

Prospects of the fourth industrial revolution for the hospitality industry: a literature review

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Abstract

Purpose – The economy of today has moved toward the fourth industrial revolution (FIR), which is characterized by the adoption of technologies such as cyber-physical systems, internet of things, big data, artificial intelligence and robotics. Globally, there is a lot of awareness created on the influence of the FIR on all industries, including hospitality and tourism. A plethora of studies on FIR have been conducted in the setting of manufacturing industries. Nonetheless, there seems to be in-exhaustive and non-consensual agreement among researchers as to the development and prospects of the FIR for service industries. Therefore, the aim of this paper was to comprehensively review the prospects of the FIR for the hospitality and tourism industry.

Design/methodology/approach – As a result of the novelty and gaps associated with the FIR in the hospitality literature, the authors explored the concept of FIR using a comprehensive literature review approach. Specifically, this paper reviews existing literature from diverse academic backgrounds, and annotates issues with regard to the evolution and prospects of the FIR for the hospitality industry.

Findings – Emphatically, the development and principles of FIR were expatiated. Additionally, an exegesis was carried out on the prospects (positives and challenges) of FIR for the hospitality industry. Finally, practical and social implications were also discussed.

Originality/value – It still remains a discourse among scholars and industry stakeholders as to the prospects of the FIR. This paper clarifies the confusion among researchers and bridges the literature gaps. Moreover, this review serves as a theoretical foundation for future research on the impact of FIR on the hospitality industry.

Keywords Tourism, Challenges, Hospitality, Fourth industrial revolution, Prospects, Hospitality revolution 4.0

Paper type Literature review

摘要

论酒店业的第四次工业革命之前景：文献综述 – 研究目的 – 今日经济已经迈入第四次工业革命 (FIR) 阶段；其特点包括科技运用，如网络-实体系统、物联网、大数据、人工智能、和机器人。全球人已经达成共识：FIR 整个产业包括酒店和旅游业有着重大影响。目前有很多FIR研究在生产工业背景中。然而，研究者们似乎对FIR在服务产业中的发展和前景未达成太多的共识。

研究涉及/方法/途径 – 由于FIR在酒店文献中的新奇和欠缺，本文借助全面文献综述法，来专注于研究FIR的概念。具体来说，本论文审视了多个科研背景下的现有文献；以及指出FIR对酒店产业的革命和前景的相关问题。

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研究结果 – 研究结果展示了FIR的发展和原则。此外, 本论文还指出了FIR对酒店产业的前景分析。最后, 本论文还讨论了基于本论文结果而衍生的实际启示和社会启示。

研究原创性/价值 – 目前在学者和产业相关者之间, 对于FIR的前景讨论存在分歧。本论文解释了研究人员之间的疑惑以及弥补文献缺口。此外, 本论文还对未来关于FIR在酒店产业影响的研究奠定了理论基础。

关键词, 第四次工业革命, 酒店业, 旅游业, 酒店革命4.0, 前景, 挑战

Introduction

In the realm of industrial production, the advances of science and technology continuously support the development of industrialization all around the world (Belvedere *et al.*, 2013). As a result of these technological leaps, all industries are beckoned with paradigm shifts. In the academic literature, these paradigm shifts are popularly classified as industrial revolutions (Maynard, 2015). Up until now, there are four major industrial revolutions that have been identified from the perspective of technological evolutions. The first three industrial revolutions took around two centuries, as a result of certain technological advancements and events associated with industrial manufacturing and production (Freeman and Soete, 1997).

The first industrial revolution occurred for almost 200 years and was driven majorly by the steam engine by Watt during the 1780s (Drath and Horch, 2014). Also, at the end of the 18th century, the introduction of the steam engine coupled with water and coal brought about the mechanical production (Liao *et al.*, 2017). These technologies changed the face of the manufacturing abilities of industries such as agriculture, manufacturing and textiles (Liao *et al.*, 2018). This was the dawn of industries and factories that we see today.

The second industrial revolution also took place in the 1870s, spanning from the early 19th century to the mid of the 20th century. It saw the application of electrically powered mass production technologies through the division of labor. One notable change with the second industrial revolution is the usage of specialized and expensive machinery; however, industrial investments were offset by the economies of scale (Blinder, 2006). During this same era was when the global economy witnessed major crises (e.g. Great Depression in 1893 and two world wars). Nonetheless, the new technological advancements at that time initiated the emergence of a new source of energy (electricity, gas and oil), which were of immense benefit to the third revolution (Liao *et al.*, 2017).

In the second half of the 20th century, a third industrial revolution appeared with the emergence of a new type of technology (i.e. internet) whose potential surpassed its predecessors (Drath and Horch, 2014). Notably, this revolution gave rise to the use of electronics, computers, information technology (IT) and telecommunications to facilitate an advanced automation of production and manufacturing (Liao *et al.*, 2017, 2018). Some researchers are of the believe that this revolution did not live up to expectation, although there were intense technological advancements (Blinder, 2006).

