EasyChair Preprint

№ 15841

Examining the Application of Circular Economy Driven by Digital Technologies in Developing Sustainable Hotel Industry Performance

Seyed Mohammad Tabataba'i-Nasab, Fatemeh Taheri-Azad and Amir Reza Konjkav Monfared

February 16, 2025

Examining the Application of Circular Economy Driven by Digital Technologies in developing Sustainable hotel industry performance

Seyed Mohammad Tabataba'i-Nasab[1], Fatemeh Taheri Azad[2]*, AmirReza Konjkav Monfared[3]

Abstract

Hotels, as one of the less sustainable subsectors within the tourism and hospitality industry, have significant negative impacts on environmental sustainability due to their year-round operations. These impacts primarily stem from high levels of energy and water consumption, as well as the substantial waste they generate. One of the global calls to address these impacts and promote sustainability is the United Nations 2030 Sustainable Development Agenda, adopted in 2015. This agenda outlines 17 Sustainable Development Goals (SDGs). In 2020, the International Tourism Partnership identified four primary goals to contribute to the Sustainable Development Goals: youth employment, water-use efficiency, carbon emission reduction, and respect for human rights. Additionally, in 2022, the World Travel and Tourism Council published the Hospitality Sustainability Framework, which emphasizes that hotel sustainability should be assessed based on the theory of sustainable development across three dimensions: economic, social, and environmental. It calls for key actions in areas such as management and efficiency, environmental protection, and social aspects. On the other hand, in 2015, the European Commission stated in a report that the circular economy plays a crucial role in achieving sustainable development goals. To achieve a circular economy, there are ten business strategies that are presented within a framework known as the 9R. Most of the existing literature on the circular economy and the 9R framework focuses on the strategic development of manufacturing and construction, while service-related industries have been largely overlooked. Therefore, the application of the 9R framework in enhancing the sustainable performance of the hospitality industry appears to be essential. However, it is important to note that the foundations of sustainability in hospitality have unique characteristics that need to be understood before implementing the 9R framework in this context. On the other hand, implementing a circular economy in any industry requires the exploration and adoption of new digital technologies. As a result, it can be said that the exploration and adoption of new digital technologies is also essential for implementing a circular economy in enhancing the sustainable performance of the hospitality industry. In this context, the present article aims to address some of the gaps in the literature regarding sustainable performance development in the hospitality industry. It begins by defining the hospitality industry, sustainable development, and the activities related to this development within the sector. Subsequently, it discusses the necessity of implementing a circular economy alongside the exploration and adoption of digital technologies in this area.

Keywords: Sustainable Development, Circular Economy, 9R Strategies, Digital Technologies, Hospitality Industry.

Introduction

[1] Professor of Business Administration, Faculty of Economics, Management, and Accounting, Yazd University, Yazd, Iran, tabatabaeenasab@yazd.ac.ir

[2] Ph.D. Candidate in Business Administration – Marketing, Yazd University, Yazd, Iran, 40101835@stu.yazd.ac.ir

[3] Associate Professor of Business Administration, Faculty of Economics, Management, and Accounting, Yazd University, Yazd, Iran, monfared@yazd.ac.ir

In 2019, the share of the tourism and hospitality industry in total employment was 10.5%, and its contribution to global GDP was 10.4% [1]. Due to the Covid-19 pandemic, this industry faced a severe recession, resulting in the loss of many jobs and a significant economic decline [2]. According to the latest report from the World Travel and Tourism Council (WTTC) in 2023, this industry contributed 1.9% to the global GDP, which is only 1.4% lower than the level in 2019. Additionally, according to statistics published in 2023, this industry has created nearly 330 million jobs worldwide. In this regard, the President and CEO of WTTC stated, 'Despite the uncertainty, the tourism and hospitality industry remains a global economic powerhouse.' The WTTC predicts that by 2024, this industry will account for 11.4% of the total economic outlook and will create employment for 449 million people [1].

Despite providing economic and social benefits, the tourism and hospitality industry also has negative impacts, such as excessive use of resources like water and energy, as well as the widespread generation of solid and liquid waste [3]. Additionally, recent research from the WTTC indicates that this industry is currently responsible for 1.8% of global greenhouse gas emissions, which contributes to changes in climate conditions [2]. In general, according to reports from United Nations research projects on the environment, by 2050, energy consumption will increase by 152%, solid waste disposal by 251%, and greenhouse gas emissions by 131%. Therefore, it can be said that addressing these consequences and challenges is essential for companies, stakeholders, governments, and ultimately for communities, as economic and environmental resilience is more important than ever [3]. One of the global calls to address these consequences and challenges and promote sustainability is the United Nations Sustainable Development Goals 2030, which was adopted in 2015. This program outlines 17 Sustainable Development Goals, which include 169 specific targets that cover all aspects of sustainability (economic, social, and environmental). The aim of this program is to end poverty, promote well-being and welfare for all, and protect the planet. These goals are also recognized as a framework for promoting and developing sustainable tourism [4].

