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The Role of Digital Technologies in Circular Entrepreneurship with a Focus on Business Models

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Abstract
In recent years, circular business models have become an inevitable requirement to foster improvements in social, environmental and economic performance. The present study was conducted by combining previous research with the aim of providing a comprehensive picture of the components of the role of digital technologies in circular entrepreneurship with a focus on business models. The research methodology is qualitative with a meta- synthesis approach. Accordingly, after searching the databases including Elsevier, MDPI, Taylor & Francis, Science Direct, Emerald, Wiley, Springer, Noormags and SID in the time range of 2010 to 2024, 132 related studies were evaluated and finally, after multiple screenings, 36 articles were selected. Using seven-step model of Sandelowski and Barroso, the findings of 36 previous studies related to the objectives of the study were reviewed, aggregated, combined, and interpreted, and with the help of coding method, 26 codes, 11 concepts and 3 components were identified and validated through Kappa Cohen coefficient. The identified components were introduced under three components, including improving the element of the value proposition of the circular business model, improving the element of value creation of the circular business model, and improving the element of value capture of the circular business model. Finally, the model of the role of digital technologies in circular entrepreneurship with a focus on business models was presented and drawn.
Keywords: *Digital technologies; Circular entrepreneurship; Business models; Meta- synthesis*

Introduction

Current linear business models, often described as "make, use, and destroy" approaches, are not sustainable (Kirchherr et al., 2017) and lead the world into a huge cycle of waste production and severe resource scarcity (Schulte, 2013). In addition, urbanization and population growth require more and more resources, even though there is currently a shortage of vital resources such as water, and some materials will run out in the next 5-10 years. Furthermore, the Covid-19 crisis revealed the exposure of current systems to various risks and showed the fragility of global supply chains and resource availability (Droege et al., 2022). In the face of these issues, fundamental changes are necessary, and circular entrepreneurship emerges as a strategy toward more sustainable development (Schroeder et al., 2019). Circular entrepreneurship seeks cleaner production arrangements, the adoption of renewable technology and technical knowledge, and the development of appropriate policies and tools in this direction (Ghisellini et al., 2016). Circular business models have been introduced to drive businesses to reduce waste, as well as reuse,

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recycle, and save materials (Oghazi & Mostaghel, 2018). These models have great potential to provide economic, social, and environmental benefits (Reim et al., 2021).

Additionally, technology is an important force in the entrepreneurial ecosystem because it has the potential to influence entrepreneurial opportunities and processes (Wilson et al., 2022). Technology is changing rapidly, and the intersection between technology and the circular economy is a rapidly growing research and operational area (Pagoropoulos et al., 2017). The application of circular economic systems, i.e., the economic and technological environment for the introduction of new solutions, allows for the development of highly innovative solutions (Fogarassy et al., 2020). Advanced technologies, such as big data, the Internet of Things (IOT), artificial intelligence (AI), and blockchain, can play an important role in the adoption of concepts and the expansion of circular economy programs (Demestichas & Daskalakis, 2020). The use of digital tools has opened new opportunities and wide gates for businesses to closely follow consumer needs, discover new market opportunities and new ways of communicating with customers, and create fast and low-cost profiles in their sourcing and sales channels (Amberg & Fogarassy, 2019). This change also means that product development or organizational development is not the most important factor in the company's competitive processes, but the improvement of marketing and product sales mechanisms (Horvath et al., 2019). Therefore, the basis of the concept of classical circular economy, Schumpeterian typology, is not product, technology, marketing, or organizational innovation, but the re-dimensions of business processes and models, i.e., innovation in the business model (Fogarassy & Finger, 2020).