Currently, the economy of today has found itself at the beginning of a revolution that is basically disrupting our style of living, relationship with one another and the way we conduct business. According to some scholars (Lee *et al.*, 2018; Schwab, 2016), the fourth industrial revolution (FIR) is not merely another phase of technological wave or prolongation of the third industrial revolution, but an arrival of the next IT revolution. According to Schwab (2016, p. 7), “the FIR is unlike anything humankind has experienced before in its scale, scope and complexity.” The astute scholar further elucidated that the FIR builds on the digital revolution that encompasses ubiquitous technology; smallest, powerful and affordable sensors; and artificial intelligence as well as machine learning (Schwab, 2016). Lee *et al.* (2018, p. 6) also illustrated that “the first-three industrial revolutions revolutionized modernization of the physical space into cyberspace; while the FIR has introduced “a fusion of physical space and cyberspace.”

Notably, there are various identities and/or labels that have been given to this current industrial revolution in the literature. [Kagermann et al. \(2013\)](#) referred to it as “Industrie 4.0”; [Brynjolfsson and McAfee \(2014\)](#) termed it as “Second Machine Age”; [Schwab \(2016\)](#) described it as the “Fourth Industrial Revolution”; [Lee et al. \(2018\)](#) referred to it as “Second IT Revolution” and/or “Manufacturing Innovation 3.0”; [Oztemel and Gursev \(2018\)](#) also called it the “Digital Age”; and [Sung \(2018\)](#) classified it as “Internet of Everything.” However, the dominant ones used in research papers are the “Fourth Industrial Revolution” or “Industry 4.0.” Additionally, there is confusion among scholars with regards to the terms “Fourth Industrial Revolution” and “Industry 4.0.” To some scholars ([Crnjac et al., 2017](#); [Oztemel and Gursev, 2018](#); [Sung, 2018](#)) the “Fourth Industrial Revolution” and “Industry 4.0” are the related terms explaining the same concept, while other scholars ([Hermann et al., 2016](#); [Lee et al., 2018](#); [Liao et al., 2018](#)) claim that they are different concepts with different meanings.

For instance, [Hermann et al. \(2016\)](#) differentiated between the two terminologies in terms of scope. The scholars opined that “FIR” as a term has been applied to significant technological developments over the years, with its meaning up for academic debate, while Industry 4.0 on the other hand, specifically focuses on manufacturing in the current context. [Shamim et al. \(2017\)](#) also views Industry 4.0 as a strategy that is well-developed to prepare for the FIR. Again, [Liao et al. \(2018\)](#) postulated that Industry 4.0 provides the relevant answers to the FIR, emphasizing the idea of consistent digitization and linking of all production units in an economy within the FIR. [Lee et al. \(2018, p. 7\)](#) envisaged that “the naming itself is not so important if the naming reflects the severity of the unprecedented disruptive changes human society is experiencing.”

Moreover, there are also some disagreements among scholars as to the time orientation with the era of the FIR. Some academics ([Maynard, 2015](#); [Schwab, 2016](#)) are of the belief that we have begun the era of the FIR. There are other scholars ([Crnjac et al., 2017](#); [Liao et al., 2017](#); [Zhong et al., 2017](#)) who are also of the view that the FIR is on its way and yet to begin. Lastly, there are other scholars ([Drath and Horch, 2014](#); [Sung, 2018](#)) with the view that the FIR is still future and hence, we are not there yet. According to [Kagermann et al. \(2013\)](#), some technologies of the FIR are being used and tested, but there are still significant developments to be made.

As clearly stated earlier, the FIR is yet to receive a clear, unique and concise definition by scholars. Given all the various labels associated with the FIR, the difficulty of finding a clear and objective definition for FIR is apparent. One surprising element of this industrial revolution is the diverse opinions among scholars and practitioners ([Hofmann and Rüscher, 2017](#)). In the view of [Hermann et al. \(2016\)](#), “this impedes scientific research, as any theoretical study requires a sound conceptual and terminological foundation.” This is creating a lot of confusion also in practice because as the concept itself lacks clarity, organizations also face difficulties in identifying and implementing FIR technologies. [Oztemel and Gursev \(2018, p. 3\)](#) proclaimed that the key promoters of the idea (i.e. the “Industry 4.0 Working Group” and the “Platform Industry 4.0”) described the vision, the basic technologies, the aims as well as some selected scenarios to be manifested.

Although there exists lack of a generally accepted understanding of FIR in the literature, there have been some efforts by academics to provide a basic definition. There are some researchers whose definitions focus on digitization, others consider the communication element dominating the manufacturing industry, some researchers opt for the intelligence and autonomy of the systems by being the main characteristics of

FIR, while the focus of some others is the generation of smart factories (Oztemel and Gursev, 2018).

