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TESIS DOCTORAL

¿INCREMENTA EL USO DE LAS TIC LA PRODUCTIVIDAD Y LA SATISFACCIÓN DEL PERSONAL Y LOS HUÉSPEDES DE LOS HOTELES?

Presentada por Miguel Mayol Tur para optar al
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Dirigida por:
Dr. Andrés Artal Tur

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PHD THESIS

DO ICT'S DEEP USE INCREASE HOTEL'S STAFF PRODUCTIVITY AND GUEST SATISFACTION?

Presented by Miguel Mayol Tur
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Resumen:

Palabras Clave: TIC, Tecnologías de la Informática y las Comunicaciones, hostelería y turismo, PYME, IP/PBX Telefonía digital, PLICA (FOSS), Programas Libres y de Código Abierto flujos de conocimiento, capacitación del personal, gestión interna y externa, niveles de productividad, satisfacción del cliente y plantilla, tecnología, uso intensivo de la tecnología, capacidades dinámicas, OIF / MIA Marco de Innovación Abierta, , liderazgo gerencial, SIG (MIS), Sistemas de Informáticos de Gestión.

Códigos JEL : L83, M15, O32.

Resumen:

Según la literatura, una constante con respecto al ciclo de adopción de tecnología es que se tarda en alcanzar todos los efectos potenciales de una tecnología dada, ya sea en el lado de la producción o en términos de ganancias de eficiencia.

En este contexto, el objetivo principal de la presente tesis es aprovechar este tema para identificar áreas de mejora de la adopción y uso de la tecnología que podría influir en el rendimiento de una empresa (hotel) en términos de productividad del personal y mejorar la satisfacción de los huéspedes.

Al hacerlo, definimos un modelo teórico y lo aplicamos empíricamente en los datos recopilados a través de cuestionarios realizados a 190 gerentes de hoteles, personal y expertos en turismo. El modelo empírico también ayuda a resaltar el papel central desempeñado en este entorno por las políticas de capacitación de los empleados cuando se trata de recursos ya instalados TIC.

Tras aplicar SEM-GSCA, los resultados del modelo empírico muestran que tanto una mejor adopción (avanzada) de los recursos de TIC existentes en los hoteles, como las políticas de capacitación influyen significativamente en el rendimiento del establecimiento del hotel con respecto a la eficiencia, la productividad laboral, los empleados y los niveles de satisfacción laborales y del huesped.

El liderazgo de los gerentes sobre la selección y la capacitación del personal sobre recursos TIC para sus tareas diarias también parece clave para estrategias satisfactorias. El estudio de caso empleado en la tesis para ilustrar todas las hipótesis establecidas, que se centra en la telefonía digital IP/PBX, se muestra importante, y también podría extenderse a otros recursos de TIC en hoteles dentro del mismo marco de análisis.

Los resultados de la investigación abren nuevas vías de operaciones para mejorar la eficiencia y el entorno de trabajo del hotel a través de un proceso de mejor comprensión de los recursos de TIC instalados. En esta dirección, proponemos arrojar más luz sobre el papel clave que las personas "tecnólogas" deberían desempeñar dentro de las empresas, para reducir la brecha temporal en la adopción y uso de la tecnología y reconocer y difundir el conocimiento creado a lo

largo de toda la estructura de cada empresa .Uno de los principales canales identificados por esta tesis se ocupa de la mejora de las capacidades de comunicación entre el personal a través de un uso más adecuado de los recursos de las TIC, que también conduce a innovaciones en ahorro de costes importantes en un escenario posterior a la covid19 con restricciones presupuestarias relevantes. Las recomendaciones de los resultados de la investigación también se incluyen en la sección de conclusiones de la presente tesis

Abstract:

Keywords: ICT, Information and Communication Technologies, hospitality and tourism, SME, IP/PBX digital telephony, FOSS environment, knowledge flows, staff training, internal and external management, productivity levels, customer and job satisfaction, technostress, technology deep adoption and use, dynamic capabilities, Open Innovation framework, managerial leadership, MIS, Management Information Systems.

JEL codes: L83, M15, O32.

Abstract:

According to the literature, one regularity regarding the technology adoption cycle is that it takes time to reach all potential effects of a given technology, either on the production side or in terms of efficiency gains. In this context, the main aim of the current PhD Thesis is to take advantage of this issue to identify areas of improvement of the technology adoption and use that could influence a firm´s (hotel) performance in terms of productivity and staff-plus-customer´s level of satisfaction.

In doing so, we define a theoretical model and apply it empirically on data gathered through questionnaires made to 190 hotel managers, staff and tourism experts. The empirical model also helps to highlight the central role played in this

setting by the employees training policies when dealing with ICT installed resources.

After running a SEM-GSCA application, the results of the empirical model show that both a better (deep) adoption and use of the existing ICT resources at hotels, and training policies significantly influence the performance of the hotel establishment regarding the efficiency, labour productivity, of employees and job and customer's satisfaction levels.

The leadership of managers on selecting and training the staff on ICT resources for their daily tasks appear also key for succeeding strategies. The case study employed in the Thesis to illustrate all the stated hypotheses, that focuses on the IP/PBX digital telephony, is shown to be important, and could also be extended to other ICT resources at hotels within the same framework of analysis.

Results of the research open new paths of operations to improve the hotel's efficiency and working environment through a process of better understanding of the installed ICT resources. In this direction, we propose to shed more light on the key role that the “technologist” persons should play inside the companies, in order to reduce the time gap in technology adoption and use and to recognize and spread the created knowledge along the whole organization structure. One of the main channels identified by this Thesis deals with the improvement of communication capabilities among the staff through a more proper use of the ICT resources, also leading to cost saving innovations important in a post-Covid scenario with relevant budget restrictions. Recommendations of the research findings are also included in the conclusions section of the present PhD manuscript.

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1.-Introduction

Pioneer contributions in the literature of technology diffusion include those of Rogers (1962), which originally identified four main elements for the extension of a technology, namely, innovation, the social system, the communication channels, and time. Bass (1969) refined that model by adding forecasting paths for technology, with the number of adopters in a given time period acting as a good proxy for expected sales. Yet in the 1990s, Bass, Mahajan & Muller (1990) added new figures to their improved Rogers' diffusion-of-innovation model. Guardiola et al. (2002) also designed a model noting the peak behaviour for the technology use process, followed by a decrease in its extension if not additional initiatives were adopted that could fuel a deeper use of the old technology. All these contributions share their focus on explaining the process of diffusion and adoption of new technologies, with some keywords arising, like early adopters, word-of-mouth diffusion channel, the need of reaching a critical mass, or additional innovations to sustain the momentum of old technologies.

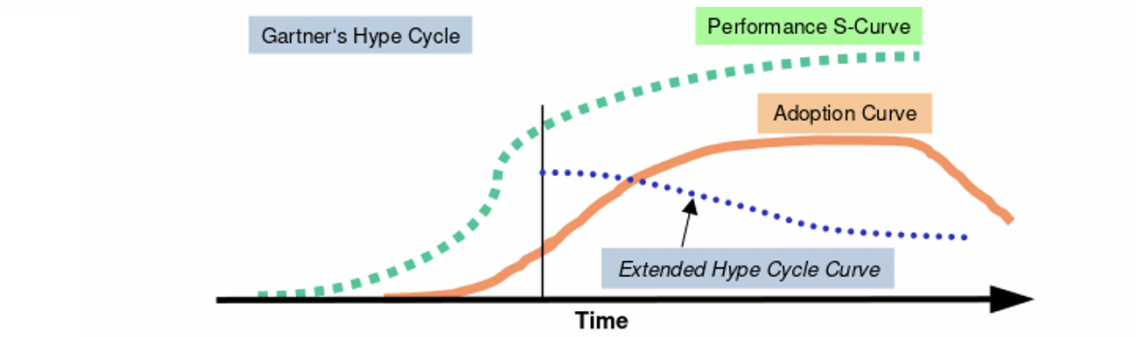
In general, as stated by the literature, a regularity regarding the technology adoption cycle is that it takes time to reach all potential effects of a given technology, either on the production side or in terms of resulting efficiency gains. This is also the case for the Information and Communication Technologies (ICT henceforth), as stated for example by the classical studies of Jorgenson on the

1990s adoption of ICT in the US economy and related productivity gains spreading across the whole economy (Jorgenson, 2000). In the case of the theory of the firm, we can also consider the S-graphic approach as some quoted by Jaakkola (1996), that studied diffusion paths for ICT, or the more general innovation theory (Rogers, 1962; Sharif, & Ramanathan, 1981; Guardiola, 2002) rooted on the pioneer contributions of Joseph Schumpeter (1934) and his theory of creative destruction and innovation cycle, where economies and organizations build on innovations to develop new competitive advantages leading to new growth cycles.

One of the most prolific authors on the adoption-use cycle for emerging technologies is Gartner (2003, 2011, 2020). In his contribution, Gartner (2003), this author defined the gap between the launching and adoption of new technologies and continued with the previously studied S shape for adoption in figure 1. In this case, the S profile of the hype cycle is employed to call attention to the time-lapse that each technology takes to completely develop all its features and new opportunities affecting the firm's performance.

As shown in the figure, there is a growing adoption on the initial stages of the new technology, while after a threshold point in time, the adoption path is reduced and new innovations have to be added to fuel the extension and use of the technology itself, drawing an S profile naming this theoretical approach to technology adoption, use and extension.

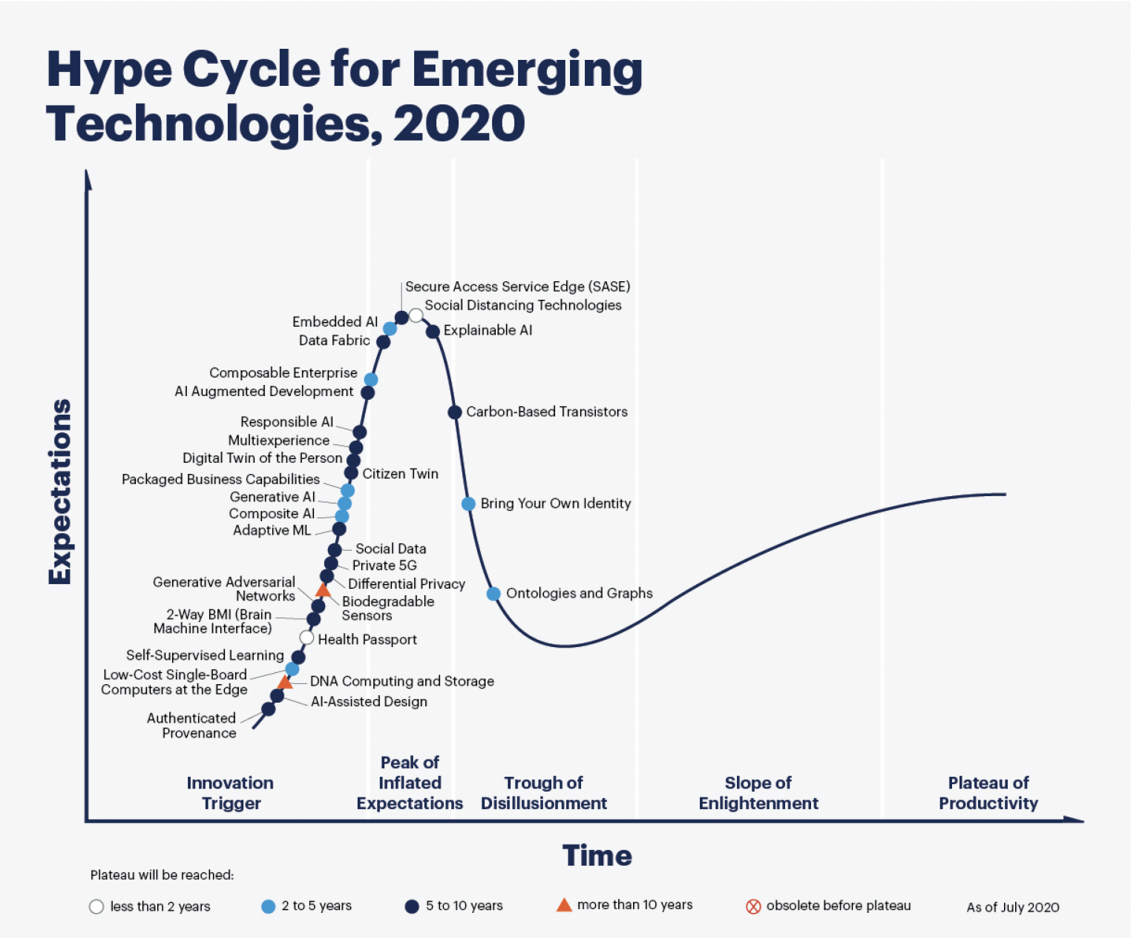
Figure 1: Hype cycle for emerging technologies



Source: Gartner, 2003.

Furtherly, Gartner (2011, 2020) explains the adoption of ICT technologies as an hype model, with a resulting gap between technology adoption and use. As shown in the figure 2, there is an initial phase of technology trigger, followed by a peak of inflated expectations regarding their possibilities, a stage of disillusionment, a new enlightenment phase when more applications of the technology are discovered, then becoming an industry standard, followed by visible demonstration effects with increasing productivity levels in management, production and distribution stages of the firm adopting that technological resource.