However, overcoming the challenges and obstacles has not yet been entirely successful, making the transition to a circular business model more of an aspiration than an achievable goal. Therefore, there is little attention and limited knowledge about technologies that can play an important role in overcoming challenges and barriers (Pagoropoulos et al., 2017). In addition, digital technologies can provide businesses with a variety of new capabilities that can lead to competitive advantages. As a result, research on the technological dimension is limited and requires further development to understand the potential benefits of using it in the implementation of circular business models (Suchek et al., 2022). Existing research is based on conceptual and overview studies, which leads to a lack of understanding of how digital technologies enable businesses in real-world environments to improve resource flow and value creation and absorption, thereby enabling business model innovation (Ranta et al., 2021). Therefore, much more theoretical, and empirical effort is needed to analyze the benefits of technology for circular business models. The existing articles in this field have addressed some indicators of the role of technology in circular business models, but in a separate and scattered manner. Therefore, to fill this knowledge gap, the current research aims to choose a different perspective from previous studies and identify, combine, and deeply understand the components, concepts, and indicators through a systematic and comprehensive meta-synthesis analysis. The goal is to answer the question: What is the role of digital technologies in the circular business model?

Theoretical foundations and research background

The business model includes a concept that describes how an organization creates, presents, and obtains value (Manninen et al., 2018). It can be described as the conceptual and constructive implementation of a business strategy and as a basis for the implementation of business processes. To implement strategies, the business model focuses on the concept of value. A business model can be identified through three elements (Oghazi & Mostaghel, 2018). The first element is value proposition. This refers

to the value embedded in the products or services provided by a business or company. For example, designing sustainable products and services to withstand technology and fashion trends. The second element refers to value creation and delivery. Every business starts by creating value, with the main goal being to create and provide value in the most efficient way that generates profit after expenses. This involves considering the supply chain, which encompasses how upstream relationships with suppliers are organized and managed, as well as customer relationships, which involve how downstream relationships with customers are structured and managed. Finally, the third element is Value capture. This relates to the company's ability to generate profit from its transactions. The financial model plays a crucial role in understanding the cost structure, income streams, benefits, and their distribution among the stakeholders of the business model. Circular business models may involve unexpected costs and higher risks. Overall, the business model serves as a framework for understanding how a business operates and how it creates and captures value.

In fact, according to Richardson's (2008) framework, the nine blocks of the business model canvas were consolidated into three blocks that emphasize the concept of value, as depicted in Figure 1 (Richardson, 2008).

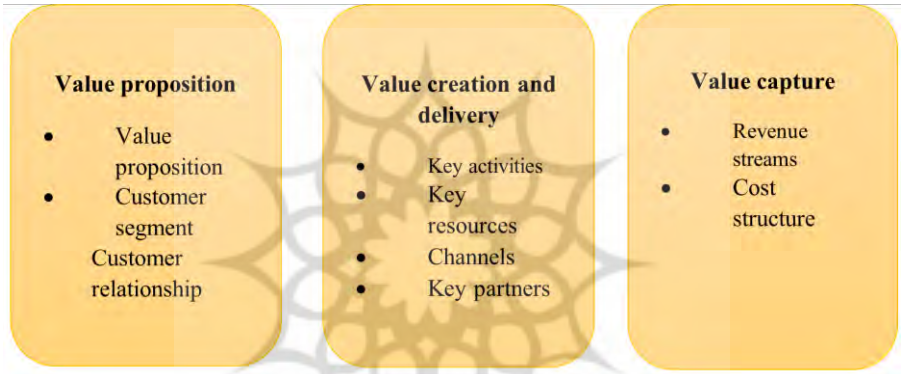

Figure 1. *The proposed framework of the business model according to Richardson's concept of value (Richardson, 2008)*

By the emergence of new trades and businesses, the need of having a business model has increased at a break neck pace world over (Heidari et al., 2022). Circular business models are one of the basic alternatives to linear economic models of take, make, consume, and throw away. The goal of linear business models is continuous economic growth based on the incorrect premise of unlimited abundance of available resources and wide access, as well as the unlimited capacity of the environment to absorb waste and greenhouse gases. Instead, circular business models are associated with minimizing resource inputs by reducing the use of new materials for production and increasing the lifespan of existing products. This is achieved by combining technical innovations, such as the development of materials with less environmental impact and more efficient production processes, with new forms of consumption, such as extended use or service-based models, or by promoting the reuse and recycling of products (Coscieme et al., 2022). A circular business model can be defined as a model that operates in closed material loops or as a model that combines the creation of economic value with limiting, slowing down, or closing resource loops (Lewandowski, 2016). In general, circular business models can be considered as a means to realize circular goals such as longer use, reuse, or recycling, supporting the transition to a circular economy (Coscieme et al., 2022). They include elements that slow down, limit, or close the resource loop so that the input of resources to the organization and its value

network is reduced and waste out of the system is minimized (Santa-Maria et al., 2021). Figure 2 shows the conceptualization of the business model (right side) and an image of embedding a circular strategy in a business model (left side) (Nußholz, 2017).

