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Key Factors in the Implementation of the Internet of Things in the Hotel Sector

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Abstract: Many factors can influence decision-making, and if you wish to know which are the most influential factors in a decision, they must be classified by their degrees of influence. This study seeks to determine the most influential factors in the decision of hotels to accept and implement the Internet of Things in their services through a literary review and a causal study carried out on experts in technology and hotels. The methodology involves the use of fuzzy cognitive maps and the FCMappers tool. The results obtained show that the following factors are among the most influential (in order of relevance): the perceived reliability of the technology, the relative advantage it gives, the level of top management support, compatibility, customer pressure, information systems provider support, security, business partner pressure, characteristics of the leader or manager, government pressure or incentives, pressure from competitors, technological organizational readiness, complexity, size of the company, and the perceived cost.

Keywords: internet of things; implementation factors; ICT; hotels

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1. Introduction

The relevance of the Internet of Things in the hotel sector is what this technology can contribute to the personalization of the experience of hotel clients, one of the latest technological trends in this sector [1].

The Internet of Things is nothing more than a system made up of people and objects (or only objects) that are connected and inter-related in order to transfer data and information so that the receiving objects undertake an action without the human being having to directly give that transfer order or undertake it, turning the objects into intelligent objects [2,3].

Within the hotel sector, some of the applications of the Internet of Things are as follows [4,5]:

- Wearable technology (for example, smart glasses) that allows you to identify and recognize a repeat customer facially (as soon as they enter the hotel) and gives information on their preferences and tastes, so that you can give personalized offers;
- Smart refrigerators that order online so as not to run out of product stock;
- Connected minibars that notify you when a product is picked up and needs to be recharged. This information will be used for future visits of the client, as you can prepare their preferences in the minibar;
- Facilities management, which manages the use and maintenance of facilities such as air conditioning, electricity, and water depending on the client's preferences and their presence (or not) in the room where it should be activated, allowing hotels to make economic savings by avoiding uncontrolled use and providing better customer satisfaction by adapting to their preferences;
- Mobile keys that allow customers to enter the rooms without the need for keys through an app installed on their mobile that also gives a notification when the room is available.

Despite these applications and the relevance of the personalization of customer experience within the current hotel sector, with the Internet of Things being one of the factors

that can most influence this personalization and one of the technologies that most hoteliers are supporting, many companies and hotels still doubt its use or are not willing to invest in the Internet of Things for different reasons, including its complexity, compatibility, benefits, costs, organizational preparation, and security, among others [6].

For this reason, and in order to take measures to increase the use of the Internet of Things in the hotel sector, this study focused on identifying the most influential factors in the decision of hotels to accept and implement the Internet of Things for their services.

Decision-making is always supported by a set of factors that influence that decision, but these factors should not be taken into account independently, since in many cases, there are relationships of influence between them that can cause a factor to be more decisive and a slight modification in what this factor entails can change the decision made.

Thus, for this research, a literary review was carried out that allowed us to establish a list of the factors that influence the adoption of the Internet of Things in the hotel sector, and subsequently, a causal map of the system was developed in which experts in technologies and hotels quantified and analyzed the most influential factors regarding the acceptance of the Internet of Things by these hotels.

In data collection (for the construction of the causal map), interviews were used as an instrument, and a causal map was made for each of the interviewees. Subsequently, a global causal map was made using the average assessment values of the experts. This allowed its analysis through the FCMappers tool, which indicated the most influential factors, the factors that receive the most influence from the rest, and the most relevant factors within the system.

In the following section, the initiatives that are being implemented regarding the Internet of Things in the hotel sector are contextualized and the factors that influence the adoption of the Internet of Things in the hotel sector are detailed. We continue with the methodology used in this study and the analysis of the results and conclude by pointing out the influential factors in the decision of hotels to accept and implement the Internet of Things in their services.

2. Literature Review

Technologies have changed the management and services of organizations so much so that they have become essential [7–15]. The same has happened in the hotel sector [16–18].

The Internet of Things is a technology that is changing management and services in hotels, and it is a current trend in the sector [1]. This means that initiatives are being carried out in this way, where hotels are focusing these initiatives towards customers, production, and systems (in order of priority), and this technology reaches each and every one of the following dimensions (without any standing out from the others): data collection, protection of information systems, legality (data protection), business model, the development of connectivity mechanisms, deployment and configuration of devices and sensors, and the definition of applications and business management. In addition, in the short–medium term, initiatives regarding the following dimensions reached by this technology will continue to follow the same line, although with a small increase in dimensions: defining applications and business management, developing connectivity mechanisms, protecting information systems, and data collection. It is thought that these dimensions will gain more value compared to others in the short–medium term. All of these initiatives are being carried out because the managers of these hotels who know about these technologies highlight the importance of their application in their hotels [19].

Even so, these initiatives are only being conducted in about half of the hotels, since almost half of the executives of this hotel sector are unaware of Internet of Things technology. Executives who do not know about these technologies generally work in lower-category hotels that do not belong to large hotel chains [19].

Thus, in order to take measures to spread the use of the Internet of Things in the hotel sector, this study focused on locating the factors influencing the decision of hotels to accept and implement the Internet of Things in their services.

First, a list of the factors that influence the adoption of the Internet of Things in the hotel sector was extracted from a previous study carried out by the authors Infante-Moro, Infante-Moro, and Gallardo-Pérez [20], who identified these factors through the Delphi method. These factors were developed by experts in technologies and hotels based on the TOES framework and its four different contexts (Technological context, Organizational context, Environmental context, and Security context), one of the most commonly used models internationally for the analysis of the adoption of Information Technologies at the organizational level [21].