Figure 2: Hype cycle for emerging technologies (gap in adoption and use)



Source: Gartner, 2020.

In this context, the main aim of the current PhD Thesis is to focus on the opportunities opened to the tourism and hospitality industry, with special regards to hotel establishments, in terms of taking advantage of all ICT possibilities for already installed technology and freely accessible ones. In particular, we want to focus on the following aspects:

1- Identify some ICT resources that could illustrate the technology adoption and use gap situation shown by the literature for a hotel environment: In doing so, we will focus on the unused features for already installed ICT and FLOSS (Free and Libre Open Source Software) software and hardware at hotels. In Particular, we will employ the “IP PBX” (Internet Protocol Private Branch eXchange) digital telephone system as a case study. This case study is interesting as a guide in the research, given that it is a General Purpose Technology (GPT henceforth) usually installed at offices and hotels, helping to illustrate how adopted technologies lack a deep use that could render improvements of the firms´ performance.

2- Identify the central role that informational and training resources should play in this setting, as a natural way to “deep" adopt and use the technology to obtain a higher performance of the firm's operations. The view here will be to better understand and highlight how an unexploited ICT resource could open new avenues to increase the performance of hotels, either for internal (managers and staff) or external (customer relations) operations. We will distinguish here between informational resources to make employees aware of the installed ICT capabilities, and the resulting training needs of the personnel leading to a “deep” adoption and use of existing ICT resources.

3- Defining a theoretical model that could settle the main hypothesis in the PhD project, that is, how the lack of “deep” adoption and use of ICT resources at

the hotel level could lead to a higher performance of the company. This model will build on the main concepts taken from the technology adoption and innovation literature as stated previously.

4- Provide empirical evidence on how the defined model performs, by taking questionnaire (quantitative) and interview (qualitative) data from hotels in Spain and Portugal, two of the leading tourism destinations worldwide (UNWTO, 2021). In doing so, we employ statistical tools from the Structural Equation Modelling methodology, in particular we will apply the GSCA-SEM approach relying on the GSCA Pro software.

5- Putting the main results in the context of the post-Covid era for the tourism and hospitality sector, where huge budget restrictions for hotels will arise. In this scenario, the research results will help to highlight that the hotel doesn´t need to invest more money on ICT resources to get improved firm's performance outcomes. In this sense, the main findings of the research become even more valuable, given the post-pandemic situation affecting the tourism sector as a whole.

6- Finally, it is noteworthy to state that this research aligns with a novel strand of the literature recently starting. The slight contributions existing on the issue, are mainly focusing, as we will do, in the analysis of the interrelationships among the ICT adoption cycle, open source and free technologies (Chesbrough 2012, 2017), and how they could affect the performance of the companies, hotels in

our case of study (Yunis et al., 2018; Hameed et al 2021). In this way, we will provide new evidence and focus about this novel topic of research, abounding in theoretical and empirical related frameworks.

After this introductory section, the second section of the PhD Thesis develops a review of the literature, the third one presents the theoretical model, the fourth section runs the empirical application, while the fifth one discusses the main results of the research. The last section concludes on the main findings of the research, related policy recommendations, and limitations encountered plus extensions to be developed furtherly.

2.- Literature Review

The literature dealing with the use and spread of ICT resources in the tourism and hospitality industries has grown significantly over the last two decades (Buhalis 2008, 2014). As in the rest of the economy, the development of ICT resources has enabled sharp changes in this industry, resulting in relevant increases of the business performance and efficiency of operations (Byrd and Turner, 2001; Kim et al., 2008). The survival of the firm depends on its capacity to develop or adopt innovations in a world with fast changing technologies, strong competition and rapid switches of the consumers' preferences (Damanpour et al., 2009; Wang & Ahmed, 2003). Hospitality is majorly a service business, where ICT applications become key in increasing the efficiency of workers, rendering new opportunities to customers, or informing the management decisions (Kim et al., 2008; Law et al., 2013). In this context, the literature has been showing how ICT technologies allow to improve the productivity of employees while raising the level of satisfaction of clients (Ham et al 2005, Hajli et al., 2015).

Important developments in this sector rely on applications linked to the wide area of communication services. Network technologies, software and mobile devices, including the outstanding role achieved by the smartphone nowadays, open a wide spectrum of opportunities to companies and customers (Aldebert et

al., 2011). The deployment of mobile technology has fundamentally transformed tourism operations. For example, the 60% of the global smartphone users have downloaded some kind of travel app (Goodworklabs, 2017). The use of mobile technologies has increased over time with the geo-localisation related applications. As tourism pioneered the development of e-commerce, it also did with mobile technologies (Aldebert et al., 2011). Mobile technologies increase the Communications among travelers in consulting, managing, covering in situ needs, and providing post-trip experiences and feed-back, as many tourists demand total connectivity before, during and after their trip (Buhalis & Law, 2008).

A pivotal issue for managers and hotels arises from the need for the necessary adaptability and customization of ICT to companies, mostly in the case of Small and Medium Enterprises (SME henceforth). This includes the design of a new service, or the need of customization of the ICT software and applications for the daily activities of the company (Melian & Bulchard, 2016) . In this direction, researchers started to develop the concept of "Information Systems Strategy" (ISS) (Chen et al., 2010; Karpovsky et al., 2014a, 2014b). Chen (2010) identified four dimensions of the ICT, namely, infrastructure, technical and managerial knowledge, and integration within the firm strategy.

Some authors have tried to obtain empirical evidence on this theory at the level of the firm (Mata et al., 1995; Ross et al., 1996; Powell and Dent-Micallef, 1997). For ICT infrastructure and technical knowledge, they measure connectivity,

velocity, capability, and degree of standardization of the firm's computer networks and platforms. As technical knowledge refers to the know-how needed to implement ICT, users provide information of the department members, as well as the degree of adaptation to new ICT innovations, and the relationship they had to colleagues in other areas. Regarding ICT managerial knowledge, authors try to anticipate the organization's future ICT needs, while contemplating aspects on the abilities to integrate the information system into the firm's vision and strategy, implementing this technology as a facilitator of the work of the firm's agents, both internal and externally (Feeny and Willcocks, 1998; Bharadwaj, 2000; Dehning and Richardson, 2002). ICT integration into the business strategy leads to measure the relationship in terms of levels of communication between those responsible for ICT and the different business units, and levels of shared knowledge about ICT capabilities and firms´ needs (Tippins and Sohi, 2003; Melville et al., 2004; Ray et al. 2005; Crawford et al. 2011). In this way, the literature has been identifying how the technology adoption and use still remain at a low level in hotels, while finding out ways of deeper and faster adoption of the ICT resources yet existing. However, contributions to this literature are still limited (Reino et al., 2014). As a response, the current research seeks to contribute to this field.

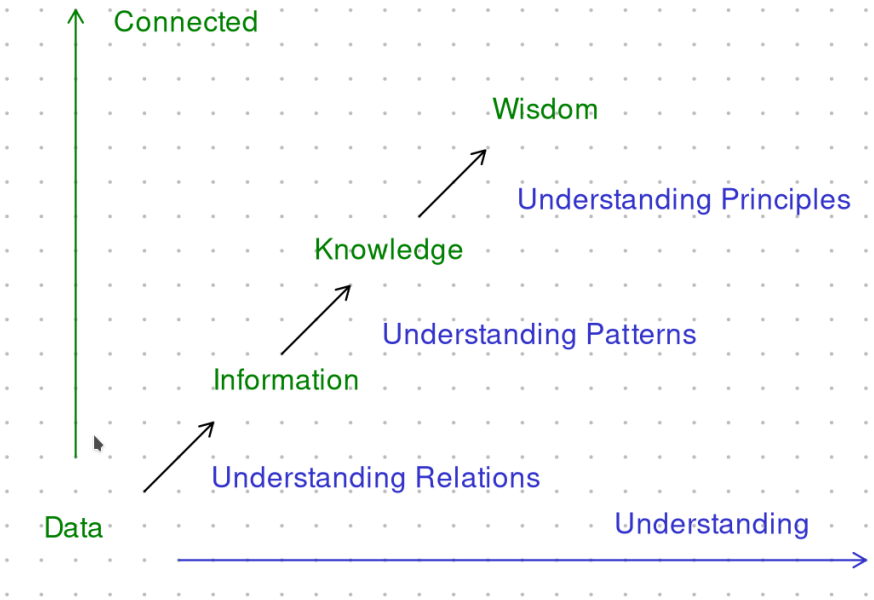
It is also interesting that governments could learn from best practices in this direction, helping to promote innovative environments where new developments lead to greater economic growth outcomes (Jorgenson, et al., 2000). In this field, the related literature on Knowledge Management (KM) has expanded

exponentially, given the relevance of the topic for improving the efficiency and scope of the managerial process itself, and in line with the high-tech revolution taking place since the 1990s (Heisig, 2009, Tiwana 2000). Knowledge Management increases the ability to learn from its environment adapting to new tools and technologies (Liautaud and Hammond, 2001). It has been recognized as an essential component of a proactive managed organization, where the technological infrastructure plays a crucial role in a knowledge-based economy (Bartlett and Ghosal, 1993; Drucker, 1997; Nonaka, Toyama and Konno, 2001).

Rosenberg (2001) defines KM as the process of creation, storing and sharing of the valuable information existing inside the firm. He also highlights how KM helps to boost the expertise and insights existing at the level of the firm and its surrounding context. The overall objective of KM is therefore to create knowledge assets, promote an efficient use of the existing resources, bringing an overall organizational effectiveness. In this sense, the KM literature shares with the current PhD project its focus on an efficient use of the firm's existing resources, proposing new ways of employing them in a more creative and innovative sense.

As previously stated, the literature on ICT resources in the tourism sector is in line with the technology focus at other disciplines, like those fields of economics and management. Information, knowledge and a deep use are highlighted along the path of development of knowledge and technology for firms and institutions (see figure 3).

Figure 3: Knowledge hierarchy in technology use



Source: Own elaboration from Bellinger et al. (2004)

Other authors emphasise the role of ICT skills, the need of counting on qualified human resources, as a pivotal issue in any ICT policy adoption and use framework (Figure 4). Differences in adoption and use are defined according to the size of the firm (SME vs big corporations), the type of users (public sector, private sector, home users), the ICT infrastructure provided (broadband, Wi-Fi free connections) or the regulatory framework arising.

In the process of knowledge management at the firm's level, both internal and external information dimensions are important. ICT technologies strengthen the autonomy of employees at work, also allowing for an effective use of organizational resources and connections (Subashini et al., 2012) . The ICT diffusion would be successful only if ICT is appropriately and innovatively used, with its potential opportunities well managed and exploited within a corporate culture that nurtures corporate entrepreneurship. Policymakers must increase their awareness of the differences between ICT adoption and ICT usage, and set policies that support and promote effective ICT and innovation diffusion and not merely adoption (Yunis et al., 2018). Policies fostering a culture of corporate entrepreneurship, for example by providing the conditions for education and training of employees in ICT operations, would enable a better exploitation of the opportunities and innovation linked to adopted ICT resources (Bae et al., 2014).

Figure 4: The seven dimensions of an ICT policy framework.

Dimension	Focused areas for promotion, upgrading, and progress monitoring
1- ICT connectivity and access	A) Broadband connectivity B) Mobile phone coverage C) Cost and quality competition among ICT products and services providers
2- ICT usage	A) Use by individual; use by business; and use by government; B) Incentives to promote ICT usage by the poor, rural communities, and SMEs
3- ICT legal and regulatory framework	A) Telecommunications regulation; B)Spectrum frequency allocation C) E-commerce laws (digital signatures, intellectual property laws, e-payment); D) Cybersecurity laws and regulations; E) ICT trade tariff and regulations; F) Access to data and cross-border data transfer; G) Investment regulations
4- ICT production and trade	A) ICT-enabled services and ICT content provision B) SMEs in the ICT sector (financing, investment, and capacity building) C) E-market places D) Innovation and R&D in the ICT sector; E) Special industrial parks/zones/villages for ICT sector development (such as software, high-tech, call centers)
5- ICT skills and human resources	A) ICT skills in primary and secondary schools B) ICT graduates and programs at universities and vocational schools C) Training projects to enhance the ICT workforce D) Incentives for private sector companies to organize/support ICT capacity building
6- Cybersecurity	A)Minimization of vulnerability to cyber-attacks; B) National Cyber Security Exercise programs; C) Emergency Response to Cyber-Attack plans
7- New ICT applications	A) Smart city development; B) Big data analysis; C) Internet of things

Source: Own elaboration from Jorgenson and Vu (2016); UNCTAD (2014); World Bank (2015); Microsoft (2015).

In the tourism sector, it is widely acknowledged that ICT have opened new and enhanced pathways for relationships between the members of the distribution channels. They increase competitiveness, productivity and improve efficiency within the hospitality sector (Berné et al., 2015). Moreover, ICT resources also make an impact on the business performance by enhancing the internal relationships of employees, bringing new methods to managers to improve the available information for decision-making processes, while creating value for customers through new products and services (Berné et al., 2015).