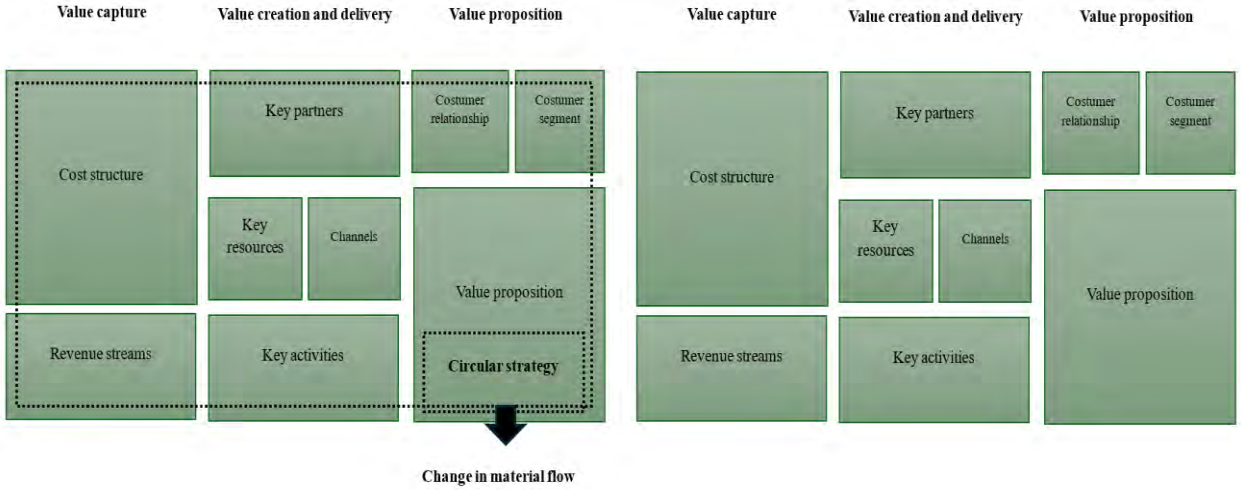

Figure 2. *Conceptualization of the business model (right side) and an image of embedding a circular strategy in a business model (left side) (Nußholz, 2017)*

The purpose of circular entrepreneurship is to promote the integration of entrepreneurial activities with the elements of industrial ecology, emphasizing the redesign of products and processes to make the system effective and self-sustainable (Veleva & Bodkin, 2018). In this perspective, businesses are exploring opportunities related to the recovery and reuse of products and components in several industries (Sun et al., 2017). The implementation of circular orientation in established and new businesses requires the adoption of advanced technical knowledge and innovative human skills, highlighting the role of entrepreneurs as important players in the process of transitioning businesses and industries towards circular models (Del Vecchio et al., 2018). This includes ensuring the right balance between long-term sustainability and economic profitability (Du et al., 2012). Digital technologies have changed the landscape of the world. The shape of today's businesses, manufacturing processes, health care, communication, education, mass media, as well as almost every other aspect of human life has changed dramatically since the advancements in information and communication technology began to snowball a few decades ago. Ignoring the importance and role of all these developments is wrong. Emerging digital technologies play a big role in the expansion of the circular economy, and these technologies can be categorized into three layers: data collection, data integration, and data analysis (Pagoropoulos et al., 2017). IOT, Blockchain technology (BCT), Radio Frequency Identification (RFID), Machine learning (ML) and AI and Big data analytics are some of the most important digital technologies. RFID is a data collection technology that uses electromagnetic fields to automatically identify and track object tags. This technology has attracted considerable attention in the context of circular economy and entrepreneurship (Pagoropoulos et al., 2017). In general, the concept of IoT is the connection of different devices to each other through the Internet. With the help of the Internet of Things, various programs and devices can interact with each other and even humans through an Internet connection (Babaie et al., 2022). Networked computer systems link sensors and actuators, enabling them to monitor and manage the health and actions of objects. In the context of the circular economy, the IoT has garnered significant attention as one of the technologies in this field (Bressanelli et

