with the intensification of scientific research fields. It should be emphasized that these studies are undertaken during the last ten years, which confirms the hidden potential in Internet of things new technology for both theoretical and practical aspects.

The opinion discussed via the paper is, among the listed areas with the greatest use of IoT technology is mentioned as transport and hospitality industry (which is key element of tourism).

As the experience of recent decades shows, the entities involved in the operation of air transport (e.g., airlines, infrastructure) and hospitality organizations (resorts and hotels) were pioneers in the implementation of new technologies. So, the paper considerations are devoted to contemporary application conditions of Internet of Things solutions in airports and hotels.

2. Research objectives:

1- Analyzing the current situation of Egypt airports and hotels.
2- Studying some international Airports and hotels implement IoT.
3- Developing a strategy applies IoT to Egypt airports and hotels.
4- Transforming Egypt airports and hotels into smart ones.

3. Literature review

3.1. Role of IOT in AirPort

The internet of things is seen as a far-reaching vision of technology and social consequences (Kwiatkowska, 2014). Therefore, among the most important reasons for implementing the Internet of Things by air transport is Optimizing the ground handling operation, communicating with passengers at the airport (e.g., navigating at airports, passing information about the time of reaching the gate) or making it easier to find luggage. These aspects allow those involved in the provision of air transport services on one hand to raise their own operational efficiency, and on the other one, to take care about luxury of clients' travel, what consequently, improves the aviation experience (Skift, 2016).

Implementing the Internet of Things technology via airport infrastructure integrates various research areas, such as intelligent buildings, intelligent production (in the provision of services to passengers), intelligent management or intelligent transport. Analyzing the journey as a multi-stage process, can be seen that most of information, on which decision-making is based, are the passenger needs from initial to final stages, i.e., during staying at the airport.

That is why, among the leading areas of application, the Internet of Things lists primarily communication with passengers at the airport in terms of navigation or information about the planned time of reaching the gate or scheduled check-in time, considering the number of passengers waiting in the queue, as well as making it easier to find luggage.
Among other areas contributing the improvement of passenger traffic services (having both direct and indirect impacts), optimization of ground handling operation, automatic passenger identification, condition management systems, airport equipment, luggage tracking systems, security systems and monitoring of fuel consumption (SITA, 2016).

The following figure represents intelligent airport.

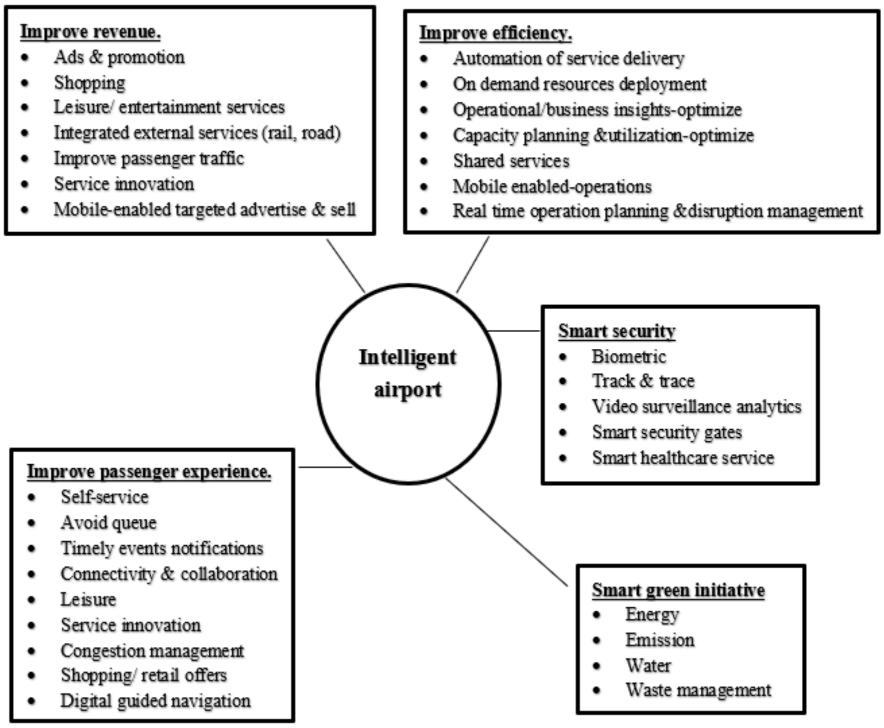

Fig. 1. Intelligent airport
Source: (Mousa, 2019)

Role of IOT in Hotels

IoT is used in many different areas to improve efficiency and provide a better client experience. Homes progressively revolve into smart ones and open the way for smart hotels, providing hoteliers an opportunity to better serve guests, offer value-added

services, and operate the facility on the back end with greater proficiency than was before.
Modernizations in smart devices and IoT enterprise technology transformation in hospitality service platform (Kansakar et al., 2017). The hotel industry applies IoT to provide combined services such as application-driven devices and automated triggers like automated door locks, set-top-boxes, thermostats, telephones, light switches, voice-based interaction, electric blinds, and other devices connected on a shared network to enable the services that guests need. So, the guest experience will be more adapted and faster, and the hotelier performance will be more competent. Also, hotels will be more valued at lower costs (Car et al., 2019).

