THE INDUSTRIAL 4.0 REVOLUTION: CAN IT POSITIVELY STEP INTO SUSTAINABLE HOSPITALITY?

Nirmeen Elmohandes[1,2], Katalin Csobán[1]

[1]Department of Tourism and Hospitality Management Institute of Rural Development, Regional Economics and Tourism Management Faculty of Economics and Business, University of Debrecen, Hungary
[2]Hotel Management Department, Faculty of Tourism and Hotel Management, Helwan University, Egypt

Elmohandes.Nirmeen@econ.unideb.hu

Abstract: *Technological advancements recently affected production, social and sustainable development. Few publications have addressed the industry 4.0 contribution to the sustainable hospitality industry. In this study, we review the ways and effectiveness of industry 4.0 in achieving sustainable development goals in the hospitality sector. Due to the modernity of the issue, resources used in this paper included articles from databases like SCOPUS, Sage, Elsevier, and Google scholar using keywords such as big data analytics, simulation, Artificial intelligence, Industry 4.0 in hospitality, sustainable hotels, industry 4.0 adaption in hospitality and smart hospitality system. This literature paper outline has five main sections—section one introduces industry 4.0. Section two is a literature review that includes industry 4.0 connotation, Industry 4.0 elements, features and drawbacks. Regarding material and methods, this literature review was conducted using articles from online databases from 2016 to 2021. The primary output of this paper is Table.1, which summarizes the most critical components of advanced technology that can aid in achieving sustainable development goals in the industry, followed by the conclusion.*

Keywords: *Industrial revolution 4.0, Industry 4.0 impacts, Industry 4.0 pros and cons, Hospitality sustainability.*
(JEL classification code: L83)

ACKNOWLEDGEMENTS

A scholarship fully funded the researcher (Nirmeen Elmohandes) under the joint executive program between the Egyptian Missions Sector, Ministry of higher education, Egypt and Hungaricum Stipendium, Hungary.

INTRODUCTION

The term 4.0 industry has become a necessary topic recently. The fourth industrial revolution is changing the way we live and work. The business and industrial landscape have changed drastically, resulting from advanced technology developments and innovations. (Pereira & Romero, 2017; Tsvetkova, 2020; Zengin et al. 2021). Industry 4.0 has different terms as it is still in the early phase. As an illustration, in a medical speciality, it is defined as a way of human life transformation, whereas, in economics and businesses, it is considered a way of enhancing economic and business growth. The umbrella of the fourth industrial revolution concludes the recent technological advancements as follows; Cyber-Physical Systems (CPS), Internet of Things (IoT), Internet of Services (IoS), Robotics, Big Data analytics (BDA), Cloud Manufacturing, and Augmented Reality (Pereira & Romero, 2017; Verevka, 2019; Zengin et al. 2021).

Fundamentally, the 4.0 industry has a significant impact on nature and humankind. Consequently, sustainable development in the industrial revolution epoch has become a topic for debate. Sustainable development (SD) can be defined as a recent idea of serving people's needs without harming the planet's current condition (Tsvetkova, 2020).

Shamim et al. (2017) ensured that a considerable amount of literature had been published on addressing the 4.0 industry related to customer reaction, work environment enhancement and cost reduction. Research in sustainability and digitalization in the hospitality sector is in its infancy, and the contribution of the industrial 4.0 revolution to sustainable hospitality is controversial and needs further exploration (Ghobakhloo, 2020). Surprisingly, sustainable development in the hospitality industry is seldomly studied, and it is unclear to what extent the 4.0 industry revolution can be harnessed to achieve sustainability goals in this sector.

Consequently, this paper evaluates the ways and effectiveness of industry 4.0 in achieving sustainable development goals in the hospitality sector.

LITERATURE REVIEW

Industry 4.0 connotation

Recently, there has been renewed interest in sustainable development in the hospitality industry. Industry 4.0 can play an essential role in addressing the issue of the sustainable hospitality industry. The fourth industrial revolution can be defined as the digital transformation in businesses and processes (Müller, 2019). Cyber-physical systems (CPS) and smart production are the main features of industry 4.0 implementation (Shamim et al. 2017). In the same vein, Koo et al. (2021) mentioned that industry 4.0 is an area of computer science that replaces humans in performing tasks to enhance business efficiency.