Tourists usually revisit a destination when they are satisfied with the tourism experience, and nowadays rely on new ICT resources fostering the destination-related information to make a more pleasant visit. High satisfaction with Smart Tourism Technology experience can create high travel experience satisfaction (Chen-Kuo Pai et al., 2020). The ICT tools also appear important in improving the inside and outside hotel operations. Adoption, deep use of technology, and information and training of employees, including the managerial staff, improves the communication channel, sets up a method to receive instant feedback along the service chain in the hotel, and creates better human links and communication among the staff (Groff, 2013). Moreover, ICT deep use could provide an environment where learners individually and collaboratively consume and create content (Selwyn, 2010).

ICT resources also help to improve the relationships with customers, providing additional information and tools to make the stay more pleasant and tailored to the customer´s needs (Deng et al., 2013). In times of Covid this is even more important for a proper and quick communication between the hotel personnel and customers (Lai et al., 2020). All these issues increase the guest satisfaction and the employees job satisfaction, resulting in increasing levels of productivity of the staff, and higher satisfaction of customers and employees because of this improved information flow (Limbu et al., 2014).

It is important to note here that we employ the concept of "deep use" of the ICT resources at a hotel environment as the capacity of employees and customers to recognize a number of opportunities linked to ICT resources that were not previously employed, despite being available, as our case study will show along this Thesis. In this context, the main objective of the current research is to focus on the technology adoption and use path at hotels, identifying the lack of knowledge for a deep use of ICT in some operations, by leaning on information and training processes, as a way of improving the hotel performance, including the dimension of the staff and customers satisfaction levels. As noted by the literature review, the gap in adoption and particularly use of ICT is also present at the hospitality industry, where a better management of knowledge flows is always pointed as a necessary resource for the success of the companies, hotels in this case. The training activities emerge in this setting as the key process allowing for a deep adoption and use of technologies, then leading to a better performance of the hotel

business, but also affecting the quality of the working environment and opportunities to foster the business scope and operations from a customer focus. In line with this setting, the next section states the theoretical framework informing the research.

3.-Theoretical Framework and Research Hypotheses

3.1. Theoretical Framework

After the literature review, we define the theoretical framework for the research. In this research, we adopt the Teece et al. (1997) framework about dynamic capabilities and strategic management, plus the Firms' Open Innovation Performance (OIP) one (Chesbrough, 2003). In order to complete the theory, we also borrow some concepts from the theory of innovation translation originally defined by Schumpetter (1937), while more recently developed by other authors (Sharif et al., 1981; Jaakkola, 1996; Gerosky, 2000; Guardiola et al., 2002).

The dynamic capabilities' theory refers to the firm's ability to integrate, build, and reconfigure internal and external competences to adapt to rapidly changing environments (Teece et al., 1997). Firms' Open Innovation Performance (OIP) focuses on the use of purposive inflow and outflow of knowledge to accelerate innovation inside the firm, while expanding the scope for new applications of existing resources (Chesbrough, 2003, 2011; Chen et al., 2017).

Contributions to the dynamic capabilities and strategic management approach concluded that empirical research is critical to understand how firms

operate and can improve, however it is also important to make proper questions when running questionnaires to gather information on the firm's operations. Bleady et al. (2018) reviewed a number of 53 studies on dynamic capabilities at firms, identifying two main strands of the literature.

The main one relies on the original contribution by Teece, Pisano & Shuen (1997), that views dynamic capabilities as the firm's ability to adapt to changing business environments by effectively identifying and connecting the tangible and intangible resources existing at the firm's level, with a proper communication policy conforming the basis for success.

The second strand is that of Eisenhardt & Martin (2000), defining dynamic capabilities as the organizational and strategic routines by which firms achieve new resource configurations resulting in new processes and products matching the emerging market trends. As one can see, both approaches identify the need of reviewing the company's resources, while finding an innovative way of interconnecting them to achieve a better performance of traditional operations.

Regarding the Firms' Open Innovation Performance (OIP) framework, it is based on external and internal knowledge management of the company (McKelvie et al., 2018). Both external and internal sources are important for innovation as stated by the literature (Rastrollo-Horrillo and Rivero Díaz, 2019). OIP brings service innovation, and therefore business performance (Grissemann et al., 2013).

OIP initiatives require the use of existing knowledge to be integrated and transformed into new innovative outcomes (Pateli and Lioukas, 2019).

OIP also comprises the abilities to integrate the ICT system into the firm's vision and strategy (Feeny and Willcocks, 1998; Bharadwaj, 2000; Dehning and Richardson, 2002). It also comprises good communication and shared knowledge on ICT capabilities and firms´ needs (Tippins and Sohi, 2003; Melville et al., 2004; Ray et al., 2005; Crawford et al., 2011). This line of research is a promising one for the hotel industry, and it is still in progress (Reino et al., 2014).

Finally, an interesting complement in our research from a theoretical point of view is that of the theory of innovation translation, stating that innovations allow firms to better compete in the markets by creating new knowledge and methods, which results in the gain of market share and created value. As stated originally by the great Austrian economist Joseph Schumpeter (1937), the process of creative destruction shapes the economic cycle, conferring to the economy new growth horizons, where creative companies and ideas develop, while the non-adapting ones disappear with time.

In this case, we are interested in the references that this theoretical framework makes about innovations that could be thought of a radical type or just an adaptive (deep) use of the existing ones (Jaakkola, 1996; Gerosky, 2000). It is obvious that at the beginning of the 21st century, where complex ICT technologies

quickly arrive to the market in an innovation fast-growing wave, companies could not have the time or the resources to completely take profit from them, with many of the ICT related opportunities staying unused or even unknown (Guardiola et al., 2002).

In this way, we take the innovation translation features of the theory as a complement in our theoretical framework, where, as Gartner and other authors remark, deep adoption and particularly a deep use of technology would require some time-lapse, but specifically, of qualified human resources serving as internal or external advisors in ICT guarantee and up-to-date knowledge of technology leading to incremental and adaptive increases of the firm's performance in a complex and rapid changing business environment.

In sum, the key pieces of the subsequent empirical model become described in this theoretical framework we adopt, namely, knowledge flows, adaptive focus, technology and innovation path, time lags, and the need of counting on qualified human resources. Helping to spread the ICT capabilities across the company for inside and outside operations, including the staff communications, relations to customers and operations with outside providers and required services.

3.2. Research Hypotheses.

3.2.1. ICT knowledge & deep adoption.

The end of the past century closed with an extension of the use of innovative ICT resources resulting in virtuous cycles of economic growth, as for example in the well documented contributions to factor productivity growth for the USA economy (Jorgenson et al, 2000). ICT resources lead to the consolidation of the knowledge-based economies, where intangible and knowledge resources become key in the firm´s and societies performance. As the well-known Knowledge Management and Intellectual Capital theory (KM/IC henceforth) states, the scholarly research would be transformed into practical managerial approaches and organizational tools fueling the labour productivity and firm´s performance (Serenko et al., 2010). Empirical evidence on the issue points to high correlations between GDP per capita growth paths and the KM/IC resources arriving to the market and being adopted by companies, as the large metadata analysis by Bontis (2004) reflects.

In this context, the ICT resources become essential for properly managing the stock of knowledge inside the company (García-Álvarez, 2015). The ICT staff capabilities also show a strong link with a superior firm´s performance, this being an issue of (deep) adoption rather than a mere investment operation (Bharadwaj, 2000). In this way, the level of operational profits is related to ICT competencies, that would help to manage the flow of knowledge inside and outside the company (Tippins et al., 2003). To be strict, we define “deep adoption” processes as a

profound awareness of the staff on the capabilities that the ICT resources at hotels allow for, with a subsequent need of “deep use” of the adopted technologies, as we will see in the next subsection. In line with the technology hype or gap adoption-and-use theory reviewed previously, this framework of (deep) adoption and use points to the need of deeply awareness of the installed ICT capabilities at hotels, leading to the necessity of receiving internal or external training and informational resources to be able of taking the maximum performance of the yet realized investments at the company level.

Regarding tourism and hotel studies on ICT impacts, the adoption and frequency of use of those technologies appear as the key variables in terms of new knowledge creation while fostering their impact on the firm's operations. As shown by the literature, the ICT adoption enhances the hotel performance, while the intensity of ICT use shows a significant positive relationship with both, the operational productivity and the customer satisfaction level (Sirirak et al., 2011). In the hospitality sector, the adoption of ICT applications appears to be positively and significantly affecting the performance of lodging operations, enabling better communications (Ham, 2005; Chevers 2015).

In the room division of hotels adoption also appears crucial for improving its efficiency and the staff's inter-connectivity (Aziz et al., 2012). However, as noted, the hotel managers should carefully analyze the extent to which a specific

ICT product or service can improve the company's productivity, and particularly focus on the specific company needs (Melián-González, 2016).

A recent contribution by Yunis, Tarhini & Kassar (2018) elaborates on the ICT diffusion strategy, noting that a successful path requires an adaptive and innovative adoption and use of such resources, also connecting knowledge and innovative adoption. This type of connection is also referred to in the recent work of Hameed et al. (2021), pointing to a set of relationships between external knowledge, firms' open innovation, service innovation and business performance in the Pakistani hotel industry. One of the most important contributions arises here related to the novel approach of the authors to the adoption and use of free and open source software (FOSS) available in the market.

This in fact emerges as a useful way of improving the capacity of customizing their operations to a lower cost, accessing enhanced capabilities, and being part of a virtual community that continuously refines and develops new ICT capabilities to a zero cost.

After this review, we define the first hypothesis to be tested in the empirical model of this research:

H1: ICT knowledge (& deep adoption) positively influences the improvement of the staff's processes

3.2.2. ICT processes improvement & deep use

There has been a great impact of ICT adoption and use on productivity levels of Western economies in the 1990s (Jorgenson et al., 2016), as well as in Asian economies in this century (Wong, 2002). China is a good example of that, with its current focus on innovation and education (Bai et al 2020; Wu et al., 2021). However, a deep use of the existing technology does not require new investments, but a better knowledge, personnel training, and a comprehensive (deep) understanding of the capabilities that the currently installed capacity enables (Rogers, 2003; Cobos, 2016). The internal innovative capability and external knowledge are some of the major tools to shape the business scope in hotels, leading to service innovation, and playing a vital role in promoting the firm's performance (Hameed et al., 2021). Policymakers must notice the difference between the adoption and actual use of ICT, and set policies to support and promote effective ICT and innovation diffusion, not merely its adoption. (Yunis et al., 2018).

The tourism and hospitality sector is a fast-growing activity nowadays, with the revolution of ICT resources allowing to scale up in their operations, providing new ways of marketing their services, innovating in the way traditional tourism services were provided, and opening new channels for stay in touch with their potential and actual customers. In particular, the hotel industry employs a variety

of ICT resources to market their products, selling accommodation services through online platforms and allowing for virtual visits to potential clients.

The disruption of massive platforms like Booking.com and Tripadvisor.com have also changed the rules of the hospitality industry. Reviews of clients in social networks allow for new types of promotional campaigns, while the Web 2.0 and Smartphone developments continue opening new channels for companies in this branch of the tourism industry (González, Gascó & Llopis, 2019; Goodworklabs 2016).

All these ICT innovations allow for the improvement of processes and tasks, leading to higher productivity levels of the labour force at hotels and in the hospitality sector in general, as the literature has been showing (see, i.e., the excellent survey about ICT and hotel management in González, Gascó & Llopis, 2019).

As a result, taking advantage of those already installed ICT resources requires from, as the empirical model captures, informational and training resources allowing for a "deep use" of the existing technologies at the hotel establishment.

In this sense, we define “deep use” as the capability of majorly extracting the value of adopted ICT by employees and managerial staff, something that doesn't seem to be the rule in a fast changing technological and connected business world.

It is necessary that academics can help to bridge the technological gap through research and diffusion of results towards the hospitality industry, transmitting the idea that ICT constitute a strategic element and an integral part of the highest-level decision-making in hotels, moving away from a merely theoretical tool at the service of the top management (Gonzalez, et al.,2019).

Moreover, in line with the central focus of the present PhD project, it is also important to reduce the gap between hospitality managers and ICT experts. Where managers become more directed towards the main issues of service quality and customer relationships, whereas the ICT experts usually focus on rapid application development and server protocols. As a result, advanced studies along this line would have to be showing the hospitality industry how to integrate ICT into service quality and processes improvement, extracting the entire value of the range of ICT applications adopted (Law et al., 2013).

In empirical terms, a number of studies have been showing the effects of ICT on labor productivity (Yazdan et al., 2013). However, even the recent study of Abramova et al. (2020) for Russia, shows that ICT require a period of time to reach

maturity and become an influential source of labour productivity growth, labelling this situation as “technological unemployment”.

Strohmaier et al., (2016) for Denmark show how it took two decades for ICT to become a major source of productivity growth, which indicates the long time span necessary for a general-purpose technology (GPT) to reach maturity and for the economic system to adapt to a new technology. In sum, despite this time adoption lag described by Gartner, GPT would be acting as an enabling mechanism for complementary innovations, the development of which leads to a transformation of the economic system, increasing the productivity of employees and improving the firm's internal and external processes (Laino, 2019).

Additionally, in terms of the self-reinforcing relationship of invested ICT capital and productivity growth, authors also note the pivotal role of qualification and formative tasks of employees enabling an efficient (deep) use of the technology (Gargallo-Castel, 2012; Liao et al., 2016).