IoT in hospitality industry is best defined as: A network of digital devices and machines are connected via the internet for enhancing the guest experience and optimizing expenses (Magalhães et al., 2017).

The following figure represents intelligent hotel.

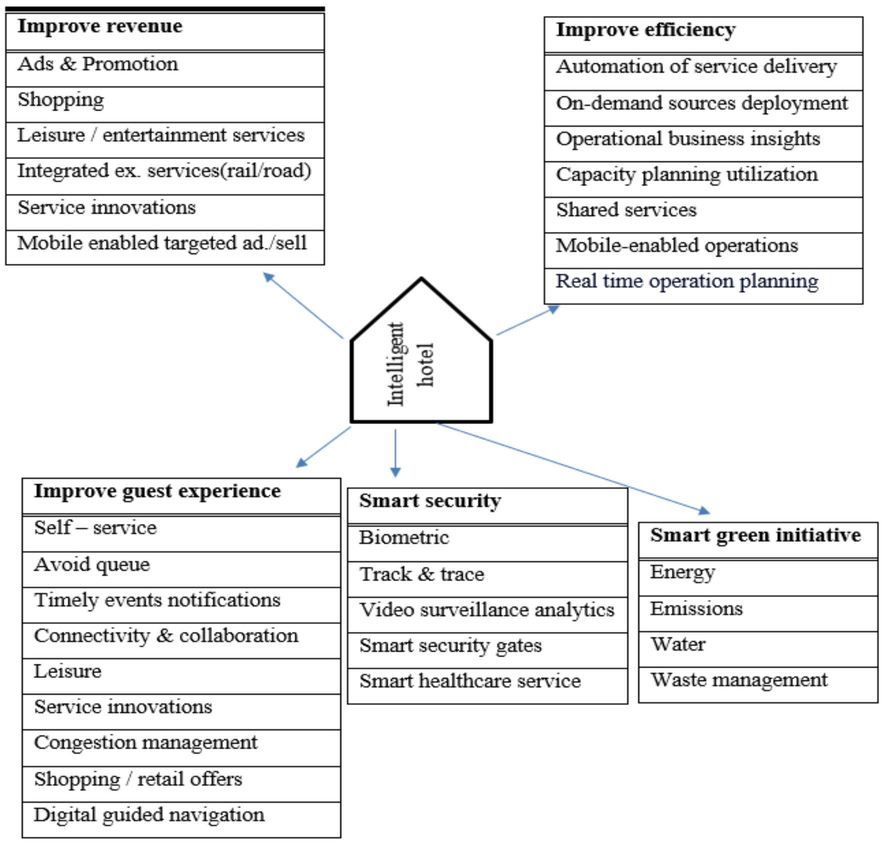

Fig. 2. Intelligent hotel

Source: Prepared by researcher.

3.2. World successful experiences

3.2.1. Helsinki Airport

Helsinki Airport in Finland uses Wi-Fi and beacons which track passengers and offer location- grounded facilities. Airport operator teams up with local company install dozens of sensors all around the terminal. These are intelligent to follow smartphones from parking to terminal. So, airport can avoid queues and jams everywhere, and permit retailers forward notifications to travelers depending on exact location (https://www.finavia.fi/, 2021).

3.2.2. London City Airport

London City Airport represented as the world's first airport tests IoT after getting approximately £800,000 in UK government funding to launch a pilot project in 2013. The pilot project matures an interconnected sensor network and data hub to follow and realize passenger's stream and behavior in the airport. So, airport can measure passenger journeys (sensor/camera network tracked individuals through the airport), tail assets (GPS, 3G and Wi-Fi devices) and send location-based services to clients. Wi-Fi supports tracking devices and rapid turnaround of planes (https://www.londoncityairport.com/, 2021).

3.2.3. Miami Airport

location-based technology of more than 500 data beacons installed throughout Miami airport provides a personalized travel experience. New technology presents exhaustive information and adaptive services for clients at terminals and all-around airport. Miami International Airport's new - improved mobile app, 'MIA Airport Official 2.0', connects to the beacons, provides gate information, as well as shopping and dining details. Version2 enables Consumers scan boarding pass for real-time flight updates, navigate airport with blue-dot technology, guides to their gates including estimated walk times, even find nearby shopping and dining based on their own profile (http://www.miami-airport.com/, 2021).

3.2.4. Wynn Resort in Las Vegas

It looks like a small town provides guests smart hospitality facilities, malls with branded shops, entertainment venues, clubs, casinos, magnificent views, and even theaters & concerts where guests can live the authentic Las Vegas experience perfectly within the resort's premises. For the guests' absolute accessibility, the resort has created mobile app for phones and tablets provides all information guests need about shops, current events, shows, and offers. The app also enables guests make restaurant reservations, book spa appointments, and order additional activities within the resort.