This list consisted of the following factors:

- In the technological context, complexity, compatibility, relative advantage, and perceived cost are important.
  - Complexity is defined as the level of perceived difficulty in understanding and use of the Internet of Things, according to Sonnenwald, Maglaughlin, and Whitton [22]. Berman, Kesterson-Townes, Marshall, and Srivathsa [23] stated that the adopted technologies must be user-friendly, easy to take advantage of, and manageable to increase opportunities for their adoption;
  - Compatibility is defined as the degree to which the Internet of Things is perceived as being consistent with the values, needs, and prior experiences of potential adopters. This definition is based on the definition made by Rogers [24] about the compatibility factor being an influential factor in the adoption and use of new technological tools;
  - The relative advantage is defined as the degree to which the Internet of Things is perceived as better than the idea it replaces. This definition is based on the definition made by Rogers [24] of the relative advantage as an influential factor in the adoption and use of new technological tools. The adoption of an innovation will be positively encouraged if its benefits are perceived to have advantages over existing systems and practices [25];
  - The perceived cost is defined as the expenses incurred by the hotels for the adoption of the Internet of Things. This definition is based on the definition made by Premkumar, Ramamurthy, and Crum [26] about the perceived cost as being an influential factor in the adoption and use of a new technological tool.
- In the organizational context, the characteristics of the leader or manager, the perceived reliability of the technology, the level of top management support, the size of the company, and the technological organizational readiness are important:
  - The characteristics of the leader or manager include the age, training level, and degree of innovation of the manager. Cerdán [27] developed three hypotheses related to the characteristics of the manager, the age of the manager, their level of training, and their degree of innovation. Their results show that the age of the manager is among the main facilitators in the adoption of collaborative technologies, the university education of the manager is among the neutral factors, and the managerial attitude towards innovation has an intermediate level of influence;
  - The perceived reliability of the technology is defined as the trust of the hotels in new technologies. This definition is based on a definition developed by Tu [6] about the perceived reliability of the technology as an influential factor in the adoption and use of a new technological tool.
  - The level of top management support is defined as the degree of support from hotel management. The degree of support from top management plays a very important role in the decision to adopt a new technology [28]. Previous studies, such as that of Lin and Chen [29] or that of Feuerlicht and Govardhan [30], on the adoption of information technology innovation have shown that support from top management is a critical factor in the decision of the organization to adopt a

new technology. Without this support, organizations are more likely not to adopt new technologies;
- The size of the company is another factor that can affect the adoption of information technology. Small and some medium-sized companies, despite the fact that they are more adaptable, are not willing to adopt new technologies [31]. In contrast, large companies have more opportunities than small and medium-sized companies [28];
- Technological organizational readiness is defined as the availability of the organizational resources necessary for adoption, according to Iacovou, Benbasat and Dexter [32]. Different researchers such as Mehrtens, Cragg and Mills [33] and To and Ngai [34] have pointed out that the technological preparation of companies is important for the adoption of Information Systems (including technologies) and covers not only physical assets (technological infrastructure) but also specialized human resources.

– In the environmental context, there is pressure from competitors, pressure from the business partner, pressure from customers, government pressure or incentives, and support from Information Systems providers:
  - Pressure from competitors is defined as pressure to install a system in other hotels. Pressure from competitors is "the level of pressure that the company may encounter from its competitors in the same area of industry" [35];
  - Pressure from the business partner is defined as pressure from investors based on past technology adoption experiences. The decision about whether or not to adopt a new innovation in information technology is influenced by the history and past projects of a business partner [36];
  - Regarding pressure from customers, researchers such as Kula and Tatoglu [37] claim that companies innovate when their customers demand it;
  - Government pressure or incentives are defined as the appropriate use of regulations or mandates as incentives to encourage participants to take action in the implementation of Internet of Things technologies. This definition is based on the definition made by Tu [6] about the government pressure or incentives factor as being an influential factor in the adoption and use of a new technological tool;
  - Support from Information Systems providers, defined as the support of providers to implement and use Internet of Things tools. According to authors such as Rogers [24] or Premkumar and Roberts [38], the support from information systems providers refers to support to implement and use information systems that a company obtains from external sources with technical experience.

– In the security context, there is security.
  - Security is defined as the feeling of absence of danger or risk by users when using the Internet of Things. This definition is based on the definition made by Weber [39] which describes safety as an influential factor in the adoption and use of a new technological tool. Rolf H. Weber [39] stated that the Internet of Things has a significant impact on the security and privacy of the parties involved.

These factors represent the axis of distribution of the results of the study carried out with experts in technologies and hotels below. This study tried to locate the factors influencing the decision of hotels to accept and implement the Internet of Things as part of their services.

3. Methodology

The fuzzy cognitive maps methodology is one of the most relevant in the study of knowledge and is probably one of the most frequently used by researchers in their studies and projects in recent times [40]. The tool can be used in different situations or problems to identify, define, and validate the factors of a system and identify the cause–

effect relationships that exist between them in order to propose strategies and aid in decision-making [41].

In the scientific field, its applications include the following: descriptive (to describe a system using the factors intervening in that system), explanatory (to explain the "why" of the behavior of the factors intervening in a system), reflective (to make decisions as an instrument to support decision-making), and/or predictive (to predict the actions of the factors intervening in a system) [42].

For these reasons, in this study, we decided to use this methodology, a methodology that allowed us to confirm or rule out the influences of the factors obtained in the literary review regarding the decision of hotels to accept and implement the Internet of Things in their services. In addition, it allows us to identify whether or not there are influences between each of the factors that belong to this system and to determine the degrees of all these influences [43,44].

To obtain data on the degrees of influence existing among factors, university professors who are experts in technology and hotels were selected as the "population" under study (people who get to know the most influential factors in the acceptance and decision by hotels to implement the Internet of Things in their services), and the size of the sample was set by the use of cumulative graphs showing the number of new influencing factors with respect to the number of individuals belonging to the sampled interest group. This method was suggested by Özesmi and Özesmi [45] for this type of study based on fuzzy cognitive maps, and studies with sample sizes of 45 [46], 41 [47], 29 [46], 8 [48,49], 7 [50], and up to 4 experts [51] have previously been conducted.

In this case, the sample consisted of 30 experts, none of whom added new influential factors, and it was decided to continue sampling until this number of interviewees was reached so that the results were the most significant possible without observing large differences between the values that the interviewees contributed for each relationship to be analyzed (which increased the significance of the results). To determine this number, the curve of the total number of factors contributed versus the number of interviews was examined, as well as the number of new variables added per interview. As can be seen in Figure 1, 30 experts was more than enough, as none of the participating experts added new factors.