Edquist (2017) also finds a temporal gap between the purchase of the ICT goods and productivity increase, pointing to a learning-by-doing adjustment period. Díaz-Chao et al. (2015) writing about ICT and productivity growth in small firms in a SEM framework, suggest that public policies should promote ICT use, organizational change, and training of the staff to achieve their targets of increasing productivity.

In the tourism literature using surveys conclude that ICT availability and integration have a significant positive relationship only with operational productivity while the intensity of ICT usage has a significant positive relationship with both operational productivity and customer satisfaction (Ansel & Dyer, 1999; Sirirak et al., 2011). Cardona et al. (2013) in a survey paper of the literature conclude that the evidence indicates that the productivity effect of ICT is not only significant and positive, but also incremental over time.

More generally, Ham et al. (2005) with another SEM model state that using advanced ICT by the firm leads to higher levels of profitability and efficiency, with the managerial section being central in the appropriate selection of the ICT infrastructure necessary to fuel the impact on the hotel operations, including those of the front-office, the back-office, and guest-related interface applications. In particular, these authors observe that the managerial understanding of the ICT features becomes a relevant dimension helping to modulate the time gap between ICT purchases and productivity gains.

Finally, the recent contribution of Yunis et al. (2018) suggests that the entrepreneurial spirit is necessary to link the ICT use and the firm's competitiveness and performance, concluding that it is the strategic use of ICT that contributes to productivity, in line with the present research.

As a result, we define the second hypothesis of the empirical model as follows:

H2: ICT (deep) use improvement positively influences the staff's productivity level.

3.2.3. ICT resources and satisfaction

We address satisfaction in the research from a two-fold perspective. First, we are interested in studying how the ICT deep use improves the staff satisfaction by increasing their efficiency, productivity and related earnings, and operations in general through better information and communication channels. The case study on the IP/PBX digital telephony helps to illustrate such an issue. Second, the ICT deep use also could help to improve the customers or tourists´ satisfaction by enabling new applications for better communication channels with the staff and among themselves. New features of the adopted ICT resources would be leading to new opportunities in customer-oriented operations, which will increase their level of satisfaction with the hotel services.

In this way, a better use of ICT resources improves the service quality, leading to higher customer satisfaction in hotels (Oh, 1999; Deng et al., 2013; Su et al., 2016a, 2016b). Important strands of the literature on the relationship between ICT resources and customer satisfaction comes from loyalty programs through social networks´ engagement with clients to better attend their needs and

expectations (Sánchez-Casado, Artal-Tur, Tomaseti-Solano, 2018), the use of ICT at hotels to improve the experience and service quality at vacational times, and more generally, the employment of ICT to improve the efficiency and quality of provided services to customers (Gonzalez, et al.,2019). In many services, customer to customer relation is a common phenomenon (Martin, 1996) and a key element of the customer experience management (Kandampully et al., 2018). Guests' interaction could also become a good predictor of their satisfaction across several service settings (Huang and Hsu, 2010; Kim and Choi, 2016; Wu, 2007).

More generally, Sirirak et al. (2011) conclude that ICT availability and integration have a significant positive relationship with operational productivity, while the intensity of ICT use has a positive relationship with both, the productivity and customer satisfaction inside the framework of Ansel & Dwyer (1999) .

Chevers & Spencer (2017) show how five out of the twelve ICT components they define in their model appear as statistically significant in relation to customer satisfaction, including services like:

(1) Internet over WiFi service in the room.

(2) Telephone service in the room (part of the IP/PBX services if implemented).

(3) Online check-in system.

(4) In-room television.

(5) Teleconferencing/skyping facility (part of the IP/PBX services if implemented).

The managers may need to provide a substantial guest interaction management scheme to enhance the experience quality (Kim and Choi, 2016). Moreover, the promotion of favorable interactions among guests could also become a differentiating marketing strategy for businesses (Huang and Hsu, 2010). The survey study of Kandampully et al. (2018) measuring the customer experiences and satisfaction includes the role and influence of ICT and social media among a selection of future six main research avenues.

In this line, we will mostly focus on the improvements that an ICT deep use could render in terms of better communications between customers and the hotel staff, all of them showing special relevance in the post-Covid era to provide safety and security perceptions during their visits to hotel establishments. Another relevant finding of the literature here concludes that satisfaction appears both statistically significant and practically relevant in improving the firm's performance.

Their estimates indicate a 70% of probability of a positive matching between the level of customer satisfaction and the stock value of the firm (Otto et al., 2020). They also concluded that a proper ICT use affects guests and employees´ satisfaction in several ways: use of time, internal and external communication, tasks planning, management efficiency, and capabilities for guests.

On the other hand, ICT deep use could also promote higher levels of staff satisfaction by enabling an increase in the effective internal communications (Al-Omari et al., 2020). Nunkoo et al. (2020) for hotels in South Africa show that in order to become more competitive, low-end establishments need to focus on improving their employee expertise and infrastructure, as key factors in their service quality. Leading to higher staff satisfaction. The study included aspects like enhanced satisfaction sociability and interactions related to improvements in the staff training and ICT investments among others.

In this way, it becomes imperative that ICT organizations promote a knowledge sharing culture to ensure the success of their companies, while enhancing the job satisfaction of their employees (Tong et al., 2015). For example, the Carlson Rezidor Hotel Group has been seeking to implement an ECM (Enterprise Content Management) software allowing them to access the company data to be updated on the situation of the company policies, hotel procedures and corporate documentation. After trying with their own developments using Microsoft NET tools, and fail, they decided to try, and then hire Alfresco, a FOSS ECM that runs on Linux servers and leads this market. It helps to offer complete document management functionality, supports open standards, and can be easily customized to meet their specific needs in a Google style search interface (Alfresco web page 2021).

This fact illustrates an ICT development increasing the informational tools available for employees, leading to higher levels of efficiency, productivity, and corresponding satisfaction at work. In this same spirit, Batarseh et al. (2020) analyzed a survey by BlackDuck Software company showing that the percentage of companies running their operations on FOSS (Free Open Source Software) has almost doubled between 2010 and 2015, from 42% to 78%, with the number of firms contributing to FOSS projects rising from 50% in 2014 to 64% in 2016, even with Microsoft nowadays – that considered FOSS evil - participating in more than 2000 open-source projects (Anthes, 2016).

Moreover, when engaging in B2B operations, the salesforce perceptions of a firm's ICT infrastructure, training, and support positively influence the level of job satisfaction, also showing an effect of ICT adoption and use on a better administrative performance and working time schedule (Limbu et al., 2014). In the same spirit, the studies about technostress, and related effects on job satisfaction and productivity, show that new ICT adoption and use should be reinforced with training courses for the staff, with a perceived organizational commitment to reduce the effect of technostress for the ICT-mediated tasks (Tarafdar et al., 2010).

As a result, we define the third hypothesis of the empirical model as follows:

H3: ICT (deep) use improvement influences positively the staff's satisfaction levels.

3.2.4. ICT information and training

ICT literacy and knowledge are essential for productivity gains (Groff, 2013), and for knowledge management processes (García-Álvarez, 2015). ICT capabilities show a link with a superior firm´s performance (Bharadwaj, 2000) , with benefits closely related to technical competencies (Tippins et al., 2003). Investment in human capital in the form of education and experience rely on in the center of the virtuous circle for growth and firm's performance (Lucas, 2000; Porter, 1990). Hotel management should accelerate effective incorporation of external knowledge to promote open innovation performance (Hameed et al., 2021)

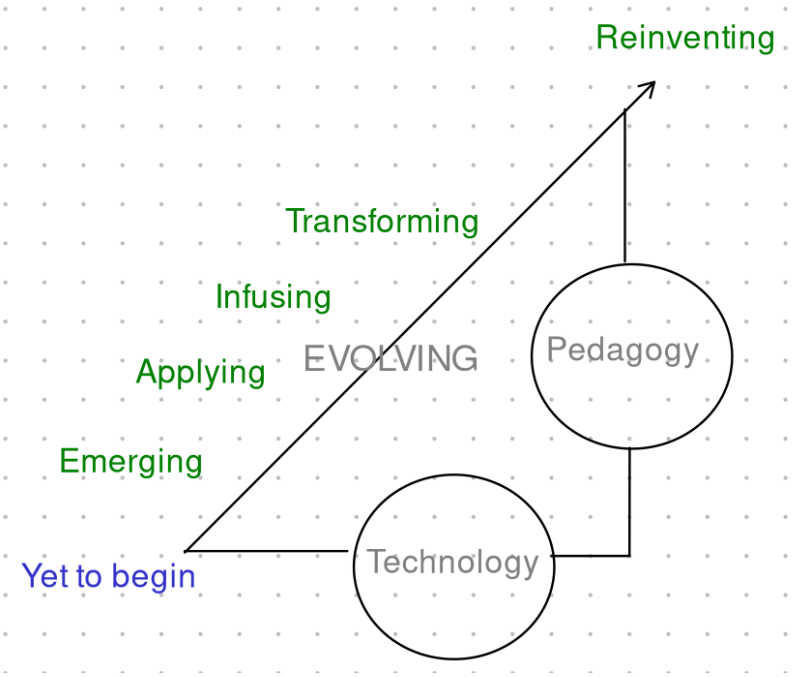
Some individual characteristics of employees and managers, like open-mind, communication abilities or pro-activity appear key in dynamizing the company behaviour and achievements (Cobos 2016; Chesbrough, 2017). Information or tacit knowledge are involved in the creation of innovation being of an incremental nature because it generally implies an organizational consensus on the potential value and impact of innovation (Behrens, 2005).

The spread of ICT has also raised the need of training the human resources at hotels. Employees and managers are not always aware of the whole capabilities that these new technologies provide for the company, including opportunities for efficiency gains in the managerial side and over the relationships with customers. Sometimes, the issue comes from an inadequate or insufficient knowledge on

information about the ICT device functioning plus a lack of training of the employees to get a deep adoption and use of the ICT resource installed. Others, the technology does not show a specific focus on the hospitality industry when being designed, and needs to be understood and customized to meet the requirements of the hotel industry. In order to avoid technostress mechanisms that facilitate innovation, communication among users, and a supportive environment reduce the intensity of ICT-related stressors by bolstering the effects of particular technostress-reducing mechanisms such as involvement facilitation. (Tarafdar, et al 2010).

And this involvement minds in our case, let the staff decide the intensity of use of each capability (previous management decision) they were informed, and asked to use, to improve their productivity in order to find themselves part of the process of implementation, and gradually use more deeply those that save them more time, and occasionally or almost never those that save them less time or their use would be only in special occasions, and the learning stress is higher than the benefits it would provide when used.

Figure 5: Technology innovative learning environments



Source: Own elaboration from Groff for UNESCO (2013).

In this way, ICT literacy appears essential to enable the ICT understanding and customization, leading to a corresponding labour productivity growth effect, in line with the approach to stages of ICT integration in education to reach a reinventing target in Figure 5 (Anderson 2010; Groff, 2013). That shows what is the apparent policy consensus, in line with the OECD and UNESCO guidelines about ICT knowledge and learning processes (UNESCO 2010, OECD 2013).

The information step refers here to the awareness of the staff and employees on the capabilities of the installed ICT resources, and how they can use it for improving their efficiency for daily tasks. It is important to take into account that adapting innovations usually implies an incremental learning of the new features of the adopted technology (Behrens, 2005).

It is also important that managers show the capability to build an organizational consensus on the ways to use ICT resources for specific operations in the company, leading in this way the organizational change process (Pateli & Lioukas, 2019). Training and re-training of hotel employees for a deep understanding and use of the ICT resources is also a necessary policy to improve the satisfaction of customers and the satisfaction and productivity of the staff (Gambo et al., 2016; Yunis et al., 2018).

A closer cooperation between universities and hospitality companies in their area of influence would be also necessary, not only for knowledge transfer, but for reaching a greater scope of the capabilities of the installed ICT resources. A cooperation in the search for a "technologist-manager" person helping to bridge the academic and industry worlds is also recommended, in order to increase the scope of the daily operations at hotels when deciding their investments and customization of the ICT resources. An example of this figure was found at the Tourism and Hospitality School of the Universidade Europeia de Lisboa during my visiting stage as a PhD student in 2020. Ramcharan (2006) also measured the effect

of ICT technologies on the university student's performance, finding a positive and significant relation.

Colleges and organizations have invested a considerable amount of resources on updated ICT technologies, although some research continue recommending more measures for a deep use of them in their educational and teaching programs (Cuban, 2001; Albin 2006; Twining at al., 2013). Jacobs (2019) recommends that educational systems should evolve to frame an integrated approach to working environments, where machines and humans work together complementing their capabilities and competences. From four complementary definitions about the human digital talent, one is identified as “people having technology-oriented knowledge and skills”, based on a multiplatform job analysis, which reinforces the recommendation given here on the figure of a technologist professional or ICT advisor.