One of the tools used by various countries, social actors, and institutions to achieve sustainable development goals is the circular economy. In fact, in 2015, the European Commission prepared a report titled 'Closing the Loop: An EU Action Plan for the Circular Economy' in line with the 2030 Sustainable Development Agenda. The aim of this report is to move towards an economy in which products, materials, and resources remain in the cycle for a longer period and waste production is minimized. The report also states that the circular economy will play a crucial role in achieving sustainable development goals by 2030 [5]. Therefore, this economy strengthens sustainable development and preserves it for current and future generations [6].

The concept of the circular economy has gained attention as an alternative economic model to the linear economy to address resource shortages, climate change, and environmental degradation [2]. In the linear economy model, resources are extracted from the earth (extraction), transformed into components (production), and discarded after use (waste) [7]. This economic model encourages the overconsumption of material resources, creates unsustainable waste management practices, and leads to serious problems in health, biodiversity, and climate [8]. Therefore, it can be said that the need for a new economic model to address the signs of environmental degradation is essential. In response, businesses have begun to explore ways to reduce their environmental impacts by reusing goods or their components to further recover valuable materials, energy, and

labor inputs. One emerging approach to this challenge is the circular economy. This economy can be defined as a regenerative system in which the input and waste of resources, emissions, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops. Unlike the linear economy model, the goal of the circular economy is to optimize natural resources, reduce greenhouse gas emissions, and create competitive opportunities [2].

To achieve a circular economy, there are ten business strategies that have been presented within a framework called 9R [9]. These ten strategies are classified into three categories: smarter product use and production, strategies for extending the lifespan of products and their components, and the beneficial application of materials [10].

By reviewing the literature on the circular economy and the 9R framework, it can be said that this concept and framework have mainly been emphasized in the context of strategic development in manufacturing and construction [9; 11]. However, service industries can also benefit from adopting circular economy processes. One of these industries, which has recently drawn significant attention to this topic, is the tourism and hospitality industry [9].

Implementing a circular economy in any industry requires discovering and applying new digital technologies, redefining business models, integrating supply chains, and fostering interactive partnerships among stakeholders and local participants [11]. Consequently, it can be said that many actions are necessary to implement a circular economy, with one of the most important being the discovery and application of new digital technologies [6]. Digitalization enables enhanced control, optimization, and collaboration, supporting more informed decision-making on production and consumption and revealing a wide range of opportunities in the circular economy. As stated in the Digital Europe report in 2023, the use of digital technologies could help reduce global carbon emissions by 20% by 2030 [8].

One of the subsectors of the tourism and hospitality industry often considered unsustainable is hotels. Due to high tourism demand, hotels operate continuously throughout the year, leading to higher energy and water consumption and significant waste generation [12]. For instance, Yousef et al. (2020) demonstrated that hotels produce one kilogram of waste per guest per day, emit 20.6 kilograms of CO_2 per night per hotel, and consume 218 gallons of water per room per day [13]. Additionally, Migdadi (2022) states that hotel buildings and operations consume substantial amounts of energy, emitting between 160 to 200 kilograms of CO_2 per square meter of floor space, indicating high energy consumption in this industry. In 2012, the European Commission reported that hotels produce around 21% of the total greenhouse gas emissions associated with tourism, a major portion of which results from high energy consumption. Approximately 40% of these emissions from hotel electricity use come from various sources, including lighting, heating, cooling, ventilation systems, water heating, and electricity used in food services [14].

As the evidence suggests, focusing on sustainability in hotels seems essential. Furthermore, investing in sustainable practices enhances competitiveness and efficiency in hotels. On the other hand, prioritizing sustainability in hotels increases booking intentions among tourists [15]. Similarly, a 2022 survey on Booking.com with over 30,000 respondents shows widespread support for sustainable travel (81%), with 78% of participants preferring eco-friendly accommodations. Not only is tourist demand for such hotels increasing, but hotel owners worldwide are also developing sustainability programs, and governments are introducing policies to encourage sustainable hospitality practices [15]. This topic is also receiving special global attention. In 2023,

the WTTC, in collaboration with a group of 11 hotel companies and supported by the Global Sustainable Hospitality Alliance, developed 12 essential actions to create sustainable hotels. These 12 criteria are grouped into three areas: 'management and efficiency, the planet, and people.

One way to strengthen sustainable development is through the circular economy [6], which has recently been the focus of much research aimed at enhancing hotel sustainability. For example, Lagioia et al. (2024) examined hotel managers' awareness in Apulia (southern Italy) of circular economy practices, particularly regarding their attitudes and understanding of food waste [16]. Scholz et al. (2023) investigated issues such as waste separation, the use of energy-saving and LED lights, various resource management methods, reducing environmental impacts, and managers' attention to environmental concerns and circular economy practices in guesthouses in the Czech Republic [17]. Garrido et al. (2023) provided indicators for assessing the circular economy in hotels by analyzing data from hotels in Portugal and Spain [18]. Finocchiaro (2022) demonstrated in his article how the circular economy can help retain human capital in the hospitality industry, reducing turnover and increasing workforce sustainability [19]. Rudan et al. (2021) proposed a framework for testing the applicability of the circular economy concept in the hospitality industry [20].