Industry 4.0 elements

The first industry 4.0 element is Artificial intelligence (AI), described as intelligent machines acting and working as employees. Turning into Augmented reality (AR), a displayed environment based on reality encloses computer effects' features to foster the real-world experience. It works as a bridge between gathered data and virtual reality to analyze, aim to redesign and repair products or services. Another feature is that it improves problem-solving skills, expands options for upgrading products and services, and helps customers get their desired products by displaying each product and service specifications. Robotics is an element that performs repetitive tasks in manufacturing and business. Big data and analytics are also practical 4.0 elements harnessed to analyze massive data incapacitated from traditional approaches. It is characterized as a transformation point of understanding, producing, selling, level of innovation, predictions Etc. Cloud refers to cloud computing providers and any services provided by them. An essential feature of the cloud is integrating services, cutting IT expenses, and fast-lane business (Moktadir et al. 2018; Bai et al. 2020; Szabó-Szentgróti et al. 2021; Zengin et al. 2021).

Internet of Things (IoT) is a set of hardware that work together within IoT to enhance the operations and processes at the workplace. It can be applied in various specialities, manufacturing, agriculture, mining, transportation, healthcare, service industry Etc. Sensors and actuators: A device with a sensor receive a physical stimulus to control things like heat, light, and sound systems. Mobile Technology is the integration of technology-based devices working wirelessly. Global Positioning System (GPS) group of satellites allows GPS to identify users' location, speed, and time. Cybersecurity provides a high level of information protection from hacking which affects brands, designs, creation, and product manufacturing. Simulation is a technology that simulates the real world and system targeting new product support. Prototyping and automation increase efficiency and improve production quality (Moktadir et al. 2018).

Advantages and disadvantages of Industry 4.0

Pereira and Romero (2017) and Moktadir et al. (2018) mentioned that the fourth industrial revolution has tremendous improvements in production, service processes, manufacturing systems and quality, offering new business models, new operating ways, strengthening stakeholder relationships, market and marketing influences and increasing competition. Bai et al. (2020) identified several features of industry 4.0. A profitable business model is one crucial merit followed by efficiency, quality, and work conditions enhancement.

In contrast, the common disadvantages are the shortage of understanding, costs, work environment system changes and adaption. Although the technological advancements pros mentioned above, there are cons; a big concern arises when humans do not work to earn money, leading to unemployment, poverty, and air pollution, which is against the sustainability goals. Moktadir et al. (2018) and Szabó-Szentgróti et al. (2021) ensured that industry 4.0 carries out cons such as insecurity of data, technology infrastructure is costly, unstable companies' connectivity, unemployment, environmental impacts, managers' strategies towards new changes, and lack of management and employees' skills.

The importance of sustainability development in various specialities has arisen from this point. Therefore, this paper reviews harnessing industry 4.0 to achieve sustainable development in the hospitality sector because it is one of the service sectors affecting the core dimensions of sustainability (Coupe, 2019).

MATERIALS AND METHODS

To understand how industry 4.0 shares in sustainable hospitality positively, a comprehensive literature review has been done based on databases and journal articles, which are secondary data sources. Moreover, this review research was conducted considering the following online databases: Elsevier (Science Direct), Scopus, Emerald Insight and Springer, over the 2016-2021 timeframe. This paper's objective consisted of (1) identifying the main articles in this regard to review different perspectives on this issue to reflect whether industry 4.0 can step in the Sustainable hospitality industry positively or not, (2) the analysis of each industry 4.0 element role to achieve sustainable hospitality goals.