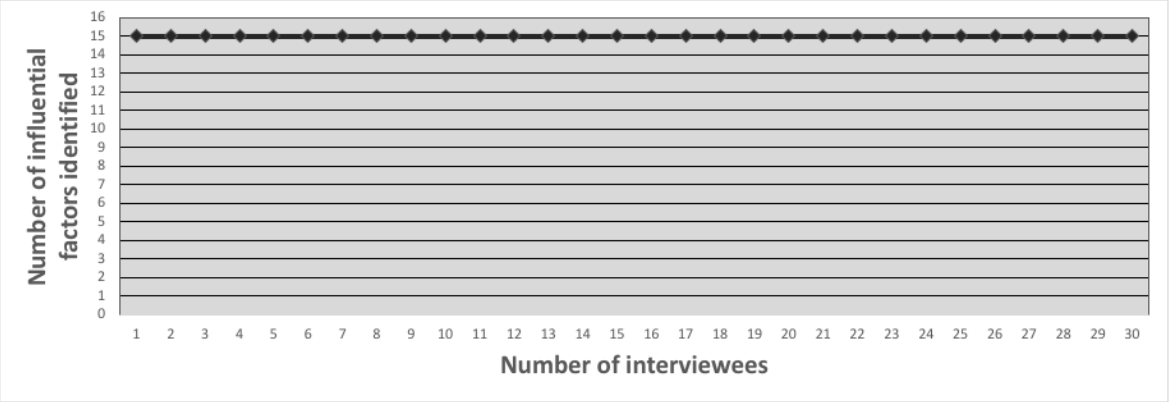

Figure 1. Sample size selection process.

These experts in technologies and hotels were made up of two groups whose opinions had the same weights in the results: a group of 15 experts who were university professors from different countries with the title of doctor and had conducted research on the use of information and communications technologies in hotels and a group of 15 experts who were responsible for the technology department in international hotels and hotel chains of 4- and 5-star hotels.

Interviews were the instrument used in this methodology to obtain data from the experts who formed the sample [45], and at the beginning of each of the interviews, as

was done in a study by Solana [50] using fuzzy cognitive maps as a study technique, each interviewee received a template with two tables, as follows:

- A table showing the factors in this system, which served as an orientation guide for the interviewees (Table 1). It was intended that the interviewees would take this list of factors and give information on the causal connections that existed between factors in addition to contributing, if they felt it appropriate, new factors.
- A table with semantic graduation for interviewees to assess the degree of causal influence that one factor could have on another and whether that influence was positive or negative [52] (Table 2).

Table 1. Factors: component concepts of the fuzzy cognitive map.

TECHNOLOGICAL CONTEXT	
FACTOR	**DEFINITION**
The complexity	The level of perceived difficulty in understanding and using the Internet of Things.
The compatibility	The degree to which the Internet of Things is perceived as being consistent with the values, needs, and prior experiences of potential adopters.
The relative advantage	The degree to which the Internet of Things is perceived as being better than the idea it replaces.
The perceived cost	The expenses incurred by the hotels for the adoption of the Internet of Things.
ORGANIZATIONAL CONTEXT	
FACTOR	**DEFINITION**
The characteristics of the leader or manager	The age, level of training, and degree of innovation of the manager.
The perceived reliability of the technology	The confidence of hotels in new technologies.
The level of top management support	The degree of support from the hotel management.
The size of the company	The size of the hotel.
The technological organizational readiness	The availability of the organizational resources necessary for adoption.
ENVIRONMENTAL CONTEXT	
FACTOR	**DEFINITION**
The pressure from competitors	The pressure for installation in other hotels.
The business partner pressure	Investor pressure based on past technology adoption experiences.
The customer pressure	Pressure from customers.
The government pressure or incentives	The proper use of regulations or mandates as incentives to encourage participants to take action in the implementation of Internet of Things technologies.
The support from Information Systems providers	Provider support to implement and use Internet of Things tools.

Table 1. *Cont.*

SECURITY CONTEXT	
FACTOR	**DEFINITION**
The security	The feeling of the absence of danger or risk by users when using the Internet of Things.

Table 2. Semantic assessment table: interpretation of cause–effect relationships.

Value	Semantic Relation
1	Very strongly positive
0.9	
0.8	Strongly positive
0.7	
0.6	Medium positive
0.5	
0.4	Weakly positive
0.3	
0.2	Very weakly positive
0.1	
0	There is no relationship
−0.1	
−0.2	Very weakly negative
−0.3	
−0.4	Weakly negative
−0.5	
−0.6	Medium negative
−0.7	
−0.8	Strongly negative
−0.9	
−1	Very strongyl negative

Once the data from the interviews had been obtained, the existence (or not) of causal relationships between the proposed factors was identified, and an adjacency matrix was constructed for each interviewee that simulated the cause–effect unions between the factors formed by values of the interval [–1, 1] [53]. Subsequently, these adjacent matrices or fuzzy cognitive maps were combined into a single matrix or collective map, in which the average value of the individual matrices was assigned to each factor. Through this, the degree of influence of these factors in the hotels' decision to accept and implement the Internet of Things in their services was obtained. The system factors were classified according to their influences on the rest of the factors and the outdegree, indegree, and centrality indicators were obtained using FCMappers software [54].

4. Results

The collective cognitive matrix or collective map based on the influences existing between the factors of this system consisted of 15 factors and 126 causal connections resulting from 30 matrices corresponding to 30 interviewed experts (Table 3).

Table 3. Adjacent matrix of the collective fuzzy cognitive map.