On the other hand, Ali et al. (2024) and Puntillo (2023) state that digital technologies can play a crucial role in transitioning to a circular economy and reducing dependency on natural resources [6; 12]. Chauhan et al. (2022) argue that emerging digital technologies, such as artificial intelligence, big data, the Internet of Things, blockchain, additive manufacturing, and digital twins, hold significant potential for advancing the circular economy [22]. For example, Liu et al. (2022) identified thirteen key functions of digital technologies that are most closely related to circular economy strategies (9R) [23]. In another study, Roberts et al. (2024) explore the use of artificial intelligence to facilitate the transition to a circular economy, noting that AI is a key enabler for the circular economy [24]. In the tourism sector, Del Vecchio et al. (2022) examine how circular economy practices and smart tourism can foster innovation in business models and create sustainable value [25]. Nassanbekova et al. (2023) also suggest that digital technologies facilitate the shift towards a circular economy in the service sector, including tourism [26].

Based on the review of existing literature, it can be said that the circular economy and digital technologies hold promising potential for developing Sustainable hotel industry performance. As observed, the existing literature suggests that digital technologies act as drivers for the transition to a circular economy, yet evidence of this transition in the hotel industry is lacking. Therefore, a novel aspect of this research is to explore the application of digital technologies in the hotel industry to develop Sustainable performance. This review addresses the research call of Chauhan et al. (2022), who emphasize the importance of examining and adopting new technologies across industries [22]. Additionally, a knowledge gap exists in integrating digital technologies with circular economy strategies (9R) in the hotel industry to develop sustainable performance, and this research aims to address this gap. In line with these considerations, the goal of this study is to examine the concepts of sustainable development, the circular economy, and digital technologies to developing Sustainable hotel industry performance. Subsequently, to achieve this goal, the study will review the concepts of the hotel industry, sustainable development, and related activities, as well as circular economy and digital technologies, with supporting research evidence.

Literature Review

Hotel industry

The hotel industry refers to a collection of institutions and companies that provide accommodation services and other tourism-related services to customers. This industry is organized in various forms and structures, with its main goal being to meet the desires and needs of customers while also seeking to achieve its economic objectives. The hotel industry plays a vital role in economic growth and development and is closely connected with other activities such as transportation, travel agencies, and commerce [27].

The hotel industry is divided into the following categories based on various characteristics:

1. **Accommodation Services**: Includes rooms and apartments in hotels provided for guest stays.
2. **Food and Beverage Services**: Depending on the type and classification of the hotel, these services are offered in dining halls, lounges, breakfast rooms, cocktail bars, and through room service.
3. **Sports and Recreational Services**: Includes facilities such as swimming pools, golf courses, tennis courts, gyms, running tracks, and hosting various events.
4. **Cultural and Entertainment Services**: Encompasses the organization of concerts, exhibitions, and conferences.
5. **Shopping and Commerce Services**: Involves the sale of souvenirs and personal items to guests.
6. **Personal and Business Services**: Includes services like hair salons, beauty salons, and photography.
7. **Health and Medical Services**: Provides rehabilitation, treatment, and diagnostic services.

In addition, the hotel industry is complemented by other services and institutions such as travel agencies, tourism organizations, marketing companies, transportation services, conference centers, and catering services. Thus, the hotel industry is significantly influenced by a wide range of services and companies, all of which contribute to the ongoing success and growth of this industry [27].

Sustainable development

In 1987, the World Commission on Environment and Development defined sustainable development as 'a form of development that meets the needs of the present without compromising the ability of future generations to meet their own needs.' Sustainable development integrates three main dimensions: economic, social, and environmental development, emphasizing a balance among these factors. This concept goes beyond mere environmental conservation and climate change mitigation. In fact, environmental considerations are just one aspect of sustainable development, which also broadly focuses on the enhancement of society and culture. The ultimate goal is to ensure a future where thriving communities, individuals from diverse cultural backgrounds, and high levels of individual well-being are secured [28].

To achieve the sustainable development scenario outlined in the definition, organizations must share common goals. This necessity led to the establishment of the Sustainable Development Goals (SDGs) by the United Nations. These goals were developed in 2015 as part of the 2030 Agenda for Sustainable Development. In total, there are 17 goals, all of which are related to environmental

sustainability, socio-cultural conditions, or economic well-being. The 17 UN Sustainable Development Goals are as follows:

1. **No Poverty**: End poverty in all its forms everywhere.
2. **Zero Hunger**: End hunger, achieve food security, improve nutrition, and promote sustainable agriculture.
3. **Good Health and Well-being**: Ensure healthy lives and promote well-being for all at all ages.
4. **Quality Education**: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5. **Gender Equality**: Achieve gender equality and empower all women and girls.
6. **Clean Water and Sanitation**: Ensure availability and sustainable management of water and sanitation for all.
7. **Affordable and Clean Energy**: Ensure access to affordable, reliable, sustainable, and modern energy for all.
8. **Decent Work and Economic Growth**: Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all.
9. **Industry, Innovation, and Infrastructure**: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.
10. **Reduced Inequalities**: Reduce inequality within and among countries.
11. **Sustainable Cities and Communities**: Make cities and human settlements inclusive, safe, resilient, and sustainable.
12. **Responsible Consumption and Production**: Ensure sustainable consumption and production patterns.
13. **Climate Action**: Take urgent action to combat climate change and its impacts.
14. **Life below Water**: Conserve and sustainably use the oceans, seas, and marine resources for sustainable development.
15. **Life on Land**: Protect, restore, and promote sustainable use of terrestrial ecosystems, manage forests sustainably, combat desertification, halt and reverse land degradation, and halt biodiversity loss.
16. **Peace, Justice, and Strong Institutions**: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable, and inclusive institutions at all levels.
17. **Partnerships for the Goals**: Strengthen the means of implementation and revitalize the global partnership for sustainable development. [29]

Sustainable development in hotel industry

Tourism companies, including hotels, can contribute to achieving all Sustainable Development Goals (SDGs). In the hotel sector, resources are continuously used for operations such as heating and cooling, lighting, and water heating [30]. These activities result in significant carbon emissions, which directly impact climate change. To align with the SDGs, hotel companies need to reduce their greenhouse gas emissions per room per year by 66% by 2030 relative to 2010 levels and achieve a 90% reduction by 2050 [31].