However, what distinguishes the hotel from the competitors, is voice assistant all-around of its over 2.000 rooms, linking with Amazon. Amazon's voice assistant "Alexa" listens to needs through voice commands and accomplish them instantly and quickly. The service covers a wide range of features, like switching on and selecting channels on room's Smart-TV, adjusting lights, picking appropriate music, drawing the curtains, and setting the room's temperature. It even provides guests with information about the current weather, traffic, daily news, etc.

At Wynn resort, services like housekeeping and "do not disturb" are more efficient. Alexa helps guests inform the hotel through voice commands from their rooms. Wynn Hotel's services are evaluated the highest five-star rating by Fores Travel Guide in 2019. Alexa makes living in Wynn Las Vegas an unforgettable experience (https://www.hotelieracademy.org/, 2021).

A qualitative analytical study determines possibility of applying the IoT in air transport and accommodation, then identify solutions implemented in the modernized infrastructure of Egypt airports and hotels. The research analyzes the successful experiences as models of the best performance for IoT applied to air transport and hotels in some regions of the world. So, these experiences can be simulated on Egypt airports and hotels which can improve quality of life via enhancing vacation experience depends on tech-based travel.

Field study depends on Likert Scale:

Several kinds of evaluation scales have been developed to measure outlooks directly. The most used is the Likert scale. In its final form, the Likert scale is a five (or seven) point scale which is used to allow individual denotes how much agree or disagree with a specific circumstance. A Likert scale adopts that the strength/intensity of an attitude is linear, i.e., on a band from strongly agree to strongly disagree, and the attitudes can be measured. For example, each of the five (or seven) responses would have a numerical value which would be used to measure the attitude studied.

In addition to measuring the agreement rating, Likert scale can measure other variations such as frequency, quality, importance, and probability, etc. (McLeod, S. A., 2019)

4. Egypt Airports:

Questionnaire conducted to some professionals and employees, have experiences 3 - 10 years, within Cairo, Alex., Hurghada, Sharm el-Sheikh, and Luxor airports. 150 specialists were questioned by author.

132 returns valid which allocates airports' specialists within Cairo, Alexandria, Hurghada, Sharm el-Sheikh, and Luxor airports.

Study aims to measure 5 variables shown in figure .1. regarding intelligent airport within Egypt's airports which are:

1- Improve revenue.
2- Improve efficiency.
3- Improve passenger experience.
4- Smart security
5- Smart green initiative.

4.1. Methods:

4.1.1. Dumping data:

Questionnaire exposes the availability level, according to Likert Scale, for each of the following characteristics regarding the intelligent airport using Egypt's airports as table. 1. represents.

Table. 1. Responses of intelligent airport characteristics

Characteristic	Excellent	Good	Average	Bad	Terrible
Improve revenue					
Ads & Promotion	33%	67%			
Shopping		75%	25%		
Leisure / entertainment services		75%	25%		
Integrated ex. services(rail/road)	33%	67%			
Improved passenger traffic	20%	10%	70%		
Service innovations	14%	20%	66%		
Mobile enabled targeted ad./sell		69%	31%		
Improve efficiency					
Automation of service delivery	34%	66%			
On-demand sources deployment	15%	20%	65%		
Operational business insights		63%	37%		
Capacity planning utilization	34%	66%			
Shared services	20%	10%	70%		
Mobile-enabled operations		70%	30%		
Real time operation planning		68%	32%		
Improve passenger experience					
Self – service		70%	30%		
Avoid queue		53%	47%		
Timely events notifications		72%	28%		
Connectivity & collaboration		60%	40%		
Leisure		72%	28%		
Service innovations	20%	10%	70%		
Congestion management	33%	67%			

Shopping / retail offers		75%	25%		
Digital guided navigation	33%	67%			
Smart security					
Biometric	34%	66%			
Track & trace	30%	16%	54%		
Video surveillance analytics		62%	38%		
Smart security gates	20%	25%	55%		
Smart healthcare service		44%	56%		
Smart green initiative					
Energy		52%	48%		
Emissions	34%	66%			
Water		53%	47%		
Waste management		55%	45%		

It is clear from the previous table that most values of intelligent airport characteristics are more than 50% good, regarded to improve revenue, improve efficiency, improve passenger experience, and smart green initiative.

Improve revenue is valued 70% average and 20% excellent about Improved passenger traffic, the remain percentage evaluated good. Also, it is valued 66% average and 14% excellent about service innovation, the remain percentage evaluated good.

Improve efficiency is valued 40% average, 30% good and 30% excellent about On-demand sources deployment. Also, it is valued 70% average, 10% good and 20% excellent about Shared services.

Improve passenger experience is valued 70% average, 10% good and 20% excellent about Service innovations.

The most values of smart security characteristic are more than 50% average such as track & trace, smart security gates, and smart healthcare service. At the same time smart security is valued, good by 66% and excellent by 34% about biometric and is valued, good by 62% and average by 38% about Video surveillance analytics.