al., 2018). BCT keeps a distributed record of digital transactions (Berenji et al., 2024). BCT is a technology that allows digital data to be stored in a public and shared database (Ahmadi et al., 2022). As a result, data storage is distributed and transparent rather than being centralized. Due to its distributed nature, immutability, which provides security and trust, as well as transparency, this technology is recognized as having high potential and is considered in the context of the circular economy (Bolier, 2019). The term of Big Data refers to large growing data sets that include heterogeneous formats: structured, unstructured and semi-structured data. Big Data has a complex nature that require powerful technologies and advanced algorithms (Oussous et al., 2018). Within the context of the circular economy, utilizing big data analysis allows for the extraction of valuable insights from diverse systems like sensors and the Internet of Things (IoT), ultimately enhancing decision-making processes. It is worth noting that big data is often referred to as an analytical approach rather than a standalone concept, as it involves the examination of substantial volumes of data derived from various sources (Pagoropoulos et al., 2017). ML is considered as an integral part of AI, which refers to the automated detection of meaningful patterns in datasets. ML tools aim to increase the efficiency of algorithms by ensuring the ability to learn and adapt based on big-data analytics (Shalev-Shwartz & Ben-David, 2014). Due to the rapid data processing capabilities of AI algorithms, machine learning can contribute to expediting the transition towards a circular economy by facilitating process and system optimization, ultimately leading to more effective practices (Macarthur & Cowes, 2019).

In the field of research, different researchers have addressed this issue in a scattered manner. Kalogiannidis et al. (2022) investigated the impact of digitalization on the performance of the circular economy in their research entitled "The Impact of Digitalization in Supporting the Performance of Circular Economy: A Case Study of Greece". The results of this research have shown that there is a positive relationship between digital practices and circular economy performance, and digital business innovations have a positive effect on circular economy performance (Kalogiannidis et al., 2022). Ranta et al. (2021) in their research entitled "Digital technologies catalyzing business model innovation for circular economy—Multiple case study" conducted a multiple case study with interviews and document data from four Northern Europe-based forerunner firms with circular economy business models enabled by digital technologies. They have provided an evidence-based empirical synthesis of improving resource flows and value creation and absorption in corporate businesses across industries and have highlighted the critical role of knowledge generation (Ranta et al., 2021). Alcayaga et al. (2019) in a research entitled "Towards a framework of smart-circular systems: An integrative literature review" elaborated a new understanding of smart-circular (product-service) systems by articulating the base strategy smart use and extending the following circular strategies (or technical loops): maintenance, reuse, remanufacturing and recycling (Alcayaga et al., 2019). Antikainen et al. (2018) in their research entitled "Digitalization as an enabler of circular economy" investigated the challenges and benefits of circular business models with the help of digital technology. In this research, the virtualization of products and processes, collaboration with stakeholders, and the use of digitalization have been highlighted as the main opportunities in adopting business models based on circular economy (Antikainen et al., 2018). Moreno and Charnley (2016) in a research entitled "Can re-distributed manufacturing and digital intelligence enable a regenerative economy? An integrative literature review" developed a set of criteria for distributed remanufacturing and circular innovation to identify 33 existing case studies on consumer goods manufacturing. and have been used. As a result, the case study analysis

led to the identification of three types of distributed remanufacturing that encompassed the integrated characteristics of rotational innovation (Moreno & Charnley, 2016).

Research Methodology

The present research is a qualitative meta-synthesis study. Meta-synthesis is a qualitative approach that synthesizes and compares the results of qualitative studies in a specific scientific field in order to develop new interpretations and theories (Rahchamani et al., 2022). Meta-syntheses are integrations that are more than the sum of parts in that they offer novel interpretations of findings that are the result of interpretive transformations far removed from these findings as given in research reports (Sandelowski & Barroso, 2003).