Training and managerial orientation is then recognised as one of the most important ways of improving hotel employees’ expertise and on-the-job efficiency and productivity levels (Jacobs & Jaseem Bu-Rahmah, 2012; Jacobs, 2019). Dhar (2015) identified the variable of training accessibility, support and derived benefits, as drivers for an increasing service quality, with organizational commitment acting as a mediator variable in the case of hotels. Al-Omari et al. (2020) also study the role of training policies in affecting the satisfaction and productivity levels of employees, leading as well to higher levels of the overall performance of the firm

and customer satisfaction. Job satisfaction becomes in this way a channel to add service value, while increasing the customer's satisfaction level.

Innovation support and involvement facilitation are the two constructs that influence positively against technostress (Tarafdar et al., 2010). Involvement facilitation describes the staff participation in the planning, development and implementation of new ICT resources. In this way, the technology orientation of the staff, with training support by the company, acts as a modulating variable towards the objective of staff satisfaction outcome (Limbu et al., 2014).

As a result, we state the last two hypotheses of the empirical model as follows:

H4: ICT information positively influences the staff's productivity level.

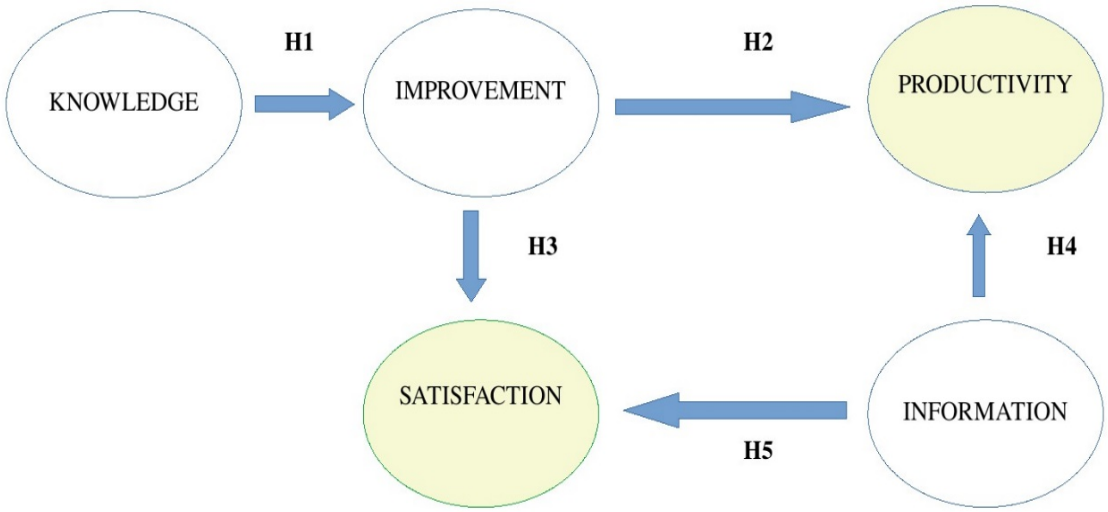
H5: ICT information positively influences the staff's satisfaction level

4.- The Empirical Model and Contrast of Hypotheses

After the analysis in the previous section, the empirical model includes five hypotheses to be tested, as follows, with the figure 6 delimiting the relationships among the constructs in the model:

H1: ICT knowledge (& deep adoption) positively influences the improvement of the staff's processes
H2: ICT (deep) use improvement positively influences the staff's productivity level.
H3: ICT (deep) use improvement influences positively the staff's satisfaction levels.
H4: ICT information positively influences the staff's productivity level.
H5: ICT information positively influences the staff's satisfaction level

Figure 6: The empirical model of the research



Source: Own elaboration.

4.1. Data issues and survey design.

When designing the questionnaire, we first started by employing a panel of experts as a primary validation method (Robles & Rojas, 2015) which contributes to improve the design of the questionnaire (Utkin, 2006), by providing key information and scientific foundations (Cruz & Martínez, 2012). It also helps to state a rational consensus on the focus of defined key questions, while giving validity to the content of the study (Cooke & Goossens, 2008). There is no clear agreement on different aspects related to expert methods, such as the selection of individuals or the choice of the best method (Burinskiene & Rudzikiene, 2009). The most widely applied one is the Delphi method (Okoli & Pawlowski, 2004; Seuring & Müller, 2008), despite there are other methods for problem-solving, including the Individual Aggregate Methods, the Technique of Nominal Group, and the Group Consensus Method (Corral, 2009).

In our research, we decide to apply the Individual Aggregates Method, as it is a quick and easy-to-use technique to provide prospective views for decision-making (Michalus et al., 2015).

It is considered an appropriate variant for the case because, among its advantages, the absence of communication between specialists stands out, who carry out their evaluations individually in a single round, with lower costs, both financially and in terms of time.

Additionally, it helps to avoid data bias due to interpersonal conflict, pressure between experts and/or the predominance of opinion of people with strong character or hierarchy (Corral, 2009).

Regarding the number of experts that have to form part of a panel, this will depend on the experience and the diversity of knowledge; however, the decision on the appropriate number of experts varies between authors. Gable and Wolf (1993) and Grant and Davis (1997) suggest a range that varies between two and twenty experts, Dalkey (1969) affirms that the error in the forecasts decreases exponentially with the number of experts added, until reaching an upper operational limit of 15-20 individuals.

Therefore, a total of seventeen experts were selected within the scope of this research work. The panel included experts from university (Universidad Politécnica de Cartagena, Spain and Universidade Europeia at Lisbon, Portugal), plus hotel managers from Spain and Portugal as well.

After the conclusions of experts, we selected the sections and key points to validate the empirical model, defining a related questionnaire that includes the final questions on the indicators for constructs in the model, plus some socio-demographic profiles of respondents available on the Annex. The table 1 shows that from a total of 230 questionnaires, finally we get 190 usable ones, with respondents including hotel managers, staff, and university Master students and

professors we decide to include given the need of increasing the rate of respondents gathered because of the pandemic situation, with many hotel establishments being closed.

Using GPower software …

F tests - Linear multiple regression: Fixed model, R^2 increase

Analysis: A priori: Compute required sample size

Input:

Effect size f^2 = **0.128**

α err prob = **0.05**

Power (1-β err prob) = **0.95**

Number of tested predictors = **6**

Total number of predictors = **6**

Output:

Non centrality parameter λ **= 21.7600000**

Critical F = **2.1545978**

Numerator df = **6**

Denominator df = **163**

Total sample size = **170**

Actual power = **0.9508416**

… we estimated that our minimal significant sample size for our minimal estimated F^2 from our panel, 0.128, and using 6 as the number of predictors to be safe, was 170. (A priori $F^2 = 0.15$, medium effect, and then the minimal significant sample size of 146 would be the usual) Faul, F., Erdfelder, E., Buchner, A. and Lang, A.-G. (2009) and then for being even safer we raised our goal to 190 samples.

We count on a total of 190 useful questionnaires, 20 and 11.76% more than the minimum calculated, 54% being female respondents, from 35 years old or more, 80% having university studies at the level of Bachelor or higher, with important experience of more than 10 years in the hospitality sector for the 36.8% of the sample. Wage level stays above the minimum wage for the 73% of the sample with higher experience.

We are interested in better understanding and measuring how improving processes could lead to better performance through knowledge and information. The focus aligns with Melián-González & Bulchand-Gidumal (2016) on the necessary adaptability and customization of ICT resources to the requirements of the hospitality industry. Table 1 shows the profile of interviewed people in our data sample.

Table 1: Survey respondents' socio-demographic profiles

Demographics	Categories	Frequency (N = 190)	Percentage
Gender	Male	86	45.26
	Female	104	54.74
Age	18-34	34	17.89
	35-55	79	41.58
	55	77	40.53
Qualification	High-School	25	13.2
	Bachelor	85	44.7
	Master or PhD studies	80	42.1
Experience	1 year or less	45	23.7
	2-10 years	75	39.5
	+10 years	70	36.8
Level of income	Minimum wage*	37	19.5
	MW x2–x3	134	63.7
	MW x3+	19	10.0
	Not available (na)	13	6.8
*Minimum wage in Spain is 950 €/month x 14 payments= 13,300 € /year of gross salary, Portugal's minimum wage is 70% of the Spanish one in 2021: 9,310 € /year. And in purchasing power parity (ppp) is 80% (2017)			

Source: Own elaboration (raw data for ppp calculation from index mundi web page)

In short, the sample included 14 hotels for managers and staff (168 questionnaires, 9 in Spain and 5 in Portugal), plus 22 responses from students and staff UEL. In socio-demographic terms, they show a balanced profile for men (45%) and women (54%), with ages among 18-34 years old (18%), 35-55 years old (42%) and more than 55 years old (40%), mostly with a Bachelor´s (44%) or a Master´s university degree (42%), plus high-school studies (13%). Some present a professional experience of 1 year or less (23.7%), mostly students at internship processes, or between 2-10 years (39.5%), and more than 10 years at work (36.8%). Most of them show a level of income around the minimum wage in Spain, this being of 13,300 euros per year in gross salary terms, or twice/three times this level (19.5% and 63.7%, correspondingly), while some showed a wage level over 40,000 euros per year before taxes. The 6.8% of the sample did not answer this question as shown in table 1.

Given the particularity of the IP PBX digital telephony questions guiding our case study, and despite we explain that this research focus could be extended for already installed ICT resources at hotels, some respondents were aware of this functionality inside their hotel, while others weren´t. We have to take into account that some of the respondents were Master students and Professors at UE Lisbon, in particular fiveteen of them, that we need to add to increase the number of available questionnaires to guide the empirical analysis. In this way, we explained them the conditions of the survey contents, the objective of the study, and additional

information related to the content of questions. In any case, the digital telephony applications were not unknown for them, despite any specificities explained, and they could answer given their experience at hotels through internship stages and research collaboration that have previously experienced, either professors or Master's students.

The focus of the questionnaire has been then on aspects of deep adoption and use, information and training, and effects on the hotel's performance substantiated in the level of labour productivity and staff and guest's satisfaction.

In line with the contribution of Chen et al. (2010), we are interested in this case in better understanding and measuring how improving the performance of the ICT devices yet adopted and installed by the hotel industry could help to improve its performance from a technical and managerial point of view with a lower cost but those of the training teams. The focus also aligns with Melian and Bulchard (2015) on the necessary adaptability and customization of those ICT resources to the requirements of the hospitality industry in general.

To avoid the Dunning–Kruger (1999) effect, which explains the cognitive bias of auto evaluation, we included questions about the HHRR´s awareness on the available ICT capabilities in the IP/PBX ICT as our case of study. With questions about 25 different capabilities or features about we asked if they know and use each one of them in line with the guidelines of Gibbs et al. (2017) for a workplace

computing setting. We also extend the questions for other GPT technologies in general as an example, adding context to that specific questions.

The digital or IP telephony (IP/PBX) has been adopted by business and the public administration for about two decades yet, mainly due to its huge cost savings. This technology provides some functions added to the telephone, such as internal messaging (WhatsApp, Telegram Signal) and other capabilities like the automatic call forwarding, that can be configured on mobile devices, phones or tablets and personal computers, that we call as "computer" functions. Our focus here is to better understand why they are not widely used, in contradiction with the great acceptance that this type of functions has in the private life sphere, and how could they contribute to improve the staff efficiency at a hotel environment, their job satisfaction, and the corresponding guest's satisfaction with the service quality when visiting the establishment.

Operations available in this case study include some like using the private instant messaging in a secure environment, the Instant communication of texts, images, sharing files and links, voice calls, video calls, video conference, multiconference, or directory tools. We also include in the questionnaire other aspects such as communications between the staff and guests, directly configurable in the program by default calls or by automatic methods, Tablets, Desktop Computer utilities, integration with PMS/CRM management programs, the immediate appearance of a sheet upon receiving a call, allowing to interact with

guests or staff if so configured, the capacity of recognizing and profiling the person or company calling, this being an employee, guest, client or provider with the fields and alerts that are configured for each user, text recording of calls with their date, time and duration, notes on each of the calls, or the configuration of the IP/PBX device to make automatic calls, video calls, or sending texts, mails, and fax messages and documents. Other utilities allowed with this installed ICT resource are detailed in the questionnaire in the Appendix, and in table 2 of the scales employed.

Table 2: Detail of the scales employed in the empirical model.