4.1.2. Reliability:

Next table reflects Reliability by internal consistency (Cronbach's alpha) (Cronbach, 1951) of the likert-32 scales (Score range 5–1), correlations (Green et al., 1977), and mean score difference (SD) (McGraw, Wong, 1996).

Table. 2. Reliability

Likert-32 Scales (Score range 5–1)					
(Items)	**Improve revenue**	**Improve efficiency**	**Improve passenger experience**	**Smart security**	**Smart green initiative**
	(7)	**(7)**	**(9)**	**(5)**	**(4)**
Sample	Internal consistency reliability: Cronbach's alpha				
132	0.96	0.93	0.92	0.95	0.96
66	0.96	0.93	0.92	0.95	0.96
33	0.97	0.94	0.92	0.95	0.96
16	0.97	0.95	0.93	0.95	0.95
8	0.96	0.94	0.95	0.97	0.96
Sample	Item total correlations				
132	0.84–0.93	0.70–0.87	0.67–0.81	0.68–0.84	0.79–0.89
66	0.84–0.93	0.72–0.87	0.67–0.82	0.81–0.84	0.80–0.89
33	0.86–0.94	0.75–0.91	0.68–0.82	0.80–0.88	0.80–0.91
16	0.85–0.95	0.76–0.91	0.70–0.84	0.78–0.87	0.75–0.91
8	0.83–0.94	0.71–0.92	0.72–0.90	0.88–0.90	0.80–0.91
Sample	Mean inter-item correlations				
132	0.85	0.73	0.64	0.71	0.73
66	0.84	0.74	0.65	0.73	0.74
33	0.88	0.76	0.67	0.75	0.75
16	0.88	0.78	0.71	0.74	0.72
8	0.86	0.75	0.76	0.81	0.75

Sample	Test–retest reproducibility: intraclass correlation (mean score difference; SD)				
52	0.85	0.83	0.85	0.85	0.83
26	0.88	0.84	0.86	0.86	0.86
13	0.86	0.84	0.82	0.85	0.85
7	0.91	0.93	0.89	0.86	0.84

It is evident that reliability estimates of the prospective sub-samples supported the findings from the study. Cronbach's alpha coefficients for the likert-32 scales remained relatively stable in all prospective sub-sample selections (range 0.92–0.97). All estimates were within ±0.10 points of the alpha for the total sample, exceeded 0.80, and were consistent with the original interpretation. 95 % confidence intervals around alphas increased as the sample size decreased and were generally larger in the sub-scales with fewer items. However, for all samples the lower limit confidence interval satisfied the 0.80 criterion, and the interpretations remain unchanged.

All corrected item-total correlations exceeded >0.30, were within ±0.10 points of the total sample, and their interpretations remained unchanged. A similar pattern was found for inter-item correlations. Test–retest reliability estimates had minor variations in level but no variation in interpretation.

4.1.3. Validity:

The impact of samples size on construct validity of the Likert-32 Scales was examined within scale analyses (correlations between sub-scales), and scale convergent and discriminant construct validity (direction, magnitude, and pattern of correlations with other scales administered at the same time) (Lohr et al., 1996).

Three preselected arbitrary measures were used to evaluate the impact of sample size on validity estimates. First, on how many occasions did the correlation between any two scales in the sub- sample differ from the correlation in the total sample by > ±0.10 points? Second, on how many occasions was the interpretation of the magnitude of the correlation between any two scales in the sub-sample different from that in the total sample? The interpretation suggested by McHorney was used (McHorney et al., 1993). ($r < 0.30$ = weak; $0.30 < r < 0.70$ = moderate; $r > 0.70$ = strong). Third, was the interpretation of the validity of the scale, based on the direction, pattern and magnitude of correlations among scales, consistent with a priori hypotheses?

Table .3. Validity

Likert-32 Scales (Score range 5–1)					
(Items)	**Improve revenue**	**Improve efficiency**	**Improve passenger experience**	**Smart security**	**Smart green initiative**
	(7)	**(7)**	**(9)**	**(5)**	**(4)**
Sample					
66	N	N	N	N	N
33	N	N	N	N	N
16	N	N	Y	N	N
8	N	Y	Y	N	N

Table 3 represents construct validity of scale, as judged by pattern and magnitude of correlations, affected (Y Yes, N No)

Validity analyses of the prospective sub-samples supported the findings from the study. The construct validity was affected for 40 % of scales in sample of n = 8, for 20 % of scales in samples of n = 16, and for no scale in samples of n > 33

4.2. Conclusion:

*** The following characteristics are strongly evaluated good regarding the intelligent airport which represent opportunities for Egypt's airports.**

Ads & promotion

Shopping/retail offers

Leisure/entertainments

Integrated external services

Mobile – enabled operations/Advertise & Sell.

Automation of service delivery

Operational / business insights

Capacity planning

Real time operation planning

Self-service

Avoid queue.