To collect data, all the research published in the field of circular entrepreneurship in reliable domestic and foreign databases including including Elsevier, MDPI, Taylor & Francis, ScienceDirect, Emerald, Wiley, Springer, Noormags and SID based on the keywords "business model", "circular business model" and "circular business model innovation" about "digital technologies" are defined for entrepreneurship and management magazines. In order to evaluate the findings of the research, the seven-step meta-synthesis method of Sandelowski and Barroso was used including determining the research question, systematic study of literature, selection of proper studies, extraction information from the studies, analysis and synthesis of findings, control of research quality, and finally presentation of findings (Sandelowski & Barroso, 2003).

Step 1: Determining the research question: The fundamental goal of this research was to reach a conceptual model of the role of digital technologies in the circular business model using the meta-synthesis method. Following the determination of the primary purpose of the meta-synthesis study, one should decide on the preliminary topical (what), population (who), temporal (when), and methodological (How) parameters of the study (Sandelowski & Barroso, 2003). The questions of this research are stated in Table 1 at this step.

Table 1.
Meta-synthesis analysis research questions

Research questions	Answers
What	Identifying the components of the role of digital technologies in the circular business model- Presenting the model of the role of digital technologies in the circular business model
Who	All reliable scientific databases
When	From 2010 to 2024
How	Documentary analysis

Step 2: Systematic study of literature: In this research, all the available research conducted in the field of circular economy from databases including Elsevier, MDPI, Taylor & Francis, ScienceDirect, Emerald, Wiley, Springer, Noormags and SID were examined. The information collection tool of scientific journals was judged by searching for keywords including: "business model", "circular business model", "circular business model innovation" in relation to "digital technologies".

Step 3: Selection of proper studies: In the current research, considering parameters such as title, abstract, and content, 132 articles were evaluated in the field of the research topic and finally 36 articles were selected. To evaluate the quality of these researches, CASP critical assessment method was used. The method of selecting articles at this step is presented in Figure 3.

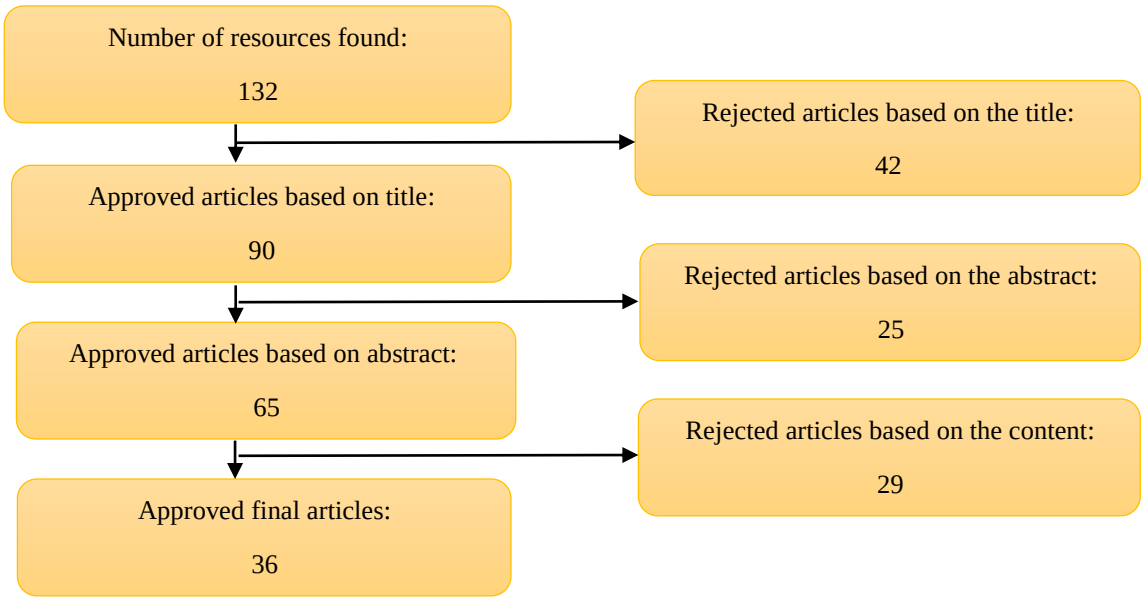

Figure 3. *Summary of search results and selection of appropriate articles*

Also, descriptive information about the final 36 articles reviewed in the meta-synthesis research method is provided according to the table below.