	The complexity	The compatibility	The relative advantage	The perceived cost	The characteristics of the leader or manager	The perceived reliability of the technology	The level of top management support	The size of the company	The technological organizational readiness	The pressure from competitors	The business partner pressure	The customer pressure	The government pressure or incentives	The support from Information Systems providers	The security
The complexity	0.00	0.30	−0.80	0.00	0.00	0.62	0.55	0.00	0.00	0.35	0.35	0.00	0.00	0.95	−0.15
The compatibility	0.00	0.00	0.60	0.35	0.00	0.60	0.85	0.00	0.00	0.75	0.50	0.42	0.00	0.00	0.00
The relative advantage	0.00	0.80	0.00	0.00	0.00	0.70	0.95	0.00	0.00	0.90	0.90	0.40	0.00	0.00	0.00
The perceived cost	0.00	0.00	0.65	0.00	0.00	0.00	−0.75	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00
The characteristics of the leader or manager	0.35	0.50	0.90	0.40	0.00	0.70	1.00	0.00	0.55	0.40	0.70	0.00	0.30	0.80	0.70
The perceived reliability of the technology	0.30	0.85	0.90	0.20	0.00	0.00	0.90	0.00	0.00	0.80	0.85	0.90	0.60	0.20	1.00
The level of top management support	0.00	0.80	0.90	0.00	0.82	0.45	0.00	0.00	0.90	0.00	0.00	0.00	0.00	0.80	0.00
The size of the company	0.85	0.75	0.60	0.80	0.00	0.00	0.00	0.00	0.65	0.60	0.60	0.00	0.70	0.90	0.70
The technological organizational readiness	0.00	1.00	0.60	0.30	0.00	0.70	0.85	0.00	0.00	0.00	0.50	0.00	0.00	0.70	0.70
The pressure from competitors	0.00	0.00	0.80	0.00	0.60	0.90	0.80	0.00	0.75	0.00	0.80	0.80	0.00	0.00	0.00
The business partner pressure	0.00	0.75	0.90	0.00	0.60	0.30	0.90	0.00	0.30	0.00	0.00	0.00	0.00	0.55	0.00
The customer pressure	0.00	0.90	0.90	0.40	0.70	0.50	0.90	0.00	0.65	0.70	0.90	0.00	0.80	0.65	1.00
The government pressure or incentives	0.80	0.70	0.50	0.50	0.00	0.70	0.60	0.00	0.50	0.00	0.30	0.60	0.00	0.75	0.90
The support from Information Systems providers	0.95	0.80	0.90	0.45	0.25	0.72	0.70	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.80
The security	0.90	0.80	0.65	0.00	0.00	1.00	0.75	0.00	0.00	0.00	0.30	0.80	0.80	0.75	0.00

Fourteen of these factors were found to exert influence and be influenced by the other factors, so these variables are ordinary variables, and one of these factors (the size of the company) only exerts influence on the other factors but is not influenced. This variable is a transmitter type variable.

When processing these connections with the FCMappers software, the structure of this fuzzy cognitive map was analyzed through the following indicators [55]:

- The "outdegree" indicator, which indicates the degree of influence of a factor on the rest of the factors. A highly influential variable has a high outdegree;
- The "indegree" indicator, which indicates the degree to which a factor is influenced by the rest of the factors. A highly influenced variable has a high indegree;
- The "centrality" indicator, which indicates the degree of participation or importance of a factor in the system; it is the sum of the outdegree and indegree indicators.

In this way, the most important factors in this decision are taken as those with higher centrality values, since they regulate the dynamics of the system [45] (Figure 2).

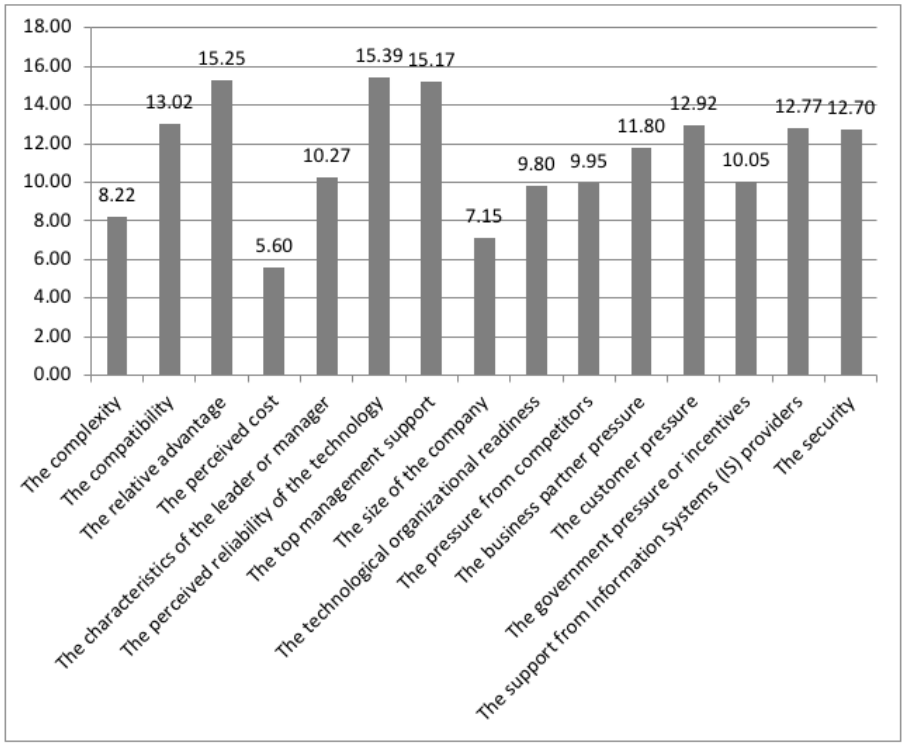

Figure 2. Indicators of the fuzzy cognitive map: Centrality.

These values were assigned by the FCMappers tool based on the causal connections contributed by the experts, allowing us to determine the most influential factors in order of preference for the aforementioned experts. As can be seen in the following figure, the values were between 5.60 for the perceived cost (this is the least valued factor) and 15.39 for the perceived reliability of the technology (this is the most valued factor); the average valuation was 10.49.