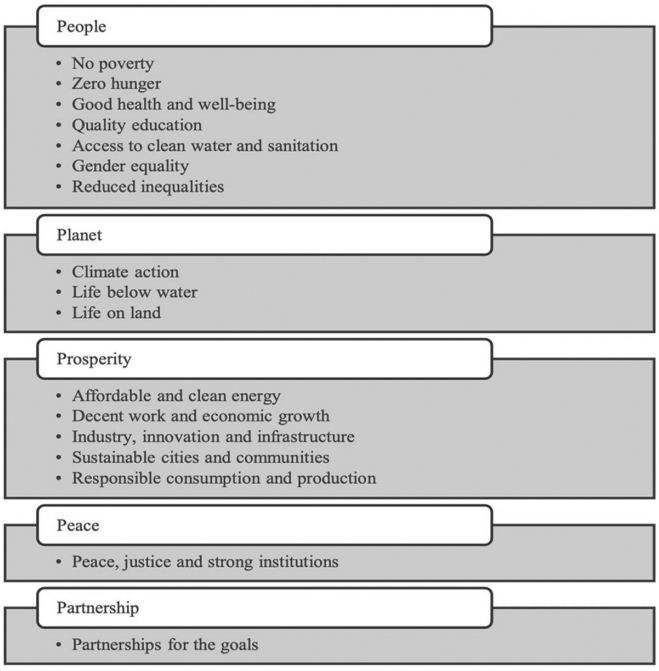
RESULTS AND DISCUSSION

Sustainable development overview and goals

Tsvetkova (2017) reflected that sustainable development (SD) preserves the planet's condition while living, working, and developing. United Nations stated that the best definition for sustainability is to enhance well-being for all, the next generations no exception, which means solving global issues such as injustice, inequality, peace, climate change, pollution, and environmental distortion and degradation; these issues were divided into three pillars environmental, economic, and social sustainability including 17 goals (Stock et al. 2018; Ghobakhloo, 2020). This study defines sustainable development as doing life activities without harming current planet conditions.

There are several ways to identify SD goals, but the UNs' General Resolution and Agenda is internationally approved. The UN tabled the main 17 goals to ensure sustainability, including the broad goals of ending poverty, protecting the planet, and guaranteeing prosperity (Figure 1).

Figure 1: The UNs' 17 goals



Source: Tsvetkova (2017).

Challenges of achieving sustainable development goals

Tsvetkova (2017) reflected that sustainable development (SD) preserves the planet's condition while living, working, and developing. United Nations stated that the best definition for sustainability is to enhance well-being for all, the next generations no exception, which means solving global issues such as injustice, inequality, peace, climate change, pollution, and environmental distortion and degradation; these issues were divided into three pillar

Industry 4.0 as possible solutions for sustainability challenges generally

Industry 4.0 has the interconnectivity feature; that is why most of its elements would be considered a possible solution for sustainable development challenges (Berawi, 2019). Looking at robotics can create options and ease decision-making by providing virtual reality. A much clearer picture of goals is provided by Augmented reality. It also helps governments plan and performs with a few shared human resources. Big data analytics can perform unlimited opportunities for gathering and analyzing data. It can specifically solve the need for more access to information and unified standards.

Furthermore, it can integrate with virtual prototyping to prioritize the SD goals based on the current situation. System integration expands governments' capacities, combines data with complementary, and leads to criteria unification. Cloud technologies provide a vast range of unification, awareness, raising, spreading, processing information, cost-saving, and improving capacity (Pereira & Romero, 2017).

Industry 4.0 for a sustainable hospitality industry

The hospitality industry changes in the environment are significant through food consumption, Co2 emissions, waste, water and electricity usage, construction activity and land use; that is why addressing sustainability plans in the hospitality industry has become a crucial issue (Nadkarni et al. 2020).

On the other hand, the hospitality industry is one of the service industries affected by AI, robotics, big data, CPS, the IoT, AR, and VR, which are aspects of the industry 4.0 revolution. The industrial 4.0 revolution is a step into hospitality sustainability as it is environmentally friendly, and it contributes to achieving sustainable development goals such as energy and water efficiency, food waste reduction and reducing air pollution (Bartodziej, 2017; Tsvetkova, 2017; Buhalis and Leung, 2018; Buhalis et al. 2019; Nadkarni et al. 2020; Nayyar & Kumar, 2020). The way each industry 4.0 element contributes to hospitality sustainability is summarised in the following table.