Following the different cues from scholars on the concept of the FIR, it is clearly evident that there exist literature gaps with regards to the concept of the FIR. A major reason for this claim can be attributed to the relative newness of the FIR concept, as well as the continuous developments of its technological components (Lu, 2017). Another justification can be attributed to the different views of scholars on the evolution and time orientation of the FIR (Hofmann and Rüsçh, 2017), as explained above. Influenced by cues from varying views, the authors theorize the FIR as:

[...] a collective term that encompasses a technological revolution in all industries through the application and integration of smart systems, including: CPS, IoT, Cloud Computing, Big Data, Artificial Intelligence and Advanced Robotics; for higher forms of digitalization and automation compared to the previous industrial revolutions

Table 1 below highlights the literature and research gaps that support this study.

The FIR in the tourism sector has been referred to in the literature as “Tourism 4.0” (Korze, 2019). Interestingly, in the tourism literature, there are some publications that also focus on these advanced technologies. Some of these publications include smart tourism foundations (Gretzel *et al.*, 2015), smart tourism for personalization of tourist services (Buhalis and Amaranggana, 2015), robots, artificial intelligence and service automation (Ivanov and Webster, 2017; Ivanov *et al.*, 2017; Ivanov *et al.*, 2018), smart tourism and tourism information systems (Li *et al.*, 2017), as well as big data and its implications for smart tourism destinations (Vecchio *et al.*, 2018). With this mentioned, one would argue that there seems to be an overlap of the smart tourism literature and that of the FIR. However, it is evident that the smart tourism literature concentrates on some technologies that were more prevalent in the third industrial revolutions, such as

No.	Literature gaps	References
(1)	Inconclusive conceptualisation of the FIR among scholars	Hofmann and Rüsçh (2017), Lu (2017), Oztemel and Gursev (2018)
(2)	Differing information on the evolution of the FIR	Lee <i>et al.</i> (2018), Liao <i>et al.</i> (2018)
(3)	Disagreements on the time orientation of the FIR (i.e. whether we are in its era or not)	Drath and Horch (2014), Hermann <i>et al.</i> (2016)
(4)	Less information on the prospects of the FIR technologies for the hospitality industry	Ivanov and Webster (2017), Loureiro (2018), Xu <i>et al.</i> (2018)
	Research gaps	
(1)	Plethora of studies conducted on the FIR at the manufacturing industries, with less attention to the service industries	Liao <i>et al.</i> (2017), Lu (2017), Zhong <i>et al.</i> (2017)
(2)	Limited studies conducted on the FIR in the hospitality and tourism setting	Kuo <i>et al.</i> (2017), Shamim <i>et al.</i> (2017)
(3)	Research paucity on the prospects of the FIR technologies for the hospitality industry	Ivanov <i>et al.</i> (2017), Onyango and Kesa (2018)

Table 1.
Support for gaps in
FIR literature/
research

self-service technologies, big data, social media and online travel websites. Currently, there are other existing and new advanced systems that make the FIR, and therefore, ongoing discussion in literature should also tow in that direction. Hence, the need for this review.

Most especially, in the hospitality literature, there exist limited studies on the prospects of the FIR for the industry (Ivanov *et al.*, 2018; Ivanov and Webster, 2017; Shamim *et al.*, 2017). To the authors, this is termed as the “Hospitality Revolution 4.0.” The authors, together with other scholars (Schwab, 2016; Lee *et al.*, 2018), believe that the FIR is not limited to the manufacturing industries alone. However, the components of the FIR also offer opportunities for service industries such as hospitality. Hence, the authors anticipate an era of advanced technological wave in the hospitality industry fueled by the technological systems of the FIR. Based on this premise, the authors conceptualize “Hospitality Revolution 4.0” as “the integration of the technological components of FIR, and their prospects for the hospitality industry; towards the successful implementation into the hospitality business environment.” Therefore, it is against these backdrops that this review sought to address by exploring the evolution, principles and prospects of the FIR technologies for the hospitality industry.

Evolution of the fourth industrial revolution

The FIR is one of the numerous concepts in academic literature that still lacks clarity and general understanding of its evolution, conceptualization and technological components. There exist diverse views among researchers with regards to the evolution of the term. According to some scholars (Drath and Horch, 2014; Hermann *et al.*, 2016; Hofmann and Rüsçh, 2017), its evolution can be associated with the first appearance of the term “Industrie 4.0” in 2011 at the Hannover Fair in Germany. On the other end, some scholars (Onyango and Kesa, 2018; Xu *et al.*, 2018) believe it first appeared in the book titled “*The Fourth Industrial Revolution*” by Klaus Schwab during the World Economic Forum at Davos in 2016. However, according to Liao *et al.* (2018, p. 13), the concept about the “Fourth Industrial Revolution” was first proposed in 1985 by Rostow, who explained its relevance for forestry by using “the concept of the Kondratieff Cycle and long-term cyclical trends in the resource enhancing activities”.