Regarding the outdegree and indegree, factors with high outdegree values strongly influence the rest of the factors (pressure from customers, perceived reliability of the technology, characteristics of the leader or manager, and the size of the company), and factors with high indegree values are strongly influenced and dependent on other factors (relative advantage, the level of top management support and compatibility) (Figures 3 and 4). These values, like the centrality values, serve to measure the different degrees of influence between the factors studied.

With all this, the variables or factors with the greatest levels of centrality, outdegree, and indegree are shown in the following table (Table 4).

The factor with the greatest level of centrality is the perceived reliability of the technology (closely followed by the relative advantage and the support of top management), which is the second most influential factor on the rest of the factors (outdegree = 7.50) and the fourth most dependent on the other factors (indegree = 7.89). The factor with the lowest centrality is the perceived cost, which is the factor with the least outdegree and the fourth least indegree. The main variables ordered according to the centrality indicator are shown in Figure 2.

The variables that exert the most influence on the rest of the variables were identified as customer pressure, the perceived reliability of the technology, the characteristics of the leader or manager, and the size of the company. The most dependent variables were the relative advantage, the level of top management support, and the compatibility. The

main variables ordered according to the outdegree and indegree indicators are shown in Figures 3 and 4.

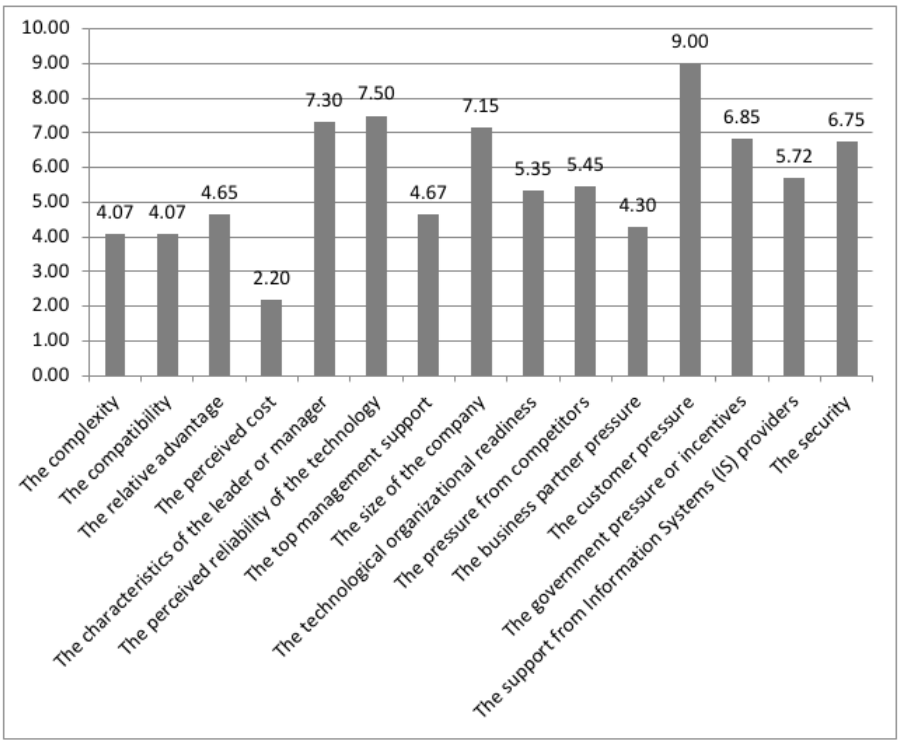

Figure 3. Indicators of the fuzzy cognitive map: Outdegree.

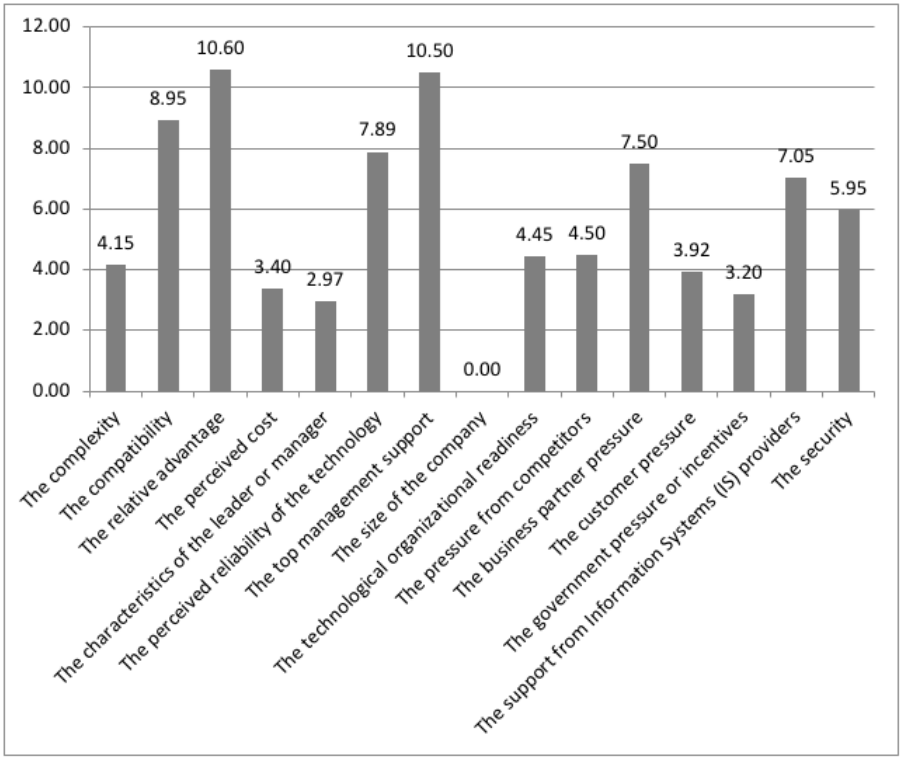

Figure 4. Indicators of the fuzzy cognitive map: indegree.

Table 4. Factors with higher centrality, outdegree and indegree indicators.