The hotel industry, with its extensive use of resources, requires sustainable practices to meet the Sustainable Development Goals (SDGs). Given the broad scope of its activities, the hotel sector holds a significant potential to contribute to the UN's SDGs. By implementing sustainable and

responsible practices across all aspects of hotel operations, the industry can help reduce environmental, economic, and social impacts, contributing to global sustainable development. The The International Tourism Association (ITP) has identified four main goals for the industry's SDG contribution: youth employment, water efficiency, carbon emissions reduction, and respect for human rights. Below are some of the key connections between the hospitality industry and the SDGs:

1. Goal 8: Decent Work and Economic Growth
   - Job Creation and Economic Development: The hospitality industry has the potential to generate numerous job opportunities and contribute to local economic development. This, in turn, can help alleviate poverty and improve living standards within host communities.
2. Goal 12: Responsible Consumption and Production
   - Resource Management and Waste Reduction: Hotels can play a pivotal role in promoting responsible consumption by optimizing energy and water usage, reducing food waste, and utilizing sustainable resources.
3. Goal 13: Climate Action
   - Reducing Environmental Impact: Hotels can contribute to climate action by lowering energy consumption, utilizing renewable energy sources, and reducing greenhouse gas emissions to mitigate the effects of climate change.
4. Goal 14: Life below Water
   - Marine Resource Protection: Coastal hotels and those near aquatic ecosystems can aid in protecting marine life through responsible wastewater management and reducing pollution, thus safeguarding marine ecosystems.
5. Goal 15: Life on Land
   - Biodiversity Conservation: Hotels can support biodiversity by sourcing local and sustainable products and engaging in environmental conservation programs.
6. Goal 6: Clean Water and Sanitation
   - Optimal Water Management: Hotels can help conserve water resources through optimized water usage and wastewater treatment initiatives.
7. Goal 11: Sustainable Cities and Communities
   - Sustainable Urban and Community Development: Hotels can support the creation of sustainable cities and communities by improving local infrastructure and participating in sustainable community development initiatives.
8. Goal 17: Partnerships for the Goals
   - Collaboration and Partnership: Hotels can contribute to achieving the SDGs by working closely with local communities, governments, and non-profit organizations to foster sustainable practices and shared goals. [32]

Another tool that many companies use to manage sustainability is the Triple Bottom Line (TBL) theory. Originally introduced by Elkington in 1977, this theory has become one of the leading models in sustainable development, particularly within the tourism and hospitality sectors [33]. TBL posits that it is no longer sufficient for companies to measure and report solely on their economic performance and profitability; they must also incorporate environmental and socio-cultural dimensions into their evaluations [34]. In this framework, two additional pillars **Planet** for environmental considerations and **People** for socio-cultural aspects—are added alongside profit. These three dimensions intersect to create the concept of corporate sustainability [35].

In hotels, sustainability must be measured across all three levels identified by the TBL theory of sustainable development. As an example of how to rationalize sustainability management and clarify which sustainability activities should be measured in hotels, the World Travel and Tourism Council has developed a list of key actions. This list includes the following:

1. **Management and Efficiency**: energy and water consumption, waste reduction, and carbon emission reduction.
2. **Environment**: use of linens, limiting and replacing single-use plastics, use of environmentally friendly cleaning products, and offering plant-based food options.
3. **Social Aspects**: benefits for the community and reducing inequality.

These guidelines also include a realistic timeline for achieving the criteria, which helps hotels in managing their sustainability efforts. The guidelines provide clear examples of what should be measured and how it should be done, as the concept of sustainability can be somewhat abstract for businesses in general [36].

Circular economy

The term 'circular economy' is encountered with various definitions across scientific and commercial literature. However, most of these definitions agree on an economic model that allows users to extend the lifespan of goods while reducing the need for resources and waste, thereby creating additional value. Unlike the linear economy, which is based on a 'take, make, use, and dispose' approach and relies on cheap, accessible resources and energy, the circular economy model proposes that today's manufactured goods become assets for future use. This model ensures that a product's lifespan is maximized and avoids the use of new resources. This is achieved through maintenance, reuse, repair, refurbishment, recycling of its parts, and minimizing waste and emissions throughout the process. The Ellen MacArthur Foundation, one of the organizations widely recognized for defining circular economy models and their application in the industrial sector, describes the circular economy as a regenerative and restorative approach by intention and design. This model not only considers the production and consumption of goods and services but also aims to optimize the systems that interconnect different flow components. Therefore, the goal of this economy is to reduce waste, utilize renewable resources in processes, and minimize negative environmental impacts. [37]