In 2011, Germany started thinking about projects and production strategies to develop and maintain its position as the “pacesetter” in the manufacturing industry (Hofmann and Rüsçh, 2017). Hence, an association of representatives from different fields (such as business, politics and academia) came under an initiative to enhance the competitiveness of Germany in the manufacturing industry. Eventually, the term “Industrie 4.0” was publicly announced at the Hanover Trade Fair in 2011. Later in April 2013, the “Industry 4.0 Working Group” acatech – National Academy of Science and Engineering, developed and published the first application proposal titled “Recommendations for implementing the strategic initiative - INDUSTRIE 4.0” (Kagermann *et al.*, 2013). According to Oztemel and Gursev (2018, p. 8), “the German federal government supported this initiative by announcing that Industrie 4.0 will be an integral part of the ‘High Technology Strategy for Germany 2020’ project; which particularly aims at leading the global innovation of technology”.

It is worth noting that the work of Kagermann *et al.* (2013) projects the aim of Industry 4.0 in creating smart factories in a world where virtual and physical systems of manufacturing, globally cooperate with each other in a flexible way. Which in turn facilitates the total creation and customization of products and new operating technologies. Also, in 2014, Brynjolfsson and McAfee published a book where they classified the

industrial revolution of today at that time as the “Second Machine Age.” The scholars elucidated that the global economy is at an inflection point where the influence of the advanced technologies we are seeing today will highly manifest through automatization. This will make it near to impossible to foretell the applications that may be used in some years to come (Brynjolfsson and McAfee, 2014).

In the year 2016, Professor Klaus Schwab, Founder and Executive Chairman of the World Economic Forum introduced the title of his book “*The Fourth Industrial Revolution*” at the World Economic Forum at Davos, Switzerland. He described this as a world where people move between the digital world and offline reality with the usage of connected technology to manage their lives (Xu *et al.*, 2018). Schwab (2016) acknowledged the earlier works by Kagermann *et al.* (2013) and Brynjolfsson and McAfee (2014). Schwab (2016) explained that the work of Kagermann *et al.* (2013) projects the aim of Industry 4.0 in creating smart factories in a world where virtual and physical systems of manufacturing, globally cooperate with each other in a flexible way. However, he critiqued these works by explaining that:

[...] the Fourth Industrial Revolution is not only about smart and connected machines and systems. Its scope is much wider; occurring simultaneously are waves of further breakthroughs in areas ranging from gene sequencing to nanotechnology, from renewables to quantum computing. It is the fusion of these technologies and their interaction across the physical, digital and biological domains that make the Fourth Industrial Revolution fundamentally different from previous revolutions (Schwab, 2016, p. 12).

Table 2 highlights some definitions of FIR by researchers who sought to conceptualize the concept.

No.	Definition	Author(s)
(1)	The fourth industrial revolution can be best described as a shift in the manufacturing logic towards an increasingly decentralised, self-regulating approach of value creation, enabled by concepts and technologies such as CPS, IoT, IoS, cloud computing or additive manufacturing and smart factories, so as to help companies meet future production requirements	Hofmann and Rüsche (2017, p. 33)
(2)	The fourth industrial revolution can be defined as an intelligent revolution of industry characterized by continuous short-term innovation with varying levels of speed, scope, depth, and trust. The broad changes in industries as well as society that are affected by the disruptive technological changes in artificial intelligence, automation, and hyper-connectivity	Lee <i>et al.</i> (2018, pp. 6–7)
(3)	FIR is the technical integration of CPS into manufacturing and logistics and the use of IoT in industrial processes	Liao <i>et al.</i> (2018, p. 13)
(4)	Industry 4.0 is an integrated, adapted, optimised, service-oriented, and interoperable manufacturing process which is correlate with algorithms, big data, and high technologies	Lu (2017, p. 3)
(5)	Industry 4.0 as a collective term that encompasses many modern automation systems, data exchanges and production technologies. This revolution is a collection of values of objects, internet services and cyber-physical systems	Oztemel and Gursev (2018, p. 8)

Table 2. Conceptualizations of FIR by authors in their literature review

Methodology

This paper opted for a comprehensive literature review approach, as a result of the gaps (literature and research) identified and the relative newness of the FIR concept. Attempts to use keywords in major scientific databases (i.e. SCOPUS, Web of Science and ABI/INFORM Proquest) for a systematic review process yielded few or limited outputs. This did not allow for a systematic review analysis to be carried out for this particular review. Hence, the researchers thought it is wise to adopt a comprehensive literature review method to address the concept and gaps under study. With this, the researchers broadened their search methods, after obtaining limited documents from the keywords search, about the FIR and the hospitality and tourism. This can be seen in [Table 3](#), together with their specific keywords' searches.

Specifically, the researchers extended their search strategies to identify seminal papers on the FIR by different scholars from diverse academic backgrounds, including hospitality and tourism. With this, particular interest and attention were also given to the evolution and the concept of the FIR, as well as the opportunities and challenges FIR presents for the hospitality and tourism industry. After this, a comprehensive exegesis was done on their relevance for the hospitality and tourism industry. These include the evolution and prospects (the positives and the challenges) of the FIR for the hospitality industry. Additionally, a matrix table was prepared and organized to show the major findings or references that were identified for the positives and challenges. Finally, the theoretical and practical implications of the FIR for the hospitality practitioners and academics were also discussed. Also with this, a table was prepared to highlight major theoretical and practical implications for this study.