Centrality	Outdegree	Indegree
The perceived reliability of the technology	The customer pressure	The relative advantage
The relative advantage	The perceived reliability of the technology	The level of top management support
The level of top management support	The characteristics of the leader or manager	The compatibility

5. Conclusions

Many factors are involved in decision-making, but these factors should not be taken into account independently, since most of the time they are interrelated. The relationships of influence between factors can cause a factor to be more influential as a whole than when it is considered independently, and this is what happens in most cases, so a slight modification of a factor that is not considered a priori to be as determining can lead to that factor changing the decision made.

Thus, taking all the possible interrelationships between the factors that influence the adoption of the Internet of Things in the hotel sector into account, this study aimed to locate the factors influencing the decision of hotels to accept and implement the Internet of Things in its services in order to take measures to spread the use of the Internet of Things in this sector.

To do this, a list of the factors influencing the adoption of the Internet of Things in the hotel sector was presented, their relationships with this decision were confirmed, and the most influential or decisive factors were determined when it came to acceptance by these hotels.

The list consisted of the following factors:

- In the technological context, complexity, compatibility, relative advantage, and perceived cost;
- In the organizational context, the characteristics of the leader or manager, the perceived reliability of the technology, the level of top management support, the size of the company, and technological organizational readiness;
- In the environmental context, pressure from competitors, business partner pressure, customer pressure, government pressure or incentives, and support from information systems providers;
- In the security context, security.

All of these factors were found to be related in decision-making, with the following being the most decisive in this process (in order of relevance): the perceived reliability of the technology, the relative advantage, the level of top management support, the compatibility, the customer pressure, information systems provider support, security, business partner pressure, characteristics of the leader or manager, government pressure or incentives, pressure from competitors, technological organizational readiness, complexity, size of the company, and the perceived cost.

In general terms, it can be said that the factor in a system that exerts the most influence on the rest of the factors is the pressure from customers (something normal in the services sector), followed by factors related to the technology to be implemented and the trust in it (among the six most influential: the perceived reliability of the technology, the characteristics of the leader or manager, and its level of security), where the size of the hotel influences the rest of the factors. It is a system in which the relative advantage and the support of top management are dependent on the rest of the factors, and they are two of the three most important factors in this system of decision making (along with the perceived reliability of the technology). The value of this decision regarding the hotels' trust in new technologies includes the advantage that the application of this technology would have

over the idea that it replaces and the corresponding support from hotel management. This is to the detriment of other factors, such as the perceived cost, which is the factor that has the least influence on the rest of the factors and the one that least influences this decision, since hotels are willing to bear the cost of its implementation if its advantages and benefits are considerable.

The latter is something that does not coincide with the study by Tu [6], where the perceived cost was considered one of the most influential factors when implementing the Internet of Things in companies in general, since they considered that costs could become major barriers to adoption. This is something that is omitted in the hotel sector, due to what has been said above.

The three most influential factors in this decision coincide with what can be seen in other sectors, where the perceived reliability of the technology, the relative advantage, and the support from top management are considered among the factors with the greatest influence in this decision [7,25,28,56,57].

We tried to determine the reasons why this technology is still not being implemented in many hotels or why its degree of implementation remains low, despite its advantages and the fact that this tool began to be used many years ago. This makes it necessary for there to be a good amount of information available on the concept of the Internet of Things, its application in the hotel sector, and its advantages, since there are studies that have reported the ignorance of these three things by almost half of hotel managers and the importance given to this technology by those who do know about it [19].

This research was limited to the study of the factors that can be collected in the context of the TOES framework (technological context, organizational context, environmental context, and security context), but this limitation could be eliminated in future studies, and this study could be extended to other factors that influence this decision, such as the study of motivational factors that can influence this decision or the study of the strengths and weaknesses that the different dimensions reached by said technology may have.

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References

1. Europa Press. Hoteliers Are Betting on the Internet of Things to Personalize the Experience. Available online: http://www.europapress.es/turismo/hoteles/noticia-hoteleros-apuestan-internet-cosas-personalizar-experiencia-20180322111219.html (accessed on 28 October 2020). (In Spanish).
2. WIRED. What Is the Internet of Things? Available online: https://www.wired.co.uk/article/internet-of-things-what-is-explained-iot (accessed on 28 October 2020).
3. IBM. What Is the Internet of Things (IoT)? Available online: https://www.ibm.com/blogs/internet-of-things/what-is-the-iot/ (accessed on 28 October 2020).
4. Scott, J. HOSPA Explains the 'Internet of Things'. HOSPA The Hospitality Professionals Association. Available online: http://hospa.org/en/weblog/2014/03/24/hospa-explains-internet-things/W6N9XJMzZTY (accessed on 28 October 2020).
5. Hinojosa, V. Internet of Things Applications in Hotels [Aplicaciones del Internet de las Cosas en los Hoteles]. Hosteltur. Available online: https://www.hosteltur.com/146860_aplicaciones-internet-cosas-hoteles.html (accessed on 28 October 2020).
6. Tu, M. An exploratory study of Internet of Things (IoT) adoption intention in logistics and supply chain management. *Int. J. Logist. Manag.* **2018**, *29*, 131–151. [CrossRef]
7. Infante-Moro, A.; Infante-Moro, J.C.; Gallardo-Pérez, J. The acquisition of ICT skills at the university level: The case of the Faculty of Business Studies and Tourism of the University of Huelva. *Pixel-Bit. Rev. Medios Educ.* **2021**, *60*, 29–58. [CrossRef]