Table 2.
Descriptive table of 36 final reviewed articles

Parameters investigated in the final articles used in meta-synthesis		**Number of final articles used**
Publications	2015 and before	1 out of 36 reviewed articles (2.8%)
	2016 to 2018	6 out of 36 reviewed articles (16.7%)
	2018 to 2020	8 out of 36 reviewed articles (22.2%)
	2020 to 2022	13 out of 36 reviewed articles (36.1%)
	2022 to 2024	7 out of 36 reviewed articles (19.4%)
	2024	1 out of 36 reviewed articles (2.8%)
Publication year	Taylor & Francis	3 out of 36 reviewed articles (8.3%)
	MDPI	5 out of 36 reviewed articles (13.9%)
	Elsevier	14 out of 36 reviewed articles (38.9%)
	Wiley	7 out of 36 reviewed articles (19.5%)
	emerald	3 out of 36 reviewed articles (8.3%)
	ScienceDirect	1 out of 36 reviewed articles (2.8%)
	Springer	3 out of 36 reviewed articles (8.3%)

Step 4: Extraction information from the studies: At this step and after selecting the sources, 26 codes were extracted, and these codes and the sources of code extraction are presented in Table 3

Table 3.
Coding of research studies

Code	Some extracted sources
A tool to improve the performance of strategies and patterns	(Bocken et al., 2016); (Lewandowski, 2016); (Ranta et al., 2021); (Lüdeke-Freund et al., 2019)
Supporting the implementation of management practices to transfer the circular economy in business	(Centobelli et al., 2020); (Ünal et al., 2018); (Urbinati et al., 2020); (Urbinati et al., 2017); (Bolier, 2019)
Product life cycle information	(Tukker, 2015); (Alcayaga et al., 2019); (Bigliardi & Filippelli, 2021)
Knowledge of usage, status and tracking of product or material over time	(Alcayaga et al., 2019); (Ranta et al., 2021); (Hedberg & Šipka, 2021); (Bressanelli et al., 2018); (Antikainen et al., 2018); (Tukker, 2015); (Ingemarsdotter et al., 2020)
Efficient waste management	(Ferasso et al., 2020); (Hedberg & Šipka, 2021); (Dantas et al., 2021); (Moreno & Charnley, 2016)
Improve recycling	(Ferasso et al., 2020); (Hedberg & Šipka, 2021)
Reducing the use of resources and energy and optimizing the required materials	(Moreno & Charnley, 2016); (Antikainen et al., 2018); (Hedberg & Šipka, 2021)
Advanced control of material transportation	(Antikainen et al., 2018); (Ranta et al., 2021)
Converting knowledge, usage, and customer needs into value	(Ranta et al., 2021); (Urbinati et al., 2021); (Charnley et al., 2022)
Improving cooperation in the value chain at the systemic level	(Ranta et al., 2021)
Help to minimize waste	(Antikainen et al., 2018); (Ranta et al., 2021); (Hedberg & Šipka, 2021); (Huynh, 2021)
Enabling more efficient business processes and efficient material processing with high efficiency	(Antikainen et al., 2018); (Lopes de Sousa Jabbour et al., 2018); (Ranta et al., 2021); (Okorie et al., 2021)
The possibility of reusing materials	(Ranta et al., 2021); (Wilson et al., 2022)
The possibility of repairing and rebuilding parts	(Ranta et al., 2021); (Wilson et al., 2022)
Improved tracking and record keeping of products in use and after use	(Mboli et al., 2022); (Kouhizadeh et al., 2020); (Bigliardi & Filippelli, 2021); (Ingemarsdotter et al., 2020); (Ranta et al., 2018); (Pagoropoulos et al., 2017); (Adelekan & Sharmina, 2024)
Increasing the productivity of resources	(Bressanelli et al., 2018); (Antikainen et al., 2018); (Ranta et al., 2021); (Urbinati et al., 2021); (Neligan et al., 2023); (Sjödin et al., 2023)
The possibility of maintaining and longer sustainability of the product	(Ingemarsdotter et al., 2020); (Ranta et al., 2021)
The possibility of producing higher quality products and improving product design	(Bressanelli et al., 2018); (Ranta et al., 2021); (Ingemarsdotter et al., 2020)
Possibility of virtualization of distribution channels	(Lewandowski, 2016)
Increase product life cycle	(Bressanelli et al., 2018); (Antikainen et al., 2018); (Hedberg & Šipka, 2021); (Salminen et al., 2017)
Help to close the loop and slow down the material loop	(Antikainen et al., 2018); (Lüdeke-Freund et al., 2019); (Bressanelli et al., 2018)
The possibility of sharing or renting products	(Hedberg & Šipka, 2021); (Antikainen et al., 2018)
Data collection and analysis	(Demestichas & Daskalakis, 2020); (Pagoropoulos et al., 2017); (Ranta et al., 2021); (Liu et al., 2022)