Results

Prospects of the fourth industrial revolution for the hospitality industry

The hospitality industry is one of the industries that have embraced technological developments associated with the earlier industrial revolutions. For instance, IT and the internet allowed automation of hospitality services, such as the emergence of the central reservation and global distribution systems, as well as the integration of Web-based technologies which saw a progression from traditional tourism to e-tourism ([Gretzel et al., 2015](#)). This brought about a

Keywords	No. of documents	Author(s)
"FOURTH INDUSTRIAL REVOLUTION" AND "TOURISM"	6	Peraković et al. (2020) , Loureiro (2018) , Onyango and Kesa (2018) , Nick et al. (2018) , Sega (2017) , Lee et al. (2017)
"FOURTH INDUSTRIAL REVOLUTION" AND "HOSPITALITY" 0		
"IR 4.0" AND "TOURISM" 0		
"IR 4.0" AND "HOSPITALITY" 0		
"INDUSTRY 4.0" AND "TOURISM"	7 (with 3 non-specified authors)	Peraković et al. (2020) , Nick et al. (2018) , Lee et al. (2017) , Marini (2016)
"INDUSTRY 4.0" AND "HOSPITALITY"	1	Shamim et al. (2017)

Note: All keyword searches were executed from the titles, abstracts and keywords of the documents, with no limitation to year, subject area, author name, document type, publication stage, source type, country, language, etc.

Table 3.
Results of relevant keywords' searches from SCOPUS database on July 10, 2019

debate in literature termed as the “disintermediation effect,” where information and communication technologies transformed the travel-distribution channel by bringing the tourists closer to the producer (service provider). This reduced transaction costs and led to the emergence of online travel intermediaries and markets at the expense of traditional travel intermediaries (Rasoolimanesh *et al.*, 2019).

Similarly, the technological components of the FIR (e.g. cyber physical systems, internet of things, big data, artificial intelligence and robotics) also have a bearing on the hospitality industry. Wang *et al.* (2016) projected that, in the future, the industry will continue growing and changing significantly with smart technologies applied more widely and frequently. Hence, the traditional way of operating a business in the hospitality industry is insufficient for the challenges it faces in the era of the FIR. The applications of these smart technologies in hospitality have led to fundamental changes as to how the industry operates and functions, as well as in tourist behavior and demands (Wang *et al.*, 2016).

The main goal of these advanced systems for the hospitality industry is their application in improving resource management effectiveness, as well as enhancing the guest experience toward maximizing both organization’s competitiveness and consumer satisfaction, while also demonstrating sustainability over an extended timeframe (Buhalis and Amaranggana, 2015). These technologies of the FIR do not only critically affect the competitiveness of hospitality businesses, but also the tourists as well as their experience (Huang *et al.*, 2017). Gretzel *et al.* (2015) explained the influence of these smart technologies for the tourism and hospitality businesses, as well as for the guests (tourists).

For the businesses, the influence is on the opportunities and contributions of these technologies in terms of process automation, efficiency gains, new product development, demand forecasting, crisis management and value co-creation (Gretzel *et al.*, 2015). With the guests or tourists, the scholars explained that these systems aim to support them by anticipating user needs based upon a variety of factors, and making recommendations with respect to the choice of context-specific consumption activities such as points of interest, dining and recreation (Gretzel *et al.*, 2015, p. 4). Also, these systems enhance their on-site experiences by offering rich information, location-based, customized and interactive services. Again, these systems enable them to share their experiences, so that it guides other guests with their decision-making and/or reinforcing their experiences.

These systems of the FIR are key components of information systems that promise to supply tourism and hospitality organizations and consumers with more relevant information, greater mobility, better decision support and more enjoyable experiences. Some of these smart technologies that directly affect the tourism and hospitality industry are decision support systems, virtual reality systems, robotic technologies, ambient intelligence, autonomous agents searching and mining Web sources, recommender systems and context-aware systems (Buhalis and Amaranggana, 2015; Gretzel *et al.*, 2015). Although technologies of the FIR have already reached the tourism and hospitality industry, adoption of these technologies is still low (Loureiro, 2018). Ivanov *et al.* (2017, p. 1506) forecasted that in the near future, the hospitality industry may observe higher penetration of such technologies. It is worth noting that “technology” in the era of the FIR should be seen as an “infrastructure,” rather than as individual information systems (Figure 1).