Timely events notifications

Connectivity & collaboration

Congestion management

Digital guided navigation

Biometric

Video surveillance

Energy

Emissions

Water

Waste management

What consequently support implementing iot in Egypt's airports.
*** The following characteristics are strongly evaluated average regarding the intelligent airport which represent challenges face Egypt's airports.**
Improved passenger traffic

Service innovations

On-demand sources deployment

Shared services

Track & trace

Smart security gates

Smart healthcare service

What consequently need to be improved for implementing iot in Egypt airports.
In this paper, intelligent airports are studied, through emphasized certain characteristics regarding what an intelligent airport should look like. Subsequent, several airport subsystems within Egypt are investigated, which can be powered by iot, to transform them into smart ones. Then performance weaknesses and strengthens are provided according to each characteristic evaluation percentage showed in table 1.

Finally, several opportunities and challenges that can face the intelligent airport's performance are swotted, which need to be addressed by the research community.

4.3. Recommendations:

- **4.3.1.** Egypt Airports must get government and private funding.
- **4.3.2.** Implementing new technology via airport infrastructure integrates intelligent buildings, intelligent services, intelligent management, intelligent transport, navigation, information about time of reaching the gate, scheduled check-in time, considering the number of passengers to avoid queues and jams everywhere, automatic passenger identification, airport equipment, luggage tracking systems, security systems and monitoring the fuel and the water consumption.
- **4.3.3.** Airport must implement very strong Wi-Fi covers all spots.
- **4.3.4.** Numerous beacons should be installed throughout airport.

4.3.5. Airport staff must team up with software company to design mobile app for smart phones and tablets connects to the beacons.

4.3.6. Mobile app must follow passenger's stream and behavior in the airport from parking to terminal based on their own profile, also must support tracking devices and rapid turnaround of planes.

4.3.7. Whole system must be maintained permanently.

5. Egypt Hotels:

Questionnaire conducted to some hoteliers and employees, have experiences 5 - 10 years, within Cairo hotels. 200 workers were questioned by author.

166 returns valid which allocates managers and employees within Cairo hotels.

Study aims to measure 5 variables shown in figure .2. regarding intelligent hotel within Egypt's hotels which are:

1- Improve revenue.
2- Improve efficiency.
3- Improve guest experience.
4- Smart security.
5- Smart green initiative.

5.1. Methods:

5.1.1. Dumping data:

Questionnaire exposes the availability level according to Likert Scale for each of the following characteristics regarding the intelligent hotel.

Table. 1. Responses of intelligent hotel characteristics

Characteristic	Excellent	Good	Average	Bad	Terrible
Improve revenue					
Ads & Promotion	36%	64%			
Shopping		77%	23%		
Leisure / entertainment services		74%	26%		
Integrated ex. services(rail/road)	24%	13%	63%		
Service innovations	16%	23%	61%		
Mobile enabled targeted ad./sell		71%	29%		
Improve efficiency					
Automation of service delivery	39%	61%			
On-demand sources deployment	35%	40%	25%		
Operational business insights		72%	28%		
Capacity planning utilization	34%	66%			
Shared services	40%	33%	27%		

Mobile-enabled operations		40%	60%			
Real time operation planning		58%	42%			
Improve guest experience						
Self – service		82%	18%			
Avoid queue		44%	56%			
Timely events notifications		64%	36%			
Connectivity & collaboration		77%	23%			
Leisure		86%	14%			
Service innovations	36%	37%	27%			
Congestion management	38%	62%				
Shopping / retail offers	42	33%	25%			
Digital guided navigation	44%	56%				
Smart security						
Biometric		21%	79%			
Track & trace	22%	24%	54%			
Video surveillance analytics		64%	36%			
Smart security gates	16%	32%	52%			
Smart healthcare service	21%	23%	56%			
Smart green initiative						
Energy	33%	53%	14%			
Emissions	46%	54%				
Water	62%	38%				
Waste management	45%	35%	20%			

As shown within the previous table, the most values of iot characteristics regarding the intelligent hotel are evaluated more than 50% good, such as ads & promotion, shopping, Leisure/entertainment services, Mobile enabled targeted ad./sell, automation of service delivery, Operational business insights, capacity planning utilization, Real time operation planning, self–service, timely events notifications, Connectivity & collaboration, leisure, congestion management, Digital guided navigation, video surveillance, energy, and emissions.

The characteristics such as Integrated ex. services(rail/road) and service innovations (related to improve revenue) are evaluated more than 60% average.

On-demand sources deployment is evaluated 35% excellent, 40% good, and 25% average.

Shared services are evaluated 40% excellent, 33% good, and 27% average

Mobile-enabled operations are evaluated, 40% good and 60% average.
Avoid queue is evaluated 44% good, and 56% average.
Service innovations (related to improve guest experience) are evaluated 36% excellent, 37% good, and 27% average.
Shopping / retail offers are evaluated 42% excellent, 33% good, and 25% average.
Biometric is evaluated 21% good and 97% average.
Track & Trace are evaluated 22% excellent, 24% good, and 54% average.
Smart Security Gates are evaluated 16% excellent, 32% good, and 52% average.
Smart healthcare service is evaluated 21% excellent, 23% good, and 56% average.
Water is evaluated 62% excellent and 38% good.
Waste management is evaluated 45% excellent, 35% good, and 20% average.