8. Abad-Segura, E.; González-Zamar, M.D.; Luque de la Rosa, A.; Gallardo-Pérez, J. Management of the digital economy in higher education: Trends and future perspectives [Gestión de la economía digital en la educación superior: Tendencias y perspectivas futuras]. *Campus Virtuales* **2020**, *9*, 57–68.
9. Sánchez, C.P.; De Llano Monelos, P.; López, M.R. IT as inductors of competitiveness and facilitators success [Las TIC como inductores de competitividad y facilitadores del éxito empresarial]. *Int. J. Inf. Syst. Softw. Eng. Big Co. (IJISEBC)* **2016**, *3*, 8–26.
10. Cabero-Almenara, J.; Llorente-Cejudo, C. Covid-19: Radical transformation of digitization in university institutions [Covid-19: Transformación radical de la digitalización en las instituciones universitarias]. *Campus Virtuales* **2020**, *9*, 25–34.
11. Abad-Segura, E.; González-Zamar, M.D.; Infante-Moro, J.C.; Ruipérez García, G. Sustainable Management of Digital Transformation in Higher Education: Global Research Trends. *Sustainability* **2020**, *12*, 2107. [CrossRef]
12. Infante-Moro, A.; Infante-Moro, J.C.; Gallardo-Pérez, J. Motivational factors that justify the implementation of the Internet of Things as a security system in the hotel sector [Factores motivacionales que justifican la implementación del Internet de las Cosas como sistema de seguridad en el sector hotelero]. *Rev. Pensam. Estratégico Segur. CISDE* **2020**, *5*.
13. García-Machado, J.J.; Roca, J.C.; De La Vega, J.J. User Satisfaction of Online Trading Systems: An Empirical Study. In *Soft Computing in Management and Business Economics*; Gil-Lafuente, A.M., Gil-Lafuente, J., Merigó-Lindahl, J.M., Eds.; Springer: Heidelberg, Germany, 2012; pp. 313–326. [CrossRef]
14. García-Peñalvo, F.J.; Corell, A. The COVID-19: The enzyme of the digital transformation of teaching or the reflection of a methodological and competence crisis in higher education? [La COVID-19: ¿enzima de la transformación digital de la docencia o reflejo de una crisis metodológica y competencial en la educación superior?]. *Campus Virtuales* **2020**, *9*, 83–98.
15. Infante-Moro, A.; Infante-Moro, J.C.; Gallardo-Pérez, J. The Importance of ICTs for Students as a Competence for their Future Professional Performance: The Case of the Faculty of Business Studies and Tourism of the University of Huelva. *J. New Approaches Educ. Res.* **2019**, *8*, 201–213. [CrossRef]
16. Kuen Yi, Y.; Martínez del Vas, G.; Muñoz, A. An integral mobile application for pre-travel, on-site and post-travel stages. *Int. J. Inf. Syst. Tour. (IJIST)* **2019**, *4*, 7–17.
17. Soares, A.L.V.; Mendes-Filho, L.; Gretzel, U. Technology adoption in hotels: Applying institutional theory to tourism. *Tour. Rev.* **2020**.
18. Anser, M.K.; Yousaf, Z.; Usman, M.; Yousaf, S. Towards Strategic Business Performance of the Hospitality Sector: Nexus of ICT, E-marketing and Organizational Readiness. *Sustainability* **2020**, *12*, 1346. [CrossRef]
19. Infante-Moro, A.; Infante-Moro, J.C.; Gallardo-Pérez, J. The employment possibilities of the internet of things in the hotel sector and its training needs [Las posibilidades de empleo del Internet de las Cosas en el sector hotelero y sus necesidades formativas]. *Educ. Knowl. Soc.* **2020**, *21*, 14. [CrossRef]
20. Infante-Moro, A.; Infante-Moro, J.C.; Gallardo-Pérez, J. Factors that influence the adoption of the Internet of Things in the hotel sector [Factores que influyen en la adopción del Internet de las Cosas en el sector hotelero]. *RISTI–Rev. Iber. Sist. Tecnol. Inf.* **2021**, *41*, 370–383.
21. Oliveira, T.; Martins, M.F. Literature review of information technology adoption models at firm level. *Electron. J. Inf. Syst. Eval.* **2011**, *14*, 110.
22. Sonnenwald, D.H.; Maglaughlin, K.L.; Whitton, M.C. Using innovation diffusion theory to guide collaboration technology evaluation: Work in progress. In Proceedings of the 10th IEEE International Workshop on Enabling Technologies: Infrastructure for Collaborative Enterprises. WET ICE 2001, Cambridge, MA, USA, 20–22 June 2001; pp. 114–119. [CrossRef]
23. Berman, S.J.; Kesterson-Townes, L.; Marshall, A.; Srivathsa, R. How cloud computing enables process and business model innovation. *Strategy Leadersh.* **2012**, *40*, 27–35. [CrossRef]
24. Rogers, E. *Diffusion of Innovations*; Simon and Schuster: Delran, NJ, USA, 2003.
25. Ekong, U.O.; Ifinedo, P.; Ayo, C.K.; Ifinedo, A. E-commerce adoption in Nigerian businesses: An analysis using the technology-organization-environmental framework. In *Leveraging Developing Economies with the Use of Information Technology: Trends and Tools*; IGI Global: Hershey, PA, USA, 2012; pp. 156–178. [CrossRef]
26. Premkumar, G.; Ramamurthy, K.; Crum, M. Determinants of EDI adoption in the transportation industry. *Eur. J. Inf. Syst.* **1997**, *6*, 107–121. [CrossRef]
27. Cerdán, Á.L.M. Analysis of the adoption of collaborative technologies in SMEs [Análisis de la adopción de tecnologías colaborativas en Pymes]. *Rev. Econ. Empresa* **2006**, *24*, 51–66.
28. Al-Shura, M.S.; Zabadi, A.M.; Abughazaleh, M.; Alhadi, M.A. Critical success factors for adopting cloud computing in the pharmaceutical manufacturing companies. *Manag. Econ. Rev.* **2018**, *3*, 123–137. [CrossRef]
29. Lin, A.; Chen, N.C. Cloud computing as an innovation: Percepetion, attitude, and adoption. *Int. J. Inf. Manag.* **2012**, *32*, 533–540. [CrossRef]
30. Feuerlicht, G.; Govardhan, S. Impact of cloud computing: Beyond a technology trend. *Syst. Integr.* **2010**, 262–269.
31. Lippert, S.K.; Govindarajulu, C. Technological, organizational, and environmental antecedents to web services adoption. *Commun. IIMA* **2006**, *6*, 14.
32. Iacovou, C.L.; Benbasat, I.; Dexter, A.S. Electronic data interchange and small organizations: Adoption and impact of technology. *MIS Q.* **1995**, *9*, 465–485. [CrossRef]
33. Mehrtens, J.; Cragg, P.B.; Mills, A.M. A model of Internet adoption by SMEs. *Inf. Manag.* **2001**, *39*, 165–176. [CrossRef]