Positives

Financial benefits

The first major opportunity of the technological components of FIR to the hospitality industry is financial benefits associated with their adoption and usage. The most obvious financial benefit resulting from their adoption is savings on labor costs. Ivanov and Webster (2017)

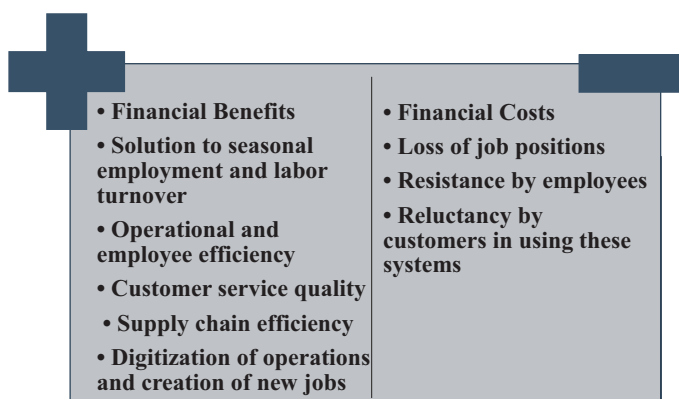


Figure 1.
Relationship among the prospects of the FIR for the hospitality industry

highlighted that labor costs savings do not necessarily mean substituting employees with technologies, but rather enhancing their operations. For instance, self-service kiosks, service robots and chatbots operate all day, much more than the usual 40-h work per week of human employees and also serve numerous customers. Hence, if these systems can execute certain tasks as effectively as humans, then based on costs, there are clear financial advantages and productivity for hospitality firms that adopts them. In addition, these systems could directly contribute positively to sales (Kuo *et al.*, 2017). This benefit can mostly be enjoyed in the early stages of the technology adoption because of its novelty (Ivanov and Webster, 2017).

Solution to seasonal employment and labor turnover

Second, the FIR systems can enable hospitality firms to cope with the issue of seasonal employment and labor utilization (Kuo *et al.*, 2017). Self-service technologies are used to supplement human services by introducing new employee-based technology interfaces. These systems (e.g. robots and chatbots) can perform their tasks thousands of times without complaints and without forgetting to do it, unlike human employees who get bored by tedious, repetitive and intellectually unchallenging tasks (Ivanov and Webster, 2017). Further, the hospitality industry faces the problem of high employee turnover, and hence the FIR technologies provide enormous benefit for solving that problem. For instance, when an employee resigns, it affects the innovative capability and intellectual capital of the firm as a result of the knowledge loss. According to Shamim *et al.* (2017, p. 8):

[...] it is very logical to argue that hospitality firms need to have special arrangements for knowledge retention, which is among one of the key requirements of the FIR, along with learning and innovation capability.

Operational and employee efficiency

The FIR technologies provide opportunities for enhancing operations and employee performance at hospitality firms (Gretzel *et al.*, 2015). More specifically, adopting these technologies will save employees' time from performing tedious and repetitive tasks, which they could use for other more creative and revenue generating activities (Ivanov and Webster, 2017). This allows for increased productivity as well as serving more guests with same or fewer employees. Also, these systems increase service capacity as well as easier scheduling and planning of operations (Xu *et al.*, 2018). This is because these systems do not

complain or shirk from their assigned duties. Additionally, these systems allow employees to be efficient by making informed and better decisions. For example, big data analytics stimulates information availability across all departments of an organization (Vecchio *et al.*, 2018), which aids in proper use of information innovative thinking and informed decisions. The availability of such a system helps hospitality employees to be prepared for any type of customer query and also feel more proactive and confident because of the availability and clarity of information (Shamim *et al.*, 2017).

Customer service quality

FIR systems improve customer service quality by providing a new and attractive form of customer interaction, information systems and service delivery at hospitality firms (Kuo *et al.*, 2017; Li *et al.*, 2017). This can be achieved by the communication and engagement of customers with these advanced automated technologies. For instance, service kiosks and chatbots can communicate in diverse languages, unlike the limited number of languages usually used by staff of hospitality firms. These technologies create value for guests by making the service delivery fun, curious and entertaining (Ivanov and Webster, 2017). Furthermore, hospitality and tourism organizations that adopt these systems also stand to enjoy high perceived image and a positive word of mouth, which any high-tech company boast of in the eyes and minds of their clients.

Supply chain efficiency

The effective implementation of FIR systems provides the capacity to ensure supply chain efficiency in hospitality firms. Currently, the sequence and arrangement of processes to provide services to customers have been greatly influenced by technology (Shamim *et al.*, 2017). As a matter of fact, there has been an increased integration of suppliers' information systems and hospitality and tourism organizations. For instance, the internet of things has allowed the supply chain process to become smarter and more efficient. Hospitality organizations now have their own mobile apps for booking and other services. These firms are also linked with third-party booking websites and other online travel intermediaries offering different options and packages for different hospitality firms (Shamim *et al.*, 2017). This has enhanced the disintermediation effect mentioned earlier, and allowed a collaborative supply chain that makes the supply chain process smoother and more efficient. For instance, most hotel clients of today that are technology-inclined are comfortable with the use of these smart self-service technologies provided by these hotels. Penultimately, FIR systems also ensure improved sustainable operations on the environment (Lee *et al.*, 2018). In effect, automation with advance technologies leads to waste reduction, elimination of unnecessary operations and reduction in the use of resources (Huang *et al.*, 2017; Loureiro, 2018).