In recent decades, academics and stakeholders have utilized various principles known as the 'R principles' as fundamental principles of the circular economy. However, pinpointing the exact origin of these principles has proven challenging, and no specific article serves as a definitive starting point. In the literature, the circular economy (CE) is often introduced with the 3R principles (Reduce, Reuse, and Recycle), which are as follows:

- **Reduce**: This foundational principle refers to eliminating waste and pollution resulting from linear economies, which typically extract natural resources, transform them, release greenhouse gases and hazardous materials during the process, and ultimately dispose of them. This principle, therefore, aims for waste-free design, leading to the creation of products with awareness and precision. If these materials are designed with consideration for their biological or technical characteristics, they can enter an appropriate cycle within the circular economy—either being composted, reused, repaired, or refurbished to become part of a new creation—without generating waste in the process.

- **Reuse**: Similar to the previous principle, this one focuses on all goods and products that remain in circulation, maintaining their high value throughout this process. Therefore, it is important to consider the type of material from which they are made and whether they will be used as their original product or transformed into a component or raw material for another product. In this way, all goods continue to circulate, and no waste is generated within the system.
- **Recycle**: In contrast to the linear economy, which focuses on the extraction of natural resources, production, and waste generation in the process while relying on fossil fuels as an energy source, this principle aims to utilize renewable resources and build systems and natural capital. This is achieved by recovering all biological elements from the production process and reintegrating them, leading to the restoration of the environment and the creation of a sustainable cycle. [2]

Over time, additional R principles have gained attention. The EU Waste Framework Directive introduced the recovery principle and expanded the initial 4R framework. Various academic contributions have proposed alternative R frameworks, such as 6R [38], and even broader models like 9R have emerged [39].

The 9R framework proposes strategies based on the principles of the circular economy that companies can implement in their processes. This framework takes into account various business models, infrastructures, relationships among stakeholders, and policies. It includes ten actions that can be undertaken by users and businesses, which are divided into three main sections:

Smarter Use and Production of Products

- **R0 Refuse**: From the users' perspective, this stage means refusing to accept services or consume products that are not environmentally friendly or are unnecessary. For companies, this concept entails not using hazardous raw materials or chemicals in the production process.
- **R1 Rethink**: This section includes four actions: viewing products as services, sharing assets, industrial symbiosis, and input sharing based on performance. These actions help increase the utilization of products or enhance their multifunctionality. In this way, companies can reconsider the design and functionality of their products while simultaneously reducing their environmental footprint.
- **R2 Reduce**: From the users' perspective, this means consciously thinking about the best ways to meet needs without having a negative impact on nature and buying less. From an industrial standpoint, this refers to optimizing the production processes of products and changing operations to utilize renewable resources (energy, water, raw materials).

Strategies for Extending the Lifespan of Products and Their Components

- **R3 Reuse**: This involves the repeated use of goods for the same purpose for which they were produced. It also includes reselling or distributing products as second-hand goods, which helps maintain material flow and extend the lifespan of goods.
- **R4 Repair**: This refers to the restoration or maintenance of products or their components to preserve their functionality and extend their lifespan without losing overall value or discarding them.
- **R5 Refurbish**: Similar to repair, this process aims to maintain the highest possible value of products, even when they are not in optimal condition. In the industrial sector,

comprehensive refurbishment provides almost new services for product longevity, updating it while delivering high quality with minimal environmental impact.

- **R6 Remanufacture**: This process requires specific technical conditions to integrate discarded product components into new products. This method preserves only part of the original value.
- **R7 Repurpose**: This involves using products or components that are no longer in use for adaptation and acquiring new functionality, thereby creating a new life cycle. This allows users to receive unique designs and helps companies reduce costs of raw materials and/or waste production from previous goods.

Beneficial Use of Materials

- **R8 Recycle**: Waste generated from previous goods is processed to convert it into new inputs and reintegrate them into the circular loop. This prevents the use of raw materials and reduces waste generation. Although recycling is a valid option, it is positioned as one of the last strategies within the framework, as it requires collection systems at various points and specific infrastructure and technology.
- **R9 Recover**: The final strategy in the framework refers to the waste treatment process, where waste is incinerated to recover energy. [40]

Circular economy in hotel industry

European countries are at the forefront of implementing the circular economy in their hotels. For example, the luxury QO Hotel in Amsterdam, recognized as the first circular hotel in the European Union, has taken steps to implement circular economy practices, particularly in the areas of water, energy, and materials. First, the hotel has created a groundwater storage system that collects warm water in the summer and stores it until needed. Additionally, the hotel has developed an extra system for greywater to limit wastewater production. Furthermore, the water from showers and sinks is reused for flushing toilets. Second, the building's facade and the greenhouse located on the roof help keep carbon emissions low and automatically manage the heating of guest rooms. Third, the hotel's commitment to the materials used in the building's structure is based on selected circular criteria. For example, one-third of the concrete used in construction comes from the Shell building in Amsterdam. Finally, other materials are also reused, such as carpets made from cotton threads sourced from fishing nets.