34. To, M.L.; Ngai, E.W. Predicting the organisational adoption of B2C e-commerce: An empirical study. *Ind. Manag. Data Syst.* **2006**, *106*, 1133–1147. [CrossRef]
35. Laforet, S. A framework of organisational innovation and outcomes in SMEs. *Int. J. Entrep. Behav. Res.* **2011**, *17*, 380–408. [CrossRef]
36. Gutierrez, A.; Boukrami, E.; Lumsden, R. Technological, organisational and environmental factors influencing managers' decision to adopt cloud computing in the UK. *J. Enterp. Inf. Manag.* **2015**, *28*, 788–807. [CrossRef]
37. Kula, V.; Tatoglu, E. An exploratory study of Internet adoption by SMEs in an emerging market economy. *Eur. Bus. Rev.* **2003**, *15*, 324–333. [CrossRef]
38. Premkumar, G.; Roberts, M. Adoption of new information technologies in rural small businesses. *Omega* **1999**, *27*, 467–484. [CrossRef]
39. Weber, R.H. Internet of Things–New security and privacy challenges. *Comput. Law Secur. Rev.* **2010**, *26*, 23–30. [CrossRef]
40. Papageorgiou, E.I.; Salmerón, J.L. A Review of Fuzzy Cognitive Maps Research During the Last Decade. *IEEE Trans. Fuzzy Syst.* **2013**, *21*, 66–79. [CrossRef]
41. Curia, L.; Lavalle, A. Decision strategies in dynamic systems–applying fuzzy cognitive maps application to a socio-economic example [Estrategias de decisión en sistemas dinámicos–aplicando mapas cognitivos difusos aplicación a un ejemplo socio-económico]. *J. Inf. Syst. Technol. Manag.* **2011**, *8*, 663–680. [CrossRef]
42. Codara, L. *Le Mappe Cognitive*; Carocci Editore: Rome, Italy, 1998.
43. Maridueña, M.R.; Leyva, M.; Febles, A. Modeling and analysis of science and technology indicators using fuzzy cognitive maps [Modelado y análisis de indicadores de ciencia y tecnología mediante mapas cognitivos difusos]. *Cienc. Inf.* **2016**, *47*, 17–24.
44. Papageorgiou, E.I.; Markinos, A.T.; Gemtos, T. Application of fuzzy cognitive maps for cotton yield management in precision farming. *Expert Syst. Appl.* **2009**, *36*, 12399–12413. [CrossRef]
45. Özesmi, U.; Özesmi, S.L. Ecological models based on people's knowledge: A multistep Fuzzy Cognitive Mapping approach. *Ecol. Model.* **2004**, *176*, 43–64. [CrossRef]
46. Carley, K.; Palmquist, M. Extracting, representing, and analyzing mental models. *Soc. Forces* **1992**, *70*, 601–636. [CrossRef]
47. Infante Moro, J.C. User Perception to Improve the Use of Social Networks as a Communication Channel in the Hotel Sector Percepción de los Usuarios Para la Mejora del uso de las Redes Sociales Como Canal de Comunicación en el Sector Hotelero. Ph.D. Thesis, University of Huelva, Huelva, Spain, 2017.
48. González-González, C.S.; Infante-Moro, A.; Infante-Moro, J.C. Implementation of E-proctoring in Online Teaching: A Study About Motivational Factors. *Sustainability* **2020**, *12*, 3488. [CrossRef]
49. Infante-Moro, A.; Infante-Moro, J.C.; Gallardo-Pérez, J. Motivational factors in the insertion of digital skills in teaching. In *Eighth International Conference on Technological Ecosystems for Enhancing Multiculturality*; Association for Computing Machinery: New York, NY, USA, 2020; pp. 365–370. [CrossRef]
50. Solana Gutierrez, J.; Rincón Sanz, G.; Alonso González, C.; Garcia De Jalon Lastra, D. Use of Maps of Diffuse Knowledge (FCMs) in the prioritization of river restoration: Application to the Esla River [Utilización de Mapas de Conocimiento Difuso (MCD) en la asignación de prioridades de la restauración fluvial: Aplicación al río Esla]. *Cuad. Soc. Española Cienc. For.* **2015**, *41*, 367–380.
51. Amat Abreu, M.; Ortega Tenezaca, D.B.; Yaguar Mariño, J.J. Determination of the degree of influence of the climatic factors of vulnerability of the agricultural sector with neutrosophic techniques [Determinación del grado de influencia de los factores climáticos de vulnerabilidad del sector agropecuario con técnicas neutrosóficas]. *Investig. Oper.* **2020**, *41*, 699–705.
52. Mouratiadou, I.; Moran, D. Mapping public participation in the Water Framework Directive: A case study of the Pinios River Basin, Greece. *Ecol. Econ.* **2007**, *62*, 66–76. [CrossRef]
53. Banini, G.A.; Bearman, R.A. Application of fuzzy cognitive maps to factors affecting slurry rheology. *Int. J. Miner. Process.* **1998**, *52*, 233–244. [CrossRef]
54. Bachhofer, M.; Wildenberg, M. FCMappers. Available online: http://www.fcmappers.net (accessed on 28 October 2020).
55. Özesmi, U.; Özesmi, S.L. A participatory approach to ecosystem conservation: Fuzzy cognitive maps and stakeholder group analysis in Uluabat Lake, Turkey. *Environ. Manag.* **2003**, *31*, 518–531. [CrossRef]
56. Hsu, C.W.; Yeh, C.C. Understanding the factors affecting the adoption of the Internet of Things. *Technol. Anal. Strateg. Manag.* **2017**, *29*, 1089–1102. [CrossRef]
57. Ifinedo, P. Internet/e-business technologies acceptance in Canada's SMEs: An exploratory investigation. *Internet Res.* **2011**, *21*, 255–281. [CrossRef]