CONSTRUCTS	INDICATORS	SOURCES
ICT ***Knowledge*** & deep adoption	Customer/Supplier profile receiving a call	Adapted from Sirirak et al. (2011). [S1]
	Ability to share files	Nan Feng, Meiyun Wang, Minqiang Li, & Dahu Li 2019
	Ability to share links	Malcolm Townsend et al 2019
	Text log of calls with date, time and duration	Paul J. Fong et al 2002 Adrian Engelbrecht et al 2019
	Ability to share pictures	Martina G. Gallarza, Francisco Arteaga Irene Gil-Saura 2019
	Ability to share texts	Md. Mazharul Islama, et al 2018
	Ability to make video calls	David Serramiá Director Inf. de Comunicación, Televés. 2019
	Ability to make voice (VoIP) calls	Melián-González, Santiago, y Jacques Bulchand-Gidumal. 2016
ICT ***information*** & training	ICT-related information	Adapted from Rastrollo-Hornillo et al. (2019). [S2]
	Fast training courses for ICT applications	
ICT processes ***Improvement*** & deep use	General improvements of communications and information through deep IP/PBX use	Adapted from Oltean (2014), Limbu et al. (2014). [S3]
	Communications among the Staff members	Fuller, Steve. 2002 Arthur Morgan et al. 2006
	Communications between Staff & Guests	M. Yunis, et al. 2018 Ramón and Pedreño, 2009 Cooper (2006)
Staff & guest ***satisfaction*** level	Among the Staff	Adapted from Khalilzadeh et al. (2013), Limbu et al (2014), Lu et al. (2015), Liu, Yao & Fan (2020). [S4]
	Of the Staff with Guests	
Productivity	From the Staff, saving time	Adapted from Oltean et al. (2014), Yunis et al. (2018). [S5]
	In guest-related operations	Fuller, Steve. 2002 Arthur Morgan et al. 2006

Source: Own elaboration

We use a 5-point Likert scale in the questions, with the survey being carried out between November 2020 and March 2021. In order to run the empirical analysis, we employ the new software GSCA Pro, that stays in a Structural Equation Modelling (SEM) framework, with a two-stage analysis as usual, through the Measurement and Structural model testing. Table 2 shows the scales employed to define indicators and construct definition and measurement in the model. GSCA-SEM is recognised to work better than PLS-SEM in terms of consistency, plus standard error and parameter estimates (Afthanorhan, 2016). GSCA maintains all the advantages of PLS (e.g., less restricted distributional assumptions, no improper solutions, and unique component score estimates). In addition, GSCA handles more diverse path analysis compared to PLS. We present the main results of the empirical GSCA-SEM analysis with a bootstrap of 10 000 samples.

Recently it was stated that “conversely, GSCA performed better than PLSpm in recovering loadings, whereas both produced similar estimates of path coefficients, irrespective of whether the population models were factor or component models” (Cho et al 2022).

Despite all the similarities, there is a fundamental difference between Component Analysis that is a linear combination of variables and Factor Analysis that is a measurement model of a latent variable.

As we started using PLSpm we run Factor Analisys (fa) from the library(psych) in R Studio, passing all the cut-offs, to be sure our data would work as factors then.

But GSCA does not need to assume a specific covariance structure of observed variables in advance, leaving them to be (un)correlated freely (Cho et al 2020).

4.2. The Measurement and Structural models

Statistical technique used for analyzing the hypotheses is that of general structured component analysis structural equation modeling (GSCA-SEM) , implemented through GSCA pro software. Given that the theoretical latent variables, or constructs, are not directly observable, empirical proxies or indicators account for them, as shown in tables 2 and 3. The GSCA-SEM technique includes a first stage applying component analysis through the measurement model, and a subsequent structural modeling stage. The first stage allows identifying how defined indicators in the questionnaire matches the constructs in the theoretical model (Müller et al., 2018). The second stage tests for the robustness of the empirical relations among the constructs, and the goodness of fit for the model (Hair Jr. et al., 2014). We used regularized GSCA as fit stats were the best ones, but basic GSCA also passed the fit stats cut-offs.

Convergent validity and reliability of the constructs in table 3 are evaluated by means of the Dijkstra and Henseler's rho (ρA), Average Variance Extracted (AVE), factor loading values, and the significance level (Henseler, Hubona & Ray, 2016).

The individual item reliability is assessed by the simple correlation of indicators with the defined constructs in the model, and by standardized loadings (λ) (Hair et al., 2017). Significant loadings with a value greater than 0.7 shows the adequacy of a single indicator in capturing the meaning of the related construct (Benitez-Amado et al., 2015). If a loading's confidence interval does not account for the zero value, then the indicator load (λ) is shown to be statistically significant. In the present case, table 3 shows that the chosen indicators capture quite well the meaning of their corresponding constructs, all above 0.7 values. Cronbach´s α, ρA, and ρc must be greater than 0.70 being our results between 0.839 and 0.950, and AVE greater than 0.5 being results between 0.670 and 0.932. As a result, the model shows a good performance in terms of reliability, convergent validity and discriminant validity of the constructs, showing a good role of indicators in reflecting the theoretical concepts in the model, also showing internal consistency.

Table 3 Indicators, loadings (λ) and measurment model assesment

Indicators	λ		Coefficient intervals		Measurement model assessment		
	Estimates	SE	95%CI		α	ρDG	AVE (PVE)
	> 0,5*		**> 0,5***	**> 0,5***	**> 0,7**	**> 0,7**	**> 0,5**
Knowledge and Deep adoption							
Ability to share texts	0.820	0.032	0.750	0.876			
Ability to share pictures	0.879	0.015	0.846	0.908			
Ability to share files	0.817	0.027	0.757	0.866			
Ability to share links	0.844	0.015	0.813	0.872	0.930	0.941	0.672
Ability to make voice (VoIP) calls.	0.872	0.020	0.826	0.905			
Ability to make video calls	0.730	0.036	0.652	0.795			
Customer/Supplier profile receiving a call	0.731	0.033	0.661	0.790			
Text log of calls with date. time and duration	0.818	0.030	0.753	0.871			
ICT processes Improvement and Deep use							
General improvements of communications and information through deep IP/PBX use	0.956	0.006	0.944	0.969	0.928	0.951	0.876
Communications among the Staff members	0.863	0.035	0.791	0.925			
Communications between Staff & Guests	0.970	0.004	0.961	0.978			
ICT Information and Training							
ICT-related information	0.960	0.009	0.939	0.976	0.927	0.959	0.932
Fast training courses for ICT applications	0.961	0.007	0.946	0.973			
Productivity							
From the Staff. saving time	0.929	0.012	0.902	0.951	0.800	0.903	0.831
In guest-related operations	0.885	0.021	0.841	0.924			
Staff & Guests´ Satisfaction level							
Among the Staff	0.928	0.010	0.906	0.946	0.791	0.899	0.825
Of the Staff with Guests	0.878	0.018	0.839	0.910			

(*): Note: In bold dark green the cut offs values of the tests in the table.

Source: Own elaboration.

Table 4. Fornell-Larcker criterion.

	Diagonal must be higher				
	Knowledge	**Improvement**	**Information**	**Productivity**	**Satisfaction**
Knowledge	0.820				
Improvement	0.666	0.936			
Information	-0.018	0.033	0.965		
Productivity	0.499	0.584	0.355	0.912	
Satisfaction	0.470	0.421	0.511	0.805	0.908

Source: Own elaboration

Table 5. Heterotrait-Monotrait Ratios (HTMT)

Heterotrait-Monotrait Ratios (HTMT)	<0,85				
	Knowledge	Improvement	Information	Productivity	Satisfaction
Knowledge					
Improvement	0.6935188				
Information	not related	not related			
Productivity	0.5460724	0.6745057	0.4086069		
Satisfaction	0.5369708	0.4748154	0.5955803	not related	

Source: Own elaboration

Table 4 also shows that discriminant validity is satisfied by all constructs in the model according to Fornell & Larcker (1981) criterion, what is also reflected by the HTMT ratios below 0.85 values in Table 5 (Henseler et al., 2015) . As shown, the model presents a good performance in terms of discriminant validity of the constructs too.

Table 6. The structural model assessment.

Hypotheses and model fit measures	β	R^2	F^2	VIF	GFI
	0.2*	**>0.25***	**>0.02***	**Near 1***	**≥0.93***
H1 Knowledge ==> Improvement	0.666	0.444	0.796	1.001	0.975
H2 Improvement ==> Productivity	0.573	0.455	0.488	1.001	
H3 Improvement ==> Satisfaction	0.404	0.425	0.196	1.001	**SRMR**
H4 Information ==> Productivity	0.336	0.455	0.128	1.001	**≤0.08***
H5 Information ==> Satisfaction	0.497	0.425	0.328	1.001	0.079

(*): Note: In bold dark green the cut offs values of the tests in the table.

Source: Own elaboration

In regard to the structural model, the hypothesized relationships of constructs are evaluated by the path coefficients (β), and R^2 and F^2 tests (Roldán & Sánchez-Franco, 2012). The βs should be higher than 0.2 and significant (Sarstedt et al., 2017) , this being the case in table 6 of the model, assessed .

R^2 test, could range on values of 0.75, 0.50 and 0.25, pointing to substantial, intermediate, or weak predictive power, respectively (Hair et al., 2017). Table 6 shows all of them being between 0.460 and 0.728, showing at least an intermediate predictive power. The goodness-of-fit has its (discussed) cut-off with GFI ≥0,93 or SRMR ≤0,08 and in our model we pass both cut-offs.

The F^2 value that indicates the effect size, measuring the quality of the sample, are considered small if ≥0.02, medium if ≥ 0.15, and large if ≥ 0.35 (Hair et al., 2017).

The table 6 shows one 0.128 result nearer to medium than low, two in the medium size effect 0.196 and 0.329, with one of them near a big size effect and the other with big size effect, what in turn indicates a great and good effect size. In order to reject the null hypothesis that the group means are equal, we also need a F^2 value as far as possible from the 0.02 cut-off.

The component correlations. Table 7 show no collinearity issues among constructs, while the Standardized Root Mean Square Residual (SRMR > 0.10 or 0.08 in a stricter version (Hu & Bentler, 1999), shows that the model is just inside the expected value, this being of 0.0795266 adding a GFI of 0.9754923 our model passing the two cut-off stats about fitness and therefore the quality of the model when only one is needed.

GFI the (Adjusted) Goodness of Fit was devised by Jöreskog and Sörbom (1984) and Tanaka and Huba (1985). as of conditions of goodness of FIT, .

All in all, the results of the structural model assessment show a good adjustment of the model, with important indicators od quality as goodness-of-fit

levels and significant relationships among the constructs in size and statistical terms.

As a result, we can accept, not reject, the five hypotheses in the model, with adjustment results summarized in figure 7.

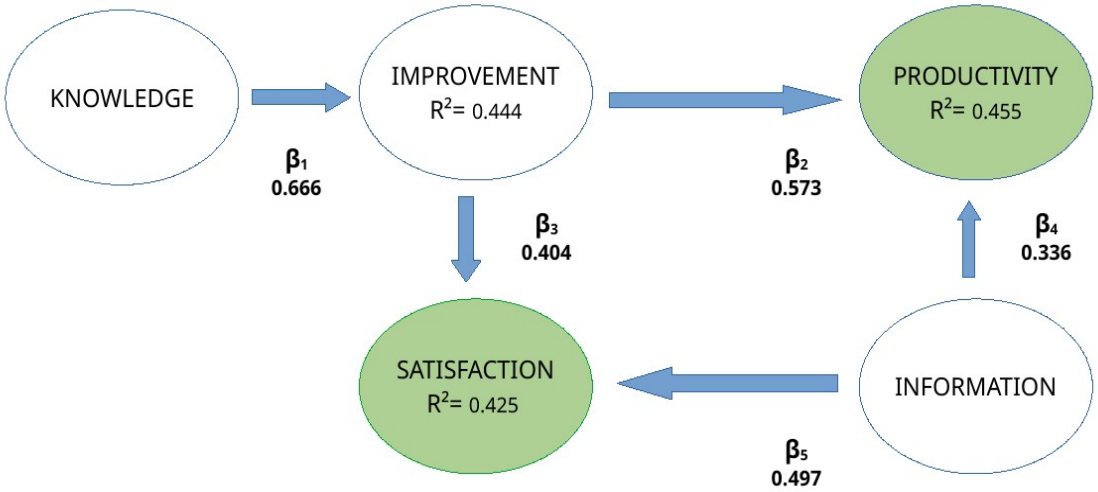
Table 7. Component correlations.

Component correlations <1

	Knowledge	Improvement	Information	Productivity	Satisfaction
Knowledge					
Improvement	0.6663795				
Information	not related	not related			
Productivity	0.4985350	0.5843518	0.3554241		
Satisfaction	0.4699430	0.4210391	0.5108129	not related	

Source: Own elaboration

Figure 7 Results of the empirical model



Source: Own elaboration

5.-Discussion of results

The previous section confirms a good definition and robust performance of the empirical model in line with theoretical prescriptions. Results lead to the acceptance of all the five hypotheses defined, showing that ICT knowledge and deep adoption influence the ICT processes improvement and deep use, then resulting in a better performance of the hotel measured by the productivity and satisfaction variables. In parallel, ICT information and training at the staff level also influence the performance of the firm in these two dimensions of productivity

and satisfaction of guests and staff by enhanced capabilities, additional ICT uses and improved job and stay experiences of the staff and guests, respectively.

The quantitative results let us see that the higher values for relations of constructs in the model are for those in H1 and H2, from deep adoption to deep use plus from deep use to staff productivity, with huge significance in both cases. Then follows H3 and H5, from deep use plus training to staff and guest´s satisfaction levels, and finally H4 from training to staff productivity.

However, all coefficients in the model appear to show a good behaviour in terms of size of the coefficients and significance. The model also shows good levels for F^2 effect size and goodness-of-fit through the R^2 tests.

In general, we can state that the measurement model behaves quite well in capturing the indicators that approximate the constructs or latent variables as shown in the previous section, while the structural model assessment also behaves correctly showing a robust adjustment of the proposed empirical model.

Once this stated, the empirical model captures quite well the role of the three main variables in the model, that is, deep adoption and use plus training courses for the staff to better deal with the installed ICT resources.