5.1.2. Reliability:

Next table reflects Reliability by internal consistency (Cronbach's alpha) (Cronbach, 1951) of the likert-32 scales (Score range 5–1), correlations (Gulliksen, 1950), and mean score difference (SD) (McGraw, Wong, 1996).

Table. 2. Reliability

Likert-32 Scales (Score range 5–1)					
(Items)	**Improve revenue**	**Improve efficiency**	**Improve guest experience**	**Smart security**	**Smart green initiative**
	(7)	**(7)**	**(9)**	**(5)**	**(4)**
Sample	Internal consistency reliability: Cronbach's alpha				
166	0.96	0.93	0.92	0.95	0.96
83	0.96	0.93	0.92	0.95	0.96
42	0.97	0.94	0.92	0.95	0.96
21	0.97	0.95	0.93	0.95	0.95
11	0.96	0.94	0.95	0.97	0.96
Sample	Item total correlations				
166	0.84–0.93	0.70–0.87	0.67–0.81	0.68–0.84	0.79–0.89
83	0.84–0.93	0.72–0.87	0.67–0.82	0.81–0.84	0.80–0.89
42	0.86–0.94	0.75–0.91	0.68–0.82	0.80–0.88	0.80–0.91
21	0.85–0.95	0.76–0.91	0.70–0.84	0.78–0.87	0.75–0.91
11	0.83–0.94	0.71–0.92	0.72–0.90	0.88–0.90	0.80–0.91

Sample	Mean inter-item correlations				
166	0.85	0.73	0.64	0.71	0.73
83	0.84	0.74	0.65	0.73	0.74
42	0.88	0.76	0.67	0.75	0.75
21	0.88	0.78	0.71	0.74	0.72
11	0.86	0.75	0.76	0.81	0.75
Sample	Test–retest reproducibility: intraclass correlation (mean score difference; SD)				
83	0.85	0.83	0.85	0.85	0.83
42	0.88	0.84	0.86	0.86	0.86
21	0.86	0.84	0.82	0.85	0.85
11	0.91	0.93	0.89	0.86	0.84

It is evident that reliability estimates of the prospective sub-samples supported the findings from the study. Cronbach's alpha coefficients for the likert-32 scales remained relatively stable in all prospective sub-sample selections (range 0.92–0.97). All estimates were within ±0.10 points of the alpha for the total sample, exceeded 0.80, and were consistent with the original interpretation. 95 % confidence intervals around alphas increased as the sample size decreased and were generally larger in the sub-scales with fewer items. However, for all samples the lower limit confidence interval satisfied the 0.80 criterion, and the interpretations remain unchanged.

All corrected item-total correlations exceeded >0.30, were within ±0.10 points of the total sample, and their interpretations remained unchanged. A similar pattern was found for inter-item correlations. Test–retest reliability estimates had minor variations in level but no variation in interpretation.

5.1.3. Validity:

The impact of samples size on construct validity of the Likert-32 Scales was examined within scale analyses (correlations between sub-scales), and scale convergent and discriminant construct validity (direction, magnitude, and pattern of correlations with other scales administered at the same time) (Lohr et al., 1996).

Three preselected arbitrary measures were used to evaluate the impact of sample size on validity estimates. First, on how many occasions did the correlation between any two scales in the sub- sample differ from the correlation in the total sample by > ±0.10 points?

Second, on how many occasions was the interpretation of the magnitude of the correlation between any two scales in the sub-sample different from that in the total sample? The interpretation recommended by McHorney was used (McHorney et al., 1993). ($r < 0.30$ = weak; $0.30 < r < 0.70$ = moderate; $r > 0.70$ = strong). Third, was the validity interpretation of the scale, based on the direction, pattern and magnitude of correlations among scales, consistent with a priori hypotheses?

Table .3. Validity

Likert-32 Scales (Score range 5–1)					
(Items)	**Improve revenue**	**Improve efficiency**	**Improve guest experience**	**Smart security**	**Smart green initiative**
	(7)	**(7)**	**(9)**	**(5)**	**(4)**
Sample					
83	N	N	N	N	N
42	N	N	N	N	N
21	N	N	Y	N	N
11	N	Y	Y	N	N

Table 3 represents construct validity of scale, as judged by pattern and magnitude of correlations, affected (Y Yes, N No)

Validity analyses of the prospective sub-samples supported the findings from the study. The construct validity was affected for 40 % of scales in sample of n = 11, for 20 % of scales in samples of n = 21, and for no scale in samples of n > 42

5.2. Conclusion:

* The following characteristics are strongly evaluated good regarding the intelligent hotel:

ads & promotion, shopping, Leisure/entertainment services, Mobile enabled targeted ad./sell, automation of service delivery, Operational business insights, capacity planning utilization, Real time operation planning, self–service, timely events notifications, Connectivity & collaboration, leisure, congestion management, Digital guided navigation, video surveillance, energy, and emissions.