Digitization of operations and creation of new jobs

The technological components of the FIR can ensure full-service automation and the creation of new jobs in the hospitality industry (Ivanov *et al.*, 2017). In other words, these systems allow for the re-engineering of the processes of service delivery; which leads to the creation of new activities, controls, service operation manuals and operations. For instance, artificial intelligence has enabled the integration of digital technology in routine service delivery. This is achieved by the use of multiple information systems in hospitality firms, which are used to store and update customer information. Some studies (Ivanov *et al.*, 2018; Schwab, 2016) have projected that some current jobs will be replaced by these systems (e.g.

robots and chatbots). However, many new jobs will also be created by the new business models championed by these systems (Vecchio *et al.*, 2018).

Challenges

Financial costs

Financial costs are the major challenge confronting hospitality firms in adopting the FIR technologies. Their acquisition, installation and maintenance are very expensive and come with a huge financial cost. Ivanov and Webster (2017) identified seven financial costs associated with the adoption of service automation and robots. They include acquisition costs, installation costs, maintenance costs, software update costs, costs for adapting the premises to facilitate robot's mobility, costs for hiring specialists and costs for staff training (Ivanov and Webster, 2017, p. 4). The researchers, however, argued that renting/leasing the robot will partially mitigate these costs because hospitality firms can outsource the robots, instead of purchasing them. Hence the researchers forecasted that it is likely that a new industry of robot leasing companies may develop in the near future (Ivanov and Webster, 2017).

Loss of job positions and resistance by employees

Some scholars (Schwab, 2016; Ivanov *et al.*, 2017; Lee *et al.*, 2018) have elucidated that FIR technologies will render some jobs redundant, causing a lot of workers to be laid off. This is one of the major challenges affecting the adoption of the FIR technologies in all industries, including hospitality. Furthermore, the adoption of these advanced technologies would require reengineering the processes within the hospitality organization, as well as rewriting the service operations and training staff in using the new technology (Schwab, 2016). In other words, there will be changes in the required skills of hospitality and tourism employees (Lee *et al.*, 2018; Li *et al.*, 2017). This may cause resistance by employees in adopting these technologies as they may feel threatened by the change and consider it as a threat to their jobs. Ivanov and Webster (2017, p. 5) postulated that resistance of employees is a powerful social factor that needs to be considered when deciding on technology adoption because employees can refuse to use it appropriately and sabotage the technology. In the long run, this can affect the image of the company and cause it to suffer a negative publicity. This is because, it may be perceived as an organization that puts financial proceeds before humans.

Reluctancy by customers in using these systems

Penultimately, another form of resistance to technology can stem from the customers as well (Ivanov and Webster, 2017). Customers can sabotage the new technology implemented by insisting on preference for human-delivered services rather than the high-tech service delivery process. This can be as a result of their inability, intimidation or fear of using the technology and hence they may refuse to use these services (Ivanov *et al.*, 2018). They may also consider the high-tech service delivery as inferior to the human-delivered services and may be less willing to use and pay for them or even willing to pay less (Huang *et al.*, 2017; Ivanov and Webster, 2017). In the long run, such attitude will lead to the downfall of the new technology implemented. Lastly, there is also a decrease in flexibility of service delivery operations for any hospitality and tourism organization that fully automate their operations with advanced technologies (e.g. artificial intelligence, advanced robotics and additive manufacturing) of the FIR (Xu *et al.*, 2018; Zhong *et al.*, 2017). Table 4 provides a summary of the positives and challenges of the FIR; with their associated references.

No.	Positives		Challenges	
	Concept	References	Concept	References
1	Financial benefits	Ivanov and Webster (2017), Kuo <i>et al.</i> (2017)	Financial costs	Ivanov and Webster (2017), Ivanov <i>et al.</i> (2018)
2	Solution to seasonal employment and labor turnover	Ivanov and Webster (2017), Kuo <i>et al.</i> (2017), Shamim <i>et al.</i> (2017)	Loss of job positions	Ivanov <i>et al.</i> (2017), Lee <i>et al.</i> (2018), Schwab (2016)
3	Operational and employee efficiency	Gretzel <i>et al.</i> (2015), Ivanov and Webster (2017), Shamim <i>et al.</i> (2017), Vecchio <i>et al.</i> (2018)	Resistance by employees	Ivanov and Webster (2017)
4	Customer service quality	Ivanov and Webster (2017), Kuo <i>et al.</i> (2017), Li <i>et al.</i> (2017)	Reluctancy by customers in using these systems	Ivanov and Webster (2017), Ivanov <i>et al.</i> (2018), Huang <i>et al.</i> (2017)
5	Supply chain efficiency and improvement of environmental sustainability of operations	Huang <i>et al.</i> (2017), Lee <i>et al.</i> (2018), Loureiro (2018), Shamim <i>et al.</i> (2017);	Decreased flexibility of the service delivery system	Xu <i>et al.</i> (2018), Zhong <i>et al.</i> (2017)
6	Digitization of operations	Buhalis and Amaranggana (2015), Gretzel <i>et al.</i> (2015), Ivanov <i>et al.</i> (2017), Lee <i>et al.</i> (2017)		
7	Creation of new jobs	Ivanov <i>et al.</i> (2017), Schwab (2016), Vecchio <i>et al.</i> (2018)		