Table 1. The ways Industry 4.0 can step into the sustainable hospitality industry

Author	Industry 4.0 element	How it Contributes to sustainable hospitality?	Sustainable development pillar
Bartodziej (2017) and Nayyar and Kumar (2020).	Cyber-physical systems (CPS)	It provides the feature of analytics, computational capability, and data management smartly. Additionally, access to real-time data is based on the interconnection between the physical and cyber worlds.	Environmental pillar.
Buhalis, and Leung (2018) and Nadkarni et al. (2020).	Internet of things (IoT)	Enables connection with guests, gathers data, establishes profiles for each guest with their preferences, and evaluates their behaviour and performance. It can share a 10% reduction in food consumption, Co2 emissions, waste, water and electricity usage. IoT helps with sensors in in-room consumption by light and climate control. Devices are supplied with the feature of decision-making for energy saving. For instance, when guests leave the room thermostat can be active in energy-saving mode.	Environmental and social pillars.
Tsvetkova (2017) and Buhalis, and Leung (2018).	Augmented Reality (AR)	It enhances personalized service experiences with additional features. Guests could share their experiences, opinion and information within a network.	Social and economic pillars.
Nayyar and Kumar (2020).	Virtual Reality (VR)	People can travel via virtual reality, which encourages cost reduction and contribute to Sustainable development (SD). It provides new patterns for tourists to travel to a destination instead of mass tourism which causes environmental pollution. People can visit museums, castles and tourist places and destinations before travelling physically in virtual reality. This would help in mass tourism reduction. The main issue is tourists' perception and satisfaction with using it as a substitute for actual travel and presence. These two factors mean that mass tourism will not be resolved unless consumers accept and know the value of sharing in this process.	Environmental and social pillars.

Moktadir et al. (2018).	Big data analytics (BDA)	It saves internal and external big data and classifies data based on properties. Data can be used to improve the strategic planning and managing operations in proportion to the ecosystem, which serves sustainable development goals at the core of environmental respect and commercial success. Previously, limited storage capacity has led tourism companies to delete old data. This cannot happen today, thanks to Big data analytics. Big data analytics allows data transformation and gathering. The importance of data comes from the benefits of these data in identifying customer patterns, targeting customers, experience creation, and offering customized service. Big data analytics allow the hospitality sector to build a relationship with customers and update them with the changes in hotels, restaurants and touristic destinations regarding new applied patterns which serve sustainable development goals and how to help in that by indicating the necessity of customers' share.	Environmental and economic pillars.
Buhalis and Leung (2018).	Artificial Intelligence (AI) and robots	It provides outstanding personalized service. As a good example, information canters at airports and hotels.	Social and economic pillars
Nayyar and Kumar (2020).	Sensors and actuators	Sensors and actuators are used in lighting, temperature adjustment, showers, sinks, laundries Etc, targeting energy and water savings and reducing bills. Smart meters in hotels and restaurants kitchens would help save food waste.	Economic and environmental pillars.
Buhalis et al. (2019).	Smartphones	It contributes with a feature of identifying customers' dishes preferences, purposing provide the right portion size and reducing waste.	Economic and Environmental pillars

Source: authors' editing

CONCLUSION

Advanced technology influences every single day we live—the awareness of the industry 4.0 revolution increases in all industries, including the hospitality industry. Many questions related to industry 4.0 in the hospitality sector have been raised, especially concerning how to harness it in serving business needs and make its adaptation effective in serving employees, consumers, and the environment. This paper aims to discuss how industry 4.0 can step into sustainability in the hospitality sector to bridge the gap in the literature review. It sheds light on reviewing the main advanced technology elements that can share with sustainable development cores in this sector (Table 1). This paper gathered the advanced technology elements useful for sustainable hospitality development from several studies to enlighten the hospitality industry players about one of the bright aspects of applying modern technology. Additionally, it guides hospitality players on how modern technology addresses sustainability challenges and helps them pick up the right technology elements to serve SD goals. Future studies can focus on an in-depth investigation of each advanced technology element's role in hospitality sustainability.