Deep adoption, and specially deep use appears here as an opportunity to better extract the value from the ICT resources, employing an incremental usage approach to reduce the time gap pointed by Gartner, all in an open innovation performance setting with dynamic capabilities and innovation translation. In doing so, the complementary role of informational and training investments appear also key in qualifying the human resources under the leadership of managers, that should recognize the opportunities that they could face and the process to reach that gains in performance and operations. Internal and external knowledge flows appear both relevant as targets of the ICT improvements in adoption and use and related productivity and satisfaction outcomes.

As shown by the indicators selected in this study the deep adoption enables new capabilities of the already installed ICT resources, improving the connectedness and digital operations through the entire hotel network, while deep use leas to better performance for internal and external relations through better communication and information sharing among the staff, with suppliers and with the guests. Higher productivity levels come from improved communication and capabilities inside the hotel, and with suppliers and visitors, while satisfaction levels increase for the staff because of the easing of previous tasks done in a more traditional way, while saving time and improved efficiency for the guest´s demands and supplier relationships. This is an important finding of the model, as further from increased productivity levels, gains in efficiency also come from the side of a better working environment, giving higher cohesion and willingness to adapt to

occurring changes from the staff, as these changes would also improve their sense of satisfaction gains on the job.

Training also backs this type of results, as the staff reduces their technological stress when facing ICT related tasks, resulting in global positive spillovers, many in the form of intangible resources, as pointed out by the level of satisfaction increases obtained. In some ways, the model could appear quite schematic or synthetic in the current complex links between technology and firms´ management and business performance.

However, it sets the goal of being scalable and testable for other type of GPT at hotels and industries, while providing a clear framework of analysis up-to-date for testing the gap time-lapse in technology adoption and use in present complex times, deploying empirical results with meaningful outcomes.

In comparative terms, the empirical results are in line with some of the previous work in the literature, contributing to novel results on the issue for the hospitality sector, while reinforcing seminal findings of previous research in a more elaborated framework and relationships. For example, in comparison to the study by Yunis et al. (2018), where innovation mediated the relationship between ICT use and firm´s performance, we add the concepts of deep adoption and use in order to point out that innovations and improvements could come from a more profound employment of the already existing resources.

We also add satisfaction as a relevant measure of the hotel´s performance, customizing in this way the theoretical approach to the hospitality industry, in line with some recent literature demands. The paper by Melian-González (2015) based on qualitative methods, also asks for more quantitative analysis in this ICT setting, as we do in this PhD project.

The quite novel study by Hameed et al. (2021) introduces the concept of open innovation in hotels, with a direct reference to open source software that we refer too along the study, recommending in particular to lean on FOSS services that are becoming commonly adopted by big hotel chains and companies in order to deal with applications requirements and the online community services that this type of technologies could afford in a timely environment for resolution of typical Q&As demands when deeply adopt and use these technologies.

FOSS evolved to business model innovation and services innovation, with big communities and entire ecosystems with their specific collaborative tools, and our research findings being usefully transferred to an SME environment to take advantage of defined processes and expected outcomes in terms of the hotel performance. To put an example, the bulk of the hotels in Spain are SME companies with less than 50 workers, and some even less than 10 workers. As shown by Spanish ITH survey, they care about ICT oriented to customers, as the

free WiFi, changing their providers annually in the 84% of the cases, 62% for a bad service quality (Spanish ITH survey 2014).

In this case. the applications in the IP telephony analyzed here could help enormously, better if it is implemented with FOSS as Asterisk. As well as other FOSS developments, once more leading to the relevance of the ICT department to provide customized and good quality tools easy to use for the staff and guest, also saving quite importantly in operational costs. This is then the spirit of the current PhD project, in order to pay attention on these issues currently affecting to many hotels and other SME companies.

6. Conclusions

The present thesis states that SME, in particular hotels, will increase their performance if their managers and rest of staff receive ICT advice (and further training) on how to better (deep) adopt and use their installed ICT stock, leading to improvements of their internal and external processes and communication by just informing management about unused features and their productivity and satisfaction improvements .

A better knowledge and use of these ICT technologies come from good knowledge from managers and staff on the existing opportunities, spreading expertise and practice along the hotel to improve communication and timing of services among the staff, as well as with the customers that could make use of those technologies to interact with the staff and among themselves.

All these raise the productivity of employees along the hotel services, while increasing on-the-job and visitors´ satisfaction, respectively. The role of external services of “techno-experts” in this process must be also highlighted, as they can help to close the gap in the ICT areas referred here.

Not being as polite, except for needed ICT, even the most tech-savvy hotel managers were unaware of the improvements that other ICT can provide to their business

Despite this technology being available since year 2007, and saves billions of USD every year, just in real state costs to telecom companies, and even more in backbone infrastructure, being able not only to save money in SME but also provide processes improvements, all of the interviewed managers and employees were not aware of the opportunity or even make a link between IP/PBX and their own smartphones, being available in every phone dialer to configure IP phone extensions, as an ICT advantage to enhance the hotel operations and internal and external communications.

But as soon as they were informed that the features were similar to those in Whatsapp, Signal, Telegram, Skype, Zoom, Messenger, and others, but internal , more and more powerful, most of them, as the results show, made the link.

In the context of a knowledge-based economy, the present research started to wonder about the capacity of SME, and hotels in our case, to take all advantages from the existing ICT resources in the market. Saving money and rendering important improvements to their firms´ performance. In this context, the current research has served several objectives. Compiling the state-of-the-art in the academic and professional literature. Providing a deep approach to the processes and variables that really appeared key in this setting. And running an empirical approach, we have taken stock of enriching conversations and measures of the reality characterizing the hotel environments.

Our research shows that just informing about ICT features to management staff they can identify how to improve processes. The actual paradigm of teaching it “all or nothing” for ICT is not working. We need a new one and just making management aware that those ICT features exist, can be it. Governments can implement this “just inform” policy in order to improve SME productivity and staff and customer satisfaction facilitating ICT deep use. At least it is what we found for IP/PBX and hotels, and we think that probably will happen for other non-essential ICT and SME, opening also new lines of research.

With all these objectives in mind, we have defined the concepts of knowledge & deep adoption and processes improvement & deep use of already installed ICT technologies, in order to frame the context of the research. We have also noted the central role that training plays. Our proposal builds on a better understanding of existing opportunities to improve the use of ICT features, with almost no additional costs for improving performance. In terms of the theoretical framework, we have built on the theories of dynamic capabilities and strategic management, firm´s open innovation performance, plus the theory of innovation translation.

All these theories appear relevant in terms of our theoretical framework, accurately defining a manageable setting to approach the context of small and

medium hotels to benefit from a better knowledge and use of ICT technologies in a crisis context or scarcity of resources.

We contribute to this line of research by focusing on incremental changes on ICT (deep) adoption and use for the hotel environment. The research confirmed the hypothesis on the need of increasing knowledge and use going hand to hand of ICT advisors, as tax advisors do in their field.

The Firms Open Innovation Performance (OIP) theory focuses on the use of purposive inflow and outflow of knowledge to accelerate innovation inside the firm. While expanding the scope for new applications of existing resources. The resource to Free Open-Source Software (FOSS) applications is also refereed in the present research in order to squeeze all potentialities and customization to small hotels that this software allows, in a context where all these open-source applications would be increasingly playing a role in the near future versus the licensed software.

Our study also helps to illustrate how to adapt more abstract theoretical frameworks to specific processes and situations. In line with the work of Eisenhardt and Martin (2000), the existence of dynamic capabilities in hotels, in terms of organizational routines, can lead to new resource configurations, processes and savings in the cost of services. The findings of the empirical model help to identify once again the time gap that still exists between the adoption of an

ICT and the capacity of the company to extract all inserted value in it. Showing how a hotel establishment could employ this existing gap to improve its performance with low additional costs. This is an important result in times of budget restrictions for business, like the Great Recession starting in 2009 and the present Covid-19 crisis, hardly hitting the tourism and hospitality sector.

The theory of innovation translation we have adopted states the need of companies to make a good use of incremental innovations, as those proposed here. Once more, the figure of an internal or external technologist appears key here, this being a key professional to improve the performance of the company. Moreover, improvements in communication inside the hotel and with customers has proven to increase the level of satisfaction of both, staff and customers, a relevant issue to enhance the vacation or business experience, as well as the level of on-the-job satisfaction, that would also impact the productivity level of the staff, as shown by the human resources´ literature.

The present research has proven relevant in underlining the concept of unused ICT capabilities, already installed or freely available, which, if deep used, would improve SME performance. And perhaps will help an - almost new - ICT advisor or technologist job to grow. Being an under-researched topic, we have pointed to new lines of continue developing the hotel operational context, while fostering inside and outside communication in times of scarce resources

contributing to the recovery of the hospitality sector after two main shocks in the last decade.

"Thinkers think and doers do. But until the thinkers do and the doers think, progress will be just another word in the already overburdened vocabulary by sense."

— Francois de La Rochefoucauld (15 September 1613 – 17 March 1680)

Not a new issue, but still alive, this thesis states that SME in particular hotels will increase their performance if their management, that knows their business and their main ICT applications very well, receive external ICT advice about those other ICT that can help them to improve their processes and therefore customers (guest in our case study) and staff satisfaction and productivity of their business, And this advice is necessary even if they are technological driven persons as they do not have the time to be up to date in common ICT. Thinkers helping doers think to do better in La Rochefault categories.

ICT resources are not a new thing in the current world economy, starting early in the First Industrial Revolution and arriving to the new millennium with renovated energies.

Despite not being a new resource of these times, the last decade of the XX century and the beginning of the XXI has faced a relevant momentum on the

acceleration and complexity of ICT resources, giving place to the so-called "knowledge-based economy".

In this context, the present research started to wonder about the capacity of firms, and hotels in particular, to take all advantages from the existing ICT resources in the market.

In doing so, we became aware of the technology time gap in adoption characterizing the ICT market, then wondering about the benefits that could arise to the hospitality sector in terms of adopting and use more deeply the already installed resources, saving in money and rendering important improvements to their firms´ performance levels. In this context, the current PhD project has served a number of objectives.

We were majorly interested in acquiring the scientific rigor and capabilities that the doctoral studies could provide to our technology knowledge, in terms of ordering ideas and contrasting them with the existing state-of-the-art in the academic and professional literature. We have been able to pursue a deep approach to the processes and variables that really appeared key in this setting. By running and empirical approach, we have taken stock of enriching conversations and measures of the reality characterizing the hotel environments, the ultimate market for our ideas and the informational channels that needed to be scrutinized. All these three objectives have been achieved along the present PhD research.

With these goals in mind, we have defined the concepts of knowledge & deep adoption and processes improvement & deep use of already installed ICT technologies, in order to frame the context of the research. We have also noted the central role that informational and customized training play in this market and operations. The definition of hotel's performance has been also expanded to account for improvements not only in quantitative outcomes, like labor productivity, but in more intangible and qualitative measures, like the satisfaction level. The number and type of agents involved in the study were also expanded from previous analysis, including the staff and managers, guests, and external suppliers providing the hotel.

Following the literature, we have lean on a case study on the digital telephony resources to illustrate the concepts of the sketched model.

In particular, the empirical work with hotel establishments has helped to demonstrate that the still incomplete understanding of existing ICT applications in three main areas of the hotel business, including managerial techniques, customer focus and the relationship between service staff and guests inside the hotel facilities, gives room to additional improvements of the hotel's efficiency in some dimensions. Our proposal builds on a better understanding of existing opportunities to improve the use of ICT features with almost no additional costs for improving these three areas.

We have also discovered that there is no special commercial action from IP/PBX main providers delegations towards small hotel companies, that the management in small hotel companies that evaluated IP/PBX do not have a financial view calculating this technology savings, and also not a technical one, and that most of them receive their ICT advice quite entirely from their ICT providers.

As a result, there is still a lack of communication between ICT providers and hotel users, and what is more important, a simple IP/PBX technology could be employed to extend the performance of the company in a number of ways, including better communication inside the company and with external providers, and an extension of the capabilities that the visitors or guest can employ from them. ICT could save time to the front desk operations, to the office tasks and guest related services, improving the service quality perceptions of visitors and on the created value. Improved communications and capabilities of the staff has also resulted in higher levels of job satisfaction, with renewed job environments and happier workers with increased efficiency.

In line with the theoretical framework informing the research, all of these three theories have provided an underlying platform to position the empirical results. First, the dynamic capabilities' theory refers to the firm’s ability to integrate, build, and reconfigure internal and external competences to adapt to rapidly changing environments (Teece et al., 1997). In this way, the present research has focused on deep adoption, awareness of ICT capabilities already

installed, and deep use, deep exploitation of the whole ICT resources to improve the hotel´s staff tasks and guest´s quality services offered, allow integrating, build and reconfigure competences leading to an improvement of the firm´s performance, increasing the staff productivity and guest and staff satisfaction level, due to better communication and connectivity levels, while enhancing the satisfaction of guests in terms of availability of ICT uses and service quality for previous existing routines.

New ICT deep use could also help to improve the relations with providers of the hotel through improvements of tasks and routines, and communication in general, using advanced features such as IP/PBX ones.