Table 4.
Results of the positives and challenges of the FIR for the hospitality industry

Conclusion

In short, FIR systems allow organizations to plan the company's future initiatives and maximize the potential of their usage. As the FIR keeps developing, the business models for traditional production also keep changing, and new business models keep evolving. Hence, new and existing organizations must be smart enough to identify and react to these new competitive challenges and adapt to new business models to enhance their operational efficiency and productivity. The components of the FIR are expected to enable businesses to organize and control themselves autonomously in real time and in a decentralized environment (Hofmann and Rüsçh, 2017).

Theoretical implications

Currently, discussions are ongoing among scholars in the academic literature, as well as with industry stakeholders, as to the prospects of the systems of the FIR for the hospitality industry. Hence, based on the conceptualization and prospects of FIR for the hospitality and tourism industry as highlighted and expatiated in this review, first, this review clarifies the confusion among researchers with regards to the evolution and development of the FIR. Second, this review bridges the gap in the literature with regards to the inconclusive agreement among researchers in hospitality, with particular reference to the prospects of the

FIR for the hospitality industry. Furthermore, this review serves as a theoretical foundation for future research on the impact of FIR on the hospitality industry.

Practical implications

In practical terms, this review enlightens industry players (e.g. hoteliers, airline operators, casino owners and travel intermediaries) on the opportunities and challenges that technologies in the FIR exert on the industry. Most especially, the potentials of these advanced systems of operations on the employees, services and business environments. For instance, the introduction of chatbots at airports or concierge robots at hotels will lead to highly personalized and prompt customer services. Inwardly, this will enhance customers' experience and higher levels of satisfaction. More importantly, this will have a lasting influence on the implementation and adoption of FIR technological systems by hospitality businesses.

Basically, it is among the goals of FIR's systems to provide smart products, services and environment for clients (both local and international), which will in turn enhance their services and experiences. As a matter of fact, this will go a long way to facilitate effective coherence between businesses, clients and societies, which has been the "talk of the moment" in these times and/or era. In other words, the adoption of these advanced FIR systems by hospitality firms will also facilitate societal sustainability and benefits that are being championed by governments worldwide in this 21st century.

To end with, the prospects that the FIR offers for production of good and services cannot be overlooked, understated or underestimated. [Oztemel and Gursev \(2018\)](#) expressed that the FIR encourages the idea of unmanned factories and promotes global understanding to emerge along this line daily by recommending more firmly connected companies worldwide, through supply chains and sensor networks. This industrial revolution holds promises for flexibility in manufacturing, along with mass customization, better quality and improved productivity. Thus, it will enable organizations to cope with the challenges of producing increasingly individualized products with higher quality and a short lead-time to market ([Zhong et al., 2017](#)). [Table 5](#) summarizes the theoretical and practical implications of the study.

No.	Theoretical implications	Practical implications
1.	Theorization of a unified definition of the concept of the FIR	Enlightenment of industry players about the benefits and challenges of the FIR for the hospitality industry
2.	Proposed conceptualisation of the FIR for the hospitality industry (Hospitality Revolution 4.0)	Provision of smart processes, services and environment for both workers and clients of hospitality and tourism establishments
3.	Clarification of inconsistencies among researchers with regards to the evolution and development of the FIR	FIR effectiveness for the planning of organizations' future initiatives and productivity in the hospitality industry
4.	Comprehensive categorization of the prospects of the FIR for the hospitality industry	Ensuring effective coherence between businesses, clients and societies
5.	Benefit–cost analysis (positives and challenges) of the FIR revolution for the hospitality industry	Facilitating societal and environmental sustainability benefits through the innovative systems of the FIR
6.	Theoretical foundation for future research on the impact of FIR on the hospitality industry	A practical guide for stakeholders in addressing the benefits and challenges of the FIR for the hospitality industry

Table 5. Summary of the theoretical and practical implications

Limitations and future research

As earlier noted, this review serves as a theoretical foundation for further studies in the academic literature. Future studies can empirically evaluate the FIR systems that are in actual usage at hospitality firms. Furthermore, studies can also examine the benefit–cost analysis of the adoption of the FIR systems for hospitality and tourism operations. Also, other studies can also focus on the extent to which the systems of the FIR apply to the hospitality and tourism industry. Again, the impact of these advanced systems of operations on organizational performance and guest satisfaction can also be investigated. Additionally, an empirical study could be done to understand the challenges associated with the implementation of the technologies of the FIR (e.g. robotics), as well as measures that were used to address these challenges. Penultimately, future studies could explore the factors that affect the adoption of such advanced systems in the hospitality industry. Lastly, measures that would enhance the adoption of these systems could also be an objective for future research, as scholars claim that we are still at the dawn of the FIR.

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