Another example is the Italian hotel called Conca Park in Sorrento, recognized as the first zero-waste hotel in Italy. Since 2014, this hotel has achieved remarkable results by implementing a policy that encourages participation from both staff and guests. Thanks to this collaboration, the hotel has been able to properly separate 95% of its waste. Additionally, it has reduced waste production by 40% and has used breakfast leftovers and fruit and vegetable peels as compost for its garden. The hotel has banned the use of disposable materials, small packaging, and plastic; only reusable and glass containers are found within the hotel. Broken glass containers are donated to a company that transforms them into pool filters. Furthermore, the hotel's green areas are irrigated with rainwater collected and stored through an artesian well. Water dispensers in the hotel are free to use, and recycled and recyclable water bottles are sold. Finally, energy-saving technologies are employed: lights are on timers, and the air conditioning system stops when doors or windows are opened.

Another example is the Crowne Plaza Hotel in Copenhagen, which opened in November 2009 as Denmark's first CO2-neutral hotel. The decision to focus on this hotel is based on its ability to

balance sustainability with digitalization, the latter of which is a key factor in the transition to a circular economy. This hotel features the largest solar panel system in the Nordic region, complemented by a south-facing facade. An innovative approach promoted by the hotel pertains to room reservations: if guests confirm their stay, the hotel warms the room through online booking. This new strategy helps the Danish hotel reduce its heating usage. Additionally, the hotel's restaurant, BARK, located in the central lobby, is home to 60 trees and over 4,500 plants. Energy is sourced from renewable resources, such as solar panels installed on the building's facade, which reduces energy consumption by 65% compared to similar hotels.

Digital technologies

Among the factors influencing the realization of a circular economy, digital technologies are recognized as one of the facilitators. Furthermore, digital technologies are considered a vital component and accelerator in this process [41]. Therefore, understanding the relationship between the circular economy and digitalization is crucial for achieving sustainable growth.

Various digital technologies have been proposed for use in circular business models, including data collection, data integration, and data analysis technologies. Chauhan et al. (2022) state that artificial intelligence and the Internet of Things play a key role in the transition to a circular economy [41]. Other digital tools, such as big data analytics, machine learning, and Internet of Things sensors, can be utilized to optimize resource management, predict maintenance needs, reduce energy consumption, and manage waste more effectively.

Digital platforms can facilitate the sharing of resources and assets, leading to more efficient use of resources and a reduced need for ownership. Additionally, digital tools such as 3D printing, virtual prototyping, and simulation can be employed to design more durable, repairable, and recyclable products. Furthermore, digital tools like blockchain can provide greater transparency and traceability in supply chains, facilitating more efficient and sustainable use of resources [26].

Conclusion

This article has examined the importance of the circular economy and the use of digital technologies in the hotel industry to promote sustainable performance in this sector. The findings of the research indicate that integrating the concepts of a circular economy with innovative technologies such as artificial intelligence, the Internet of Things, big data, and blockchain can optimize resource consumption, reduce waste, and enhance both economic and environmental sustainability. These methods facilitate reuse, repair, recycling, and reduction of material and energy consumption, which can lead to increased efficiency and reduced negative environmental impacts in the hotel industry.

Given the rising demand for sustainable tourism and the growing inclination of travelers to use eco-friendly hotels, adopting the principles of a circular economy in this industry not only helps alleviate pressure on natural resources and reduce carbon emissions but can also create new economic opportunities. Furthermore, embracing digital technologies can assist hotels in utilizing resources more intelligently and enhancing their operational efficiency.

Ultimately, the transition towards a sustainable economic model requires collaboration among hotels, governments, international organizations, and local communities. Although digital technologies play a facilitating role in this process, achieving these goals necessitates structural and cultural changes within the hotel industry.

Recommendations

To develop sustainability performance in the hospitality industry through circular economy influenced by digital technologies, the following suggestions can be made:

- **Develop Educational and Awareness Programs:**

It is essential to hold specialized training programs for hotel managers and their staff on circular economy principles. These programs should focus on recycling, reuse and repair, reducing energy and water consumption, and waste management to encourage the implementation of circular strategies in hotel operations.

- **Utilize Advanced Technologies for Resource Management:**

Hotels can improve their efficiency by leveraging digital technologies such as the Internet of Things (IoT) for monitoring energy and water consumption, and artificial intelligence for predicting operational needs. These technologies can help reduce energy waste, optimize heating and cooling systems, and facilitate smart waste management.

- **Encourage and Support Government Initiatives for Circular Economy:**

Governments should encourage hotels to invest in green technologies and implement circular economy practices by providing financial incentives, low-interest loans, and tax benefits. Additionally, it is necessary to develop mandatory policies and legal frameworks for carbon emission reduction and sustainable resource management in hotels.

- **Model Successful Global Experiences:**

Iran can draw on the successful experiences of circular hotels in Europe and other parts of the world and localize these models. For instance, European hotels have successfully reduced waste, optimized energy and water consumption, and increased customer satisfaction by utilizing innovative technologies. These models can serve as practical examples for other hotels.

- **Capitalize on Sustainable Tourism Demand:**

Given the increasing inclination of travelers to choose sustainable and eco-friendly hotels, hotels should focus on enhancing green practices and leverage this growing demand. Implementing circular solutions in energy and water management, reducing food waste, and using local and sustainable products can help attract more customers and improve brand image.