ACKNOWLEDGEMENTS

A scholarship fully funded the researcher (Nirmeen Elmohandes) under the joint executive program between the Egyptian Missions Sector, Ministry of higher education, Egypt and Hungaricum Stipendium, Hungary.

REFERENCES

Bai, C., Dallasega, P., Orzes, G., & Sarkis, J. (2020). Industry 4.0 technologies assessment: A sustainability perspective. International Journal of Production Economics, 229, 107776.

Bartodziej, C. J. (2017). Technologies and functions of the concept Industry 4.0. In The Concept Industry 4.0. Springer Gabler, Wiesbaden, 51-78.

Berawi, M. A. (2019). The role of industry 4.0 in achieving Sustainable Development Goals. International Journal of Technology, 10(4), 644-647.

Buhalis, D., & Leung, R. (2018). Smart hospitality—Interconnectivity and interoperability towards an ecosystem. International Journal of Hospitality Management, 71, 41-50.

Buhalis, D., Harwood, T., Bogicevic, V., Viglia, G., Beldona, S., & Hofacker, C. (2019). Technological disruptions in services: lessons from tourism and hospitality. Journal of Service Management.

Coupe, T. (2019). Automation, job characteristics and job insecurity. International Journal of Manpower, 40(7), 1288-1304.

Ghobakhloo, M. (2020). Industry 4.0, digitization, and opportunities for sustainability. Journal of Cleaner Production, 252, 119869.

Koo, B., Curtis, C., & Ryan, B. (2021). Examining the impact of artificial intelligence on hotel employees through job insecurity perspectives. International Journal of Hospitality Management, 95, 102763.

Moktadir, M. A., Ali, S. M., Kusi-Sarpong, S., & Shaikh, M. A. A. (2018). Assessing challenges for implementing Industry 4.0: Implications for process safety and environmental protection. Process Safety and Environmental Protection, 117, 730-741.

Müller, J. M. (2019). Assessing the barriers to Industry 4.0 implementation from a workers' perspective. IFAC-PapersOnLine, 52(13), 2189-2194.

Nadkarni, S., Kriechbaumer, F., Rothenberger, M., & Christodoulidou, N. (2019). The path to the Hotel of Things: Internet of Things and Big Data converging in hospitality. Journal of Hospitality and Tourism Technology.

Nayyar, A., & Kumar, A. (Eds.). (2020). A roadmap to industry 4.0: smart production, sharp business and sustainable development. Berlin: Springer, 1-21.

Pereira, A. C., & Romero, F. (2017). A review of the meanings and the implications of the Industry 4.0 concept. Procedia Manufacturing, 13, 1206-1214.

Shamim, S., Cang, S., Yu, H., & Li, Y. (2017). Examining the feasibilities of Industry 4.0 for the hospitality sector with the lens of management practice. Energies, 10(4), 499.

Stock, T., Obenaus, M., Kunz, S., & Kohl, H. (2018). Industry 4.0 as enabler for a sustainable development: A qualitative assessment of its ecological and social potential. Process Safety and Environmental Protection, 118, 254-267.

Szabó-Szentgróti, G., Végvári, B., & Varga, J. (2021). Impact of Industry 4.0 and digitization on labor market for 2030-verification of Keynes' prediction. Sustainability, 13(14), 7703.

Tsvetkova, A. (2020). Social responsibility practice of the evolving nature in the sustainable development of Arctic maritime operations. In Arctic Marine Sustainability. Springer, Cham,119-143.

Tsvetkova, R. (2017). What does Industry 4.0 mean for sustainable development?. Industry 4.0, 2(6), 294-297.

Verevka, T. V. (2019). Development of industry 4.0 in the hotel and restaurant business. IBIMA Business Review, 324071.

Zengin, Y., Naktiyok, S., Kaygın, E., Kavak, O., & Topçuoğlu, E. (2021). An investigation upon industry 4.0 and society 5.0 within the context of sustainable development goals. Sustainability, 13(5), 2682.