Code	Some extracted sources
Minimizing exchange costs and saving costs due to regenerating resources, reducing excess, tracking products or materials, etc.	(Rehman Khan et al., 2022); (Ranta et al., 2021); (Antikainen et al., 2018)
More connected and lasting relationships with customers	(Moreno & Charnley, 2016)
Long-term returns and increased revenues	(Rehman Khan et al., 2022); (Ranta et al., 2021)

Step 5: Analysis and synthesis of findings: At this step and using the coding method based on the analyzes done with the help of content analysis, the content of 36 final articles has been selected and a total of 26 codes, 11 concepts and 3 components have been identified. Table 4 presents the categorization of the findings. At this step, the findings showed that such a coherent and systematic study has not been done in past studies, and previous studies have paid attention to each aspect of these categories.

Table 4.
Categorization of findings

Components	Concepts	Codes
Improving the value proposition element of the circular business model	Customer	-Converting knowledge, usage, and customer needs into value -More connected and lasting relationships with customers
	Waste and recycling management	-Efficient waste management -Help to minimize waste -Improve recycling -The possibility of reusing materials -The possibility of repairing and rebuilding parts
	Increasing product quality and lifespan (designing products based on circular products)	-The possibility of maintaining and longer sustainability of the product -The possibility of producing higher quality products and improving product design -Increase product life cycle -The possibility of sharing or renting products
Improving the value creation and delivery element of the circular business model	Key resources management	-Increasing resource efficiency -Help to close the loop and slow down the material loop -Reducing the use of resources and energy and optimizing the required materials
	Channels management	-Advanced control of material transportation

Components	Concepts	Codes
		-Possibility of virtualization of distribution channels
	Process management	-The possibility of more efficient processes in business and the processing of efficient materials with high efficiency
	Key partners management	-Improving cooperation in the value chain at the systemic level
	Organizational management (improving patterns and strategies)	-A tool to improve the performance of strategies and patterns -Supporting the implementation of management practices to transfer the circular economy in business
	Information management	-Data collection and analysis -Knowledge of usage, status and tracking of product or material over time -Improved tracking and record keeping of products in use and after use -Product life cycle information
Improving the value capture element of the circular business model	Cost structure	-Minimizing exchange costs and saving costs due to regenerating resources, reducing excess, tracking products or materials, etc.
	Revenue streams	-Long-term returns and increased revenues

Step 6: Control of research quality: In the sixth stage, in order to measure the quality of the results of the previous stage, the experts were provided, and Cohen's kappa test was used. In this method, two researchers check the coding results independently. In this research, a comparison of the researcher's opinion with an expert has been used. Then, using SPSS software, kappa coefficient was calculated to compare the coding results of two people (researcher and expert). The results of calculating the kappa statistic in this research show that the kappa coefficient is equal to 0.756 and the significance level is less than 0.05, which indicates the reliability of this research.

Step 7: Presentation of findings: In the last step, the results of the research are expressed using the meta-synthesis method. In this way, the findings of the research of the final model of digital technologies in circular business models have been compiled according to Figure 4.