* The following characteristics are strongly evaluated average regarding the intelligent hotel:

Integrated ex. services(rail/road), service innovations (related to improve revenue), Mobile-enabled operations, avoid queue, Biometric, track & Trace, smart security gates and Smart healthcare service.

* The following characteristics are strongly evaluated excellent regarding the intelligent hotel:

Shared services, Shopping / retail offers, water, and waste management.

Thus, Egypt hotels are ready to implement iot within included objects, which can be easily joined to mentioned characteristics. Whereas Cairo hotels' technology structure is evaluated generally good, it should be improved and developed for better performance and enhancing vacation experience.

5.3. Recommendations:

5.3.1. Very strong technological structure should be established for hotels.

5.3.2. mobile app for phones and tablets must be implemented for hospitality requirements.

5.3.3. The app must provide all information guests need and must enable guests order all available activities within the hotel.

5.3.4. Voice assistant must be involved in mobile app and must cover a wide range of features all-around hotel rooms to execute voice commands perfectly and rapidly.

5.3.5. Mobile app must follow guest's flow from parking to check out based on their own profile to avoid queue, also must support hotel equipment managing water and energy consumption.

5.3.6. Hotel staff must involve software and hardware engineers to maintain whole system permanently.

6. General Conclusion:

Analyzing the presented results permits to visualize the future of airports and hotels in Egypt and find out the potential keys required for implementing the Internet of things within.

It is time for Egyptian airports and hotels to invest in developing technologies established on presented characteristics. So, these organizations can develop IoT products using the available technologies.

7. General Recommendations:

7.1. Egyptian airports and hotels should actively notice evolving the technology in other industries before they develop IoT products within their systems.

7.2. Airport and hotel systems inventors should alert for the opportunities, which develop IoT products, can harvest long term value to the organizations.

7.3. It is vital for the organization to realize numerous IoT characteristics and its maturity level.

7.4. Founding the relationship between the characteristics and organization systems.

7.5. organization system developers must emphasis on links among IoT characteristics displayed in Fig. 1,2.

7.6. Employees must be qualified and trained perfectly and always on using new technology.

No doubt that the findings of this study are the beginning of hope that this experiential investigation can contribute to the performance of Egyptian airports and hotels, consequently improving the vacation experience. So, further prospective studies of other scales in other airports, and hotels, are suggested to support this evidence helping inform upon future guidelines.

References

- Bui, N. and Zorzi, M. (2011). *Health care applications: a solution based on the internet of things*, Proceedings of the 4th International Symposium on Applied Sciences in Biomedical and Communication Technologies, ACM, P. 131.

- Car, T., Pilepić Stifanich, Lj. Šimunić, M. (2019). *Internet of Things (IOT) in Tourism and Hospitality*, ToSEE – Tourism in Southern and Eastern Europe, Vol. 5, p.169

- Cronbach LJ (1951) *Coefficient alpha and the internal structure of tests*. Psychometrika 16:297–334

- Green S, Lissitz R, Mulaik S (1977) Limitations of coefficient alpha as an index of test unidimensionality. Educ Psychol Measure 37:827–838

- Gulliksen H (1950) Theory of mental tests. Wiley, New York

Book Google Scholar

- Kansakar, P., Munir, A. & Shabani, N. (2017). *Technology in hospitality industry: Prospects and challenges*, arXiv preprint arXiv:1709.00105.

- Kokot, W. and Kolenda, P. (2015). *IAB Polska, Raport: Internet rzeczy w Polsce*.

Available at: http://iab.org.pl/wp-content/uploads/2015/09/Raport-Internet-Rzeczy-w-Polsce.pdf (accessed16/01/2017).

- Kwiatkowska, E.M. (2014). *Rozwój Internetu rzeczy – szanse I zagrożenia*, Internetowy Kwartalnik Antymonopolowy I Regulacyjny, no. 8 (3), P. 62.

- Laudien, S.M. and Daxböck, B. (2016). *The Influence of the Industrial Internet of Things on Business Model Design: A Qualitative-Empirical Analysis*, International Journal of Innovation Management, vol. 20, no. 8, PP. 1-28.

- Lee, W., Cho, S., Chu, P., Vu, H., Helal, S., Song, W., Jeong, Y-S. and Cho, K. (2016). *Automatic agent generation for IoT-based smart house simulator*, Neurocomputing, vol.209, PP. 14-24.