As shown by the IP/PBX case study, that could be extended to other ICT and FOSS ones, the leadership of managers in adopting, explaining and identifying the necessary training courses for a better performance of the staff and improved guest experience appears key, as previously recognized by the literature. In this way, we make a contribution to this line of research by focusing on incremental changes on ICT deep adoption and use for the hotel environment, a pivotal case that makes the point on the difficulty of really confronting the understanding of the ICT resources employed and the staff´s capacity of understanding and taking advantage of the whole capabilities they enable for the firm. In this way, the figure of a technological advisor, either internal or external to the hotel, emerges once more as a recommendation of the research, as the IP/PBX case study has shown.

The research confirmed the hypothesis on the need of counting on ICT information to SME – hotels in this case of study – management staff, to help them make the connections to understand how ICT unused features can help their company to improve processes.

Second, the Firms' Open Innovation Performance (OIP) theory focuses on the use of purposive inflow and outflow of knowledge to accelerate innovation inside the firm, while expanding the scope for new applications of existing resources (Chesbrough, 2003, 2004, 2006 2011; Chen et al., 2017). This theory shows us that main outcomes in our IP/PBX case study come from a better relational environment among the staff and with guests of the hotel, leading to communication improvements proven to be key for an increasing performance of the firm, and job and service quality satisfaction levels.

The management of knowledge flows inside the hotel is pivotal in building an efficient and quality job environment as shown by the empirical results.

This part of the research is quite in line with the contributions of the knowledge capital model highly developed in recent years, when the knowledge-based economy is gaining relevance at the firm's management and marketing dimensions, this being another feature of the defined empirical model, a useful benchmark contribution integrating different pieces of the tourism and hospitality literature, and more generally on the recent firm's management theories.

The role of the empirical analysis in settling the main research ideas has been highlighted by the literature (Bleady et al., 2018).

The simple case study on a typical ICT technology, like the IP/PBX installed at hotels, has helped us to illustrate how to adapt the more abstract theoretical frameworks of research to specific processes and situations of the managerial and working environments for the hospitality sector. In line with the work of Eisenhardt & Martin (2000), the existence of dynamic capabilities at the hotel level, in terms of organizational routines, can lead to new resource configurations and new processes and products. This approach identifies the need of exhaustively reviewing the company's resources, while finding an innovative way of interconnection to achieve a better performance of traditional operations.

In this case, the findings of the empirical model help to identify once more the time gap that still exists between the adoption of an ICT technology and the capacity of the company to extract all inserted value in it, showing how a hotel establishment or chain can employ this existing gap to improve its performance with low additional costs.

This is an important result in times of budget restrictions for business, like the Great Recession starting in 2009 and the present Covid-19 crisis hardly hitting the tourism and hospitality sector.

And third, the theory of innovation translation we have adopted (Schumpetter 1937, Jaakkola, 1996; Gerosky, 2000; Guardiola et al., 2002) also states the need of companies to make a good use of incremental innovations, with a relevant component of knowledge sharing and translation among the whole staff structure. Once more, the figure or role of a technologist with knowledge of the hotel needs in terms of ICT resources and task implementation appear key here. It would depend on the size and volume of revenues of the company that this technologist could be hired as an internal staff or provided as an externally outsourced service.

As a result, the present PhD research has proven relevant in refocusing some of the ICT uses, and ICT resources more generally speaking. The empirical results, based on a rigorous statistical analysis through up-to-date software and procedures like the SEM-GSCA framework, has shown an important reliability, validity and robustness of the model, helping to analyze and test the logic of the proposed framework to investigate this topic.

Results have also shown that this first step of our research, thinking in the subsequent knowledge transfer to the industry, has proven to be useful and in line with R&D processes in a win-win scenario for the academia and the industry collaboration.

We have focused on the concept of unused ICT capabilities, already installed or freely available, which if deep used would have more impact in the hotels daily operations and performance, and even more after the Covid-19 times, when resources are scarce for the tourism sector. This could even lead to the establishment of a new profession more rigorously, that of “the technologist”, conferring value to the technological side of the company and related external services.

And it is to consider information and (fast) training as the key variable that could add that value to unused resources, another new approach to ICT capabilities, that could be acquired in short-time formative sessions or “pills”.

As stated in interviews with managers and staff, even with university people, we did also observe that it would be not that hard to inform, design tests, teach, and implement some of these capabilities and customization needs in this type of new learning environments, including online short sessions, as they manifest to be so willing to receive them.

Regarding specific applications of the IP/PBX technology at hotels, we can indicate some of the following ones, including interactive staff texting, instant access on your screen to the personal info of the client that is calling, being able to take notes on that file, soft phones for desktop, tablet, and smartphone use, as an example. All these would save time and increase communication and productivity

of the staff, also increasing the service quality for customers. It would also give the opportunity to guests of having the room phone number services at their smartphones, of other devices, by relying on a phone app that can be installed with a QR (Quick Response code). This application kind or as I commonly named now "app", called soft phone, can be applied inside the hotel directly or merged inside a custom hotel mobile one.

A directory can also be created with internal extensions, and external ones, including phones on usual services like taxis, bus, museums, restaurants, trips, and other tourism services, even configured as "click to call" using hotel flat fees, that minds no extra cost for hotels, charging or not extra fees for these services.

Other capabilities for increase staff productivity and satisfaction include the automatic towel dispensers, or real time room cleaning monitoring. The IP/PBX software also allows not to pay for the employees´ company phone fees, as smartphones can be used inside (or outside via VPN) the network with Wi-Fi, not just for internal use, for calling and sending SMS to phones too, even mixing mobile, landlines and virtual phone numbers - even foreign ones, perhaps to offer receiving cheaper phone calls to some recurrent phone foreign visitors - in the server to optimize costs.

In implementing these deep use of ICT resources, not only the hotel will save on telephone bills and new service providing, but just by using their soft

phones in desktop computers and in mobile phones - only as WiFi devices - to replace a phone based text protocol as it would be one done with Whatsapp Telegram or Signal they would save more than 2% of the minimum annual salary per employee in Spain. That improvement and deep use increases for itself productivity without even taking in consideration the other 24 features of just this ICT: IP/PBX we were asking about in the questionnaire and interviews with the hotel managers.

All in all, the PhD project have shown an important number of academic results and industry applications for the hotel sector, leading to gains for the staff job environment and guest's quality service perception and corresponding satisfaction levels. As stated previously, the applications could also be built on the use of Free and Open Source Software resources, FOSS, opening a wide scope for extensions of this research. In general, all three objectives of the PhD project have been accomplished, and new extensions of the work for future contributions have been indicated as well.

Finally, we don´t want to end up this text without thanking all the people that has made this research possible.

Colleagues from the UPCT, Universidad Politécnica de Cartagena Spain where I have followed my doctoral studies; those from the Universidade Europeia de Lisboa where I carried out my international research stage in the international program, and all those others that along these four years of work I have met in

international conferences, and video conferences, always eager to help along the research discussions of the work in progress I submitted and presented. Moreover, all the managers, staff, professors, and students helping me to push the current research, and enriching that with their smart comments also deserve a reference here. We are plenty of ideas, developments and current examples of how to apply this defined ICT operative framework described in the research for improving first the operations and HHRR environment in hotels, and second the working environments for tomorrow.

In particular there is a great opportunity for SME in the hospitality sector, including restaurants and small services´ business to close the gap, and even pass big corporations in productivity and satisfaction that ICT can provide, but we can extend this findings not only for that sector as non essential ICT are not deeply known, nor used to improve processes because being up to date to be a technologist or ICT advisor will have to be a job, as it is now tax advisor or lawyer even for those that studied laws business or economics but they do work in other issues and they are not up to date. .

However, we have taken advantage of the present PhD project to more rigorously define a framework for the scheduled tasks in our agenda, and testing this empirically. For the near future, the agenda is now full of projects to implement the obtained results and ideas that have been emerging from the current research, but this is yet part of another story.

7.-Limitations of the study and further extensions.

As in all cases, the current study has faced a number of limitations that we want to make express here. The most relevant is of course the Covid-19 times that hit all of us during the research process of the PhD project. In this context, it has been extremely difficult to receive answers to the designed questionnaires we distribute online to different hotels and professionals of the sector. In particular, we were not able to interview any of the guests arriving to the hotels, as many of them were closed during the data gathering process. This is an important limitation of the present study that we will try to fix in further extensions when the pandemic times pass over definitely.

Second, it is also important to state that the current research relies on a case study for a GPT as ICT are, using the IP/PBX digital telephony features in the survey in order to fill the gap with asking about deep adoption and use of ICT, and as so could face some limitations for its extension to other ICT technologies. However, we think that the defined framework is quite extendible to other technologies of the type, that would surely help to consolidate our research findings and recommendations. Limitations of time are always present when doing research, so despite we have done our best, I want to expressly note here that all still remaining errors belong to me.

Finally, regarding potential extensions of the research, the questionnaire in the Appendix shows that we have still room to employ some of the survey questions to investigate new issues in this research setting, what we expect to do in the near future. Interesting extensions include the option of research differences in the applicability of this research framework between big and small hotels, personally managed or chain hotels, and identifying more ways of improving the productivity and satisfaction levels at the hotel environment.

Last but not least, it is very appealing for us to investigate how Free and Open Source Software FOSS, can help SME to have similar ICT resources than big corporations, as we are sure that there exists an extensive field of research in this area.

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Appendix

Questionnaire detail

Brief survey (answered in less than 10 minutes) for thesis on Information Communication and Technology (ICT) in hotels and IP / PBX - Digital telephony -

We hope that this survey on technology and digital IP / PBX telephony will also help you to reflect on the subject.

This technology despite being a great savings in telephony plus a more powerful and secure INTERNAL "WHATSAPP" is in disuse and / or wasted.

And we want to study why and with it how they are known and implemented - or not - the TECHNOLOGIES in the hotels.

In thanks we will mail you the study conclusions when it is published.

Thank you very much for your help.

Table 8. Hotel Questionnaire

Thank you for answering this survey for a PhD Project at Technical University of Cartagena/Universidade Europeia de Lisboa. We would very much appreciate if you could answer the following questions:

SECTION A: Personal Information

A.1. E-mail:

A.2 Gender

Woman ☐		**Man** ☐	**Other** ☐

A.3 Age	

A.4. Education

Master or PhD ☐	**University Degree** ☐	**Professional** ☐

A.5 Experience

Less than 1 year ☐	**From 1 to 5 years** ☐	**More than 10 years** ☐

A.6 Income (MWL: Minimum Wage level)

<MWL x 2	**MWL x2 - x3**	**> MWL x3**	**NA**

SECTION B: Knowledge and deep Adoption of ICT

B. Perception of knowledge of IP/PBX digital telephony features:

Do you know these "computer-based" features of IP/PBX digital telephony? I know all these features:						
	(1: strongly disagree to 5: strongly agree)	**1**	**2**	**3**	**4**	**5**
Instant communication of:						
1	Texts					
2	Images					
3	Records					
4	Links					
5	Voice or phone calls					
6	Video calls					
7	Immediate appearance of the SHEET upon receiving CALL to interact with it - when it receives a call both internally and externally on the computer it appears - if so configured - the RECORD of the natural or legal person that makes it a worker, guest, client or provider with the fields and alerts that are configured for each user.					
8	Text RECORD of CALLS with their date, time and duration					

SECTION C: Process Improvements and (deep) use

C. Perception of the improvement in the use that digital telephony brings:

Please rate your agreement with the following statements:						
	(1: strongly disagree to 5: strongly agree)	**1**	**2**	**3**	**4**	**5**
	I think the deep use of digital telephony features improves COMMUNICATIONS in my hotel...					
1	In general,					
2	Among the staff					
3	Between guests and staff					

SECTION D: Information and Training

D. Perception of the need to receive information and training:

Please rate your agreement with the following statements:						
	(1: strongly disagree to 5: strongly agree)	**1**	**2**	**3**	**4**	**5**
1	I would like to receive regular and convenient technological INFORMATION aimed at improving satisfaction and productivity					
2	I would like to receive fast and convenient technological TRAINING over the technologies we decide to use and customize.					

SECTION E: Productivity effects

E. Perception of the improvement in productivity that digital telephony brings:

Please rate your agreement with the following statements:						
	(1: strongly disagree to 5: strongly agree)	**1**	**2**	**3**	**4**	**5**
	The computer use of digital telephony could increase the PRODUCTIVITY OF THE STAFF for:					
1	Internal communications of the staff					
2	Communication with guests					

SECTION F: Effects on Satisfaction levels for customers and staff

F. Perception of the improvement in satisfaction that digital telephony brings:

Please rate your agreement with the following statements:						
	(1: strongly disagree to 5: strongly agree)	**1**	**2**	**3**	**4**	**5**
	The computer use of digital telephony increases the STAFF'S SATISFACTION by improving the:					
1	Internal communications of the staff					
2	Communications staff-guests and among guests					

Source: Own elaboration

Farewell

Thanks for reading this thesis

You are welcome to ask any questions about it at miguel.mayoltur.es@member.mensa.org |

“Thinkers think and doers do. But until the thinkers do and the doers think, progress will be just another word in the already overburdened vocabulary by sense.”
— Francois de La Rochefoucauld (15 September 1613 – 17 March 1680)

“Mediocre minds usually dismiss anything which reaches beyond their own understanding”
— Francois de La Rochefoucauld (15 September 1613 – 17 March 1680)