- **Create a Collaboration Platform among Stakeholders:**

Establishing joint platforms among hotels, governments, non-governmental organizations, and local communities to exchange knowledge and successful experiences in implementing circular economy practices is essential. These collaborations can enhance infrastructure, facilitate access to financial resources, and increase research and development capacities in the hospitality industry.

- **Invest in Research and Innovation:**

Investing in research and development to find innovative solutions and localize circular technologies can help increase hotel efficiency. Moreover, creating innovation laboratories to test new technologies in the hospitality industry and develop green solutions is of significant importance.

References

[1] World Travel & Tourism Council (WTTC) 2022a. Travel & Tourism Could Grow to $8.6 Trillion in 2022, Says WTTC. URL: https://wttc.org/news-article/travel-and-tourism-could-grow-to-8-point-6-trillion-usd-in-2022-say-wttc. Accessed: 02 February 2022.

[2] Rodrigues, S., Santos, N., & Costa, B. (2024, March). The Implementation of the Circular Economy R-Principles and Strategies: The Portuguese Hotel Industry Perspective. In *International Conference on Tourism Research* (Vol. 7, No. 1, pp. 57-66).

[3] Rodríguez-Antón, J. M., & Alonso-Almeida, M. D. M. (2019). The circular economy strategy in hospitality: A multicase approach. *Sustainability*, *11*(20), 5665.

[4] Guillen, J. J. G., & Baqué, D. T. (2024). Sustainability and the environmental impact of the tourism industry: An analysis of the hotel sector in Catalonia, Spain. *Intangible Capital*, *20*(1), 277-297.

[5] Rodriguez-Anton, J. M., Rubio-Andrada, L., Celemín-Pedroche, M. S., & Alonso-Almeida, M. D. M. (2019). Analysis of the relations between circular economy and sustainable development goals. *International Journal of Sustainable Development & World Ecology*, *26*(8), 708-720.

[6] Ali, Z. A., Zain, M., Hasan, R., Al Salman, H., Alkhamees, B. F., & Almisned, F. A. (2024). Circular Economy Advances with Artificial Intelligence and Digital Twin: Multiple-Case Study of Chinese Industries in Agriculture. *Journal of the Knowledge Economy*, 1-37.

[7] Rodríguez, C., Florido, C., & Jacob, M. (2020). Circular economy contributions to the tourism sector: A critical literature review. *Sustainability*, *12*(11), 4338.

[8] Pathan, M. S., Richardson, E., Galvan, E., & Mooney, P. (2023). The role of artificial intelligence within circular economy activities—a view from Ireland. *Sustainability*, *15*(12), 9451.

[9] Bittner, N., Bakker, N., & Long, T. B. (2024). Circular economy and the hospitality industry: A comparison of the Netherlands and Indonesia. *Journal of Cleaner Production*, *444*, 141253.

[10] Muñoz, S., Hosseini, M. R., & Crawford, R. H. (2024). Towards a holistic assessment of circular economy strategies: The 9R circularity index. *Sustainable Production and Consumption*, *47*, 400-412.

[11] Manniche, J., Larsen, K. T., & Broegaard, R. B. (2021). The circular economy in tourism: transition perspectives for business and research. *Scandinavian Journal of Hospitality and Tourism*, *21*(3), 247-264.

[12] Barakagira, A., & Paapa, C. (2024). Green practices implementation for environmental sustainability by five-star hotels in Kampala, Uganda. *Environment, Development and Sustainability*, *26*(4), 9421-9437.

[13] Tanveer, M. I., Yusliza, M. Y., & Fawehinmi, O. (2024). Green HRM and hospitality industry: challenges and barriers in adopting environmentally friendly practices. *Journal of Hospitality and Tourism Insights*, *7*(1), 121-141.

[14] Sgambati, M., Acampora, A., Martucci, O., & Lucchetti, M. C. (2021). The integration of circular economy in the tourism industry: A framework for the implementation of circular hotels. *University of South Florida (USF) M3 Publishing*, *5*(2021), 95.

[15] Pamfilie, R., Firoiu, D., Croitoru, A. G., & Ionescu, G. H. I. (2018). Circular economy–A new direction for the sustainability of the hotel industry in Romania. *Amfiteatru Economic*, *20*(48), 388-404.

[16] Lagioia, G., Amicarelli, V., Strippoli, R., Bux, C., & Gallucci, T. (2024). Sustainable and circular practices in the hotel industry in Southern Italy: Opportunities, barriers and trends in food waste management. *British Food Journal*, *126*(1), 428-452.

[17] Scholz, P., Vrabcová, P., Linderová, I., & Kotoučková, H. (2023). Integrated application of selected elements of sustainability, circular economy, bioeconomy, and environmental management system in guesthouses. *BioResources*, *18*(2), 2726-2745.

[18] Garrido, S., Rodríguez-Antón, J., Amado, C. A., Santos, S., & Dias, L. C. (2023). Development and application of a composite circularity index. *Journal of Environmental Management*, *337*, 117752.

[19] Finocchiaro, P. A. (2022). What is the role of place attachment and quality of life outcomes in employee retention?. *Worldwide Hospitality and Tourism Themes*, *14*(3), 261-273.