- Lohr KN, Aaronson NK, Alonso J et al (1996) *Evaluating quality of life and health status instruments: development of scientific review criteria*. Clin Therapeutics 18:979–992

- McGraw KO, Wong SP (1996) Forming inferences about some intraclass correlation coefficients. Psychol Methods 1:30–46

- McHorney CA, Ware JEJ, Raczek AE (1993) 36-Item Short-Form Health Survey (SF-36): II. *Psychometric and clinical tests of validity in measuring physical and mental health constructs*. Med Care 31:247–263

- McLeod, S. A. (2019, August 03). *Likert scale*. Simply Psychology. https://www.simplypsychology.org/likert-scale.html

- Moosavi, S.R., Gia, T.N., Nigussie, E., Rahmani, A.M., Virtanen, S., Tenhunen, H. and Isoaho, J. (2016). *End-to end security scheme for mobility enabled healthcare Internet of Things*, Future Generation Computer Systems, vol. 64, PP. 108-124.

- Mousa, A. (2019). *IOT in Aviation*. Available at: https://www.researchgate.net/publication/333296261 accessed: 10/1/2021.

- Qu, T., Lei, S., Wang, Z., Nie, D., Chen, X. and Huang, G. (2016). *IoT-based real-time production logistics synchronization system under smart cloud manufacturing*, International Journal of Advanced Manufacturing Technology, vol. 84, no. 1, PP. 147-164.

- “Radio-Frequency Identification.” (2015). Wikipedia, the Free Encyclopedia. Available at: https://en.wikipedia.org/wiki/Radiofrequency_identification (accessed 25/11/2020)

- Rose, K., Eldridge, S. and Chapin, L. (2015). The Internet Society (ISOC), p.12. Available at: https://www.internetsociety.org/iot (accessed 25/11/2020)

- Rudnicki,M. and Borodako,K. (2017). *Internet rzeczy w infrastrukturze portu lotniczego jako element usprawnienia obsługi ruchu turystycznego*, Prace Naukowe, Uniwersytetu Ekonomicznego we Wrocławiu, No. 473, P. 489.

- Schatten, M., Ševa, J. and Tomičić, I. (2016). *A roadmap for scalable agent organizations in the Internet of Everything*, Journal of Systems & Software, vol. 115, PP. 31-41.

- Schatten, M. (2014). *Smart residential buildings as learning agent organizations in the internet of things*, Business System 104iami104ki Journal, vol. 5, no. 1, PP. 34-46.

- Senkus, P., Skrzypek, A., Luczak, M. and Malinowski, A. (2014). *Internet of Things: przeszłość – teraźniejszość– przyszłość*, Zeszyty Naukowe Uniwersytetu Przyrodniczo-Humanistycznego w Siedlcach, No. 103, PP. 163-172.

- SITA (2016). *Airport IT Trends Survey*, P.6.

Available at: https://www.sita.aero/resources/type/surveys-reports/airportit-trends-survey-2016, (accessed 23/11/2020)

- Skift (2016). *How the Internet of Things Will Impact Travel in 2017 and Beyond*. Available at: https://skift.com/2016/12/19/how-the-internet-of-things-will-impact-travel-in-2017-and-beyond/, (accessed 23/11/2020)

- Tenreiro de Magalhães, S., Magalhães, M. J. and Revett, K. (2017). *Internet of Things for the Hotel Industry: A Review*, 10.4108/eai.14-2-2017.152285, P.1.

- Vermesan, O. and Friess, P. (2014). *Internet of Things – From Research and Innovation to Market Deployment*, River Publishers, Aalborg.

- Vermesan, O., Friess, P., Guillemin, P., Gusmeroli, S., Sundmaeker, H. and Bassi, A. (2011). (eds.), *Internet of Things: Global Technological and Societal Trends*, The Cluster of European Research Projects, PP. 9-52.

- Vlacheas, P., Giaffreda, R., Stavroulaki, V., Kelaidonis, D., Foteinos, V., Poulios, G., Demestichas, P., Somov, A., Biswas, A.R. and Moessner, K. (2013). *Enabling smart cities through a cognitive management framework for the internet of things*, Communications Magazine, vol. 51, no. 6, PP. 102-111.

- Wong, B.P. and Kerkez, B. (2016). *Real-time environmental sensor data: An application to water quality using web services*, Environmental Modeling & Software, vol. 84, PP. 505-517.

- Yun, M. and Yuxin, B. (2010). *Research on the architecture and key technology of internet of things (IoT) applied on smart grid*, Proceedings of the International Conference on Advances in Energy Engineering (ICAEE), PP. 69-72.

- Zhang, F., Xu, Y. and Chou, J. (2016). *A Novel Petri Nets-Based Modeling Method for the Interaction between the Sensor and the Geographic Environment in Emerging Sensor Networks*, Sensors, vol. 16, no. 10, DOI: 10.3390/s16101571.

- https://www.finavia.fi/en/airports/104iami104ki-airport
accessed 18/1/2021

- https://www.londoncityairport.com/accessed 18/1/2021

- http://www.miami-airport.com/miaairportofficial.asp accessed 18/1/2021

-https://www.hotelieracademy.org/5-smart-hotels-that-confirm-the-potentials-of-this-new-hotel-trend/accessed18/1/2021