[20] Rudan, E., Nižić, M. K., & Grdić, Z. Š. (2021). Effect of circular economy on the sustainability of cultural tourism (Croatia). *Economics and Environment*, *76*(1), 19-19.

[21] Puntillo, P. (2023). Circular economy business models: Towards achieving sustainable development goals in the waste management sector—Empirical evidence and theoretical implications. *Corporate Social Responsibility and Environmental Management*, *30*(2), 941-954.

[22] Chauhan, C., Parida, V., & Dhir, A. (2022). Linking circular economy and digitalisation technologies: A systematic literature review of past achievements and future promises. *Technological Forecasting and Social Change*, *177*, 121508.

[23] Liu, Q., Trevisan, A. H., Yang, M., & Mascarenhas, J. (2022). A framework of digital technologies for the circular economy: Digital functions and mechanisms. *Business Strategy and the Environment*, *31*(5), 2171-2192.
[24] Roberts, H., Zhang, J., Bariach, B., Cowls, J., Gilburt, B., Juneja, P., ... & Floridi, L. (2024). Artificial intelligence in support of the circular economy: ethical considerations and a path forward. *AI & SOCIETY*, *39*(3), 1451-1464.
[25] Del Vecchio, P., Malandugno, C., Passiante, G., & Sakka, G. (2022). Circular economy business model for smart tourism: the case of Ecobnb. *EuroMed Journal of Business*, *17*(1), 88-104.
[26] NASSANBEKOVA, S., YESHENKULOVA, G., & IBADILDIN, N. (2023). Influence of Digital Technologies on Transition to a Circular Economy in Tourism: Values and Barriers. *Journal of Environmental Management and Tourism*, *14*(7), 2871-2879.
[27] Adam, O., Jeronimo, C., Pereira, L., Gonçalves, R., Dias, A., & da Costa, R. L. (2022, September). Business Model Reinvention: Impacts of Covid-19 in the Hospitality Business. In *International Conference on Sustainability in Software Engineering & Business Information Management* (pp. 75-97). Cham: Springer International Publishing.
[28] UN Environment Programme. Climate change undermines nearly all Sustainable Development Goals. URL: https://www.unep.org/news-and-stories/press-release/climate-change-undermines-nearly-all-sustainable-development-goals. Accessed: 23 February 2024.
[29] Mohan, C., Robinson, J., Vodwal, L., & Kumari, N. (2024). Sustainable Development Goals for addressing environmental challenges. In *Green Chemistry Approaches to Environmental Sustainability* (pp. 357-374). Elsevier.
[30] Hotel Energy Solutions 2011. Analysis on Energy Use by European Hotels: Online Survey and Desk Research. Hotel Energy Solutions project publications. URL: https://www.e-unwto.org/doi/pdf/10.18111/9789284414970. Accessed: 19 March 2024.
[31] Sustainable Hospitality Alliance 2017. Global Hotel Decarbonisation Report. Sustainable Hospital-ity Alliance. s.a. URL: https://sustainablehospitalityalliance.org/wp-content/uploads/2020/05/Global-Hotel-Decarbonisation-Report-2017.pdf. Accessed: 10 March 2024.
[32] Alvarez-Risco, A., Estrada-Merino, A., & Perez-Luyo, R. (2020). Sustainable development goals in hospitality management. In *Sustainable Hospitality Management: Designing Meaningful Encounters With Talent and Technology* (pp. 159-178). Emerald Publishing Limited.
[33] Bujan, I., & Kecek, D. (2019). The application of Triple Bottom Line concept in tourism with the emphasis on the hotel industry. *Economic and Social Development: Book of Proceedings*, 322-329.
[34] Thirumalesh Madanaguli, A., Dhir, A., Kaur, P., Mishra, S., & Srivastava, S. (2023). A systematic literature review on corporate social responsibility (CSR) and hotels: past achievements and future promises in the hospitality sector. *Scandinavian Journal of Hospitality and Tourism*, *23*(2-3), 141-175.
[35] Miller, K. (2020). The triple bottom line: What it is & why it's important. *Harvard Business School Online*.
[36] World Travel & Tourism Council (WTTC) 2022b. Hotel Sustainability Basics: Toolkit. WTTC. s.a. URL: https://wttc.org/Portals/0/Documents/Hotel%20Sustainability%20Basics-Toolkit.pdf?ver=2022-08-16-131107-417. Accessed: 10 May 2024.
[37] Blomsma, F., Tennant, M., & Ozaki, R. (2023). Making sense of circular economy: Understanding the progression from idea to action. *Business Strategy and the Environment*, *32*(3), 1059-1084.
[38] Sihvonen, S., & Ritola, T. (2015). Conceptualizing ReX for aggregating end-of-life strategies in product development. *Procedia Cirp*, *29*, 639-644.
[39] Potting, J., Hekkert, M. P., Worrell, E., & Hanemaaijer, A. (2017). Circular economy: measuring innovation in the product chain. *Planbureau voor de Leefomgeving*, (2544).
[40] Cárdenas Paico, A. S. (2023). Development of a circular economy analysis tool for the hotel industry.
[41] Chauhan, C., Parida, V., & Dhir, A. (2022). Linking circular economy and digitalisation technologies: A systematic literature review of past achievements and future promises. *Technological Forecasting and Social Change*, *177*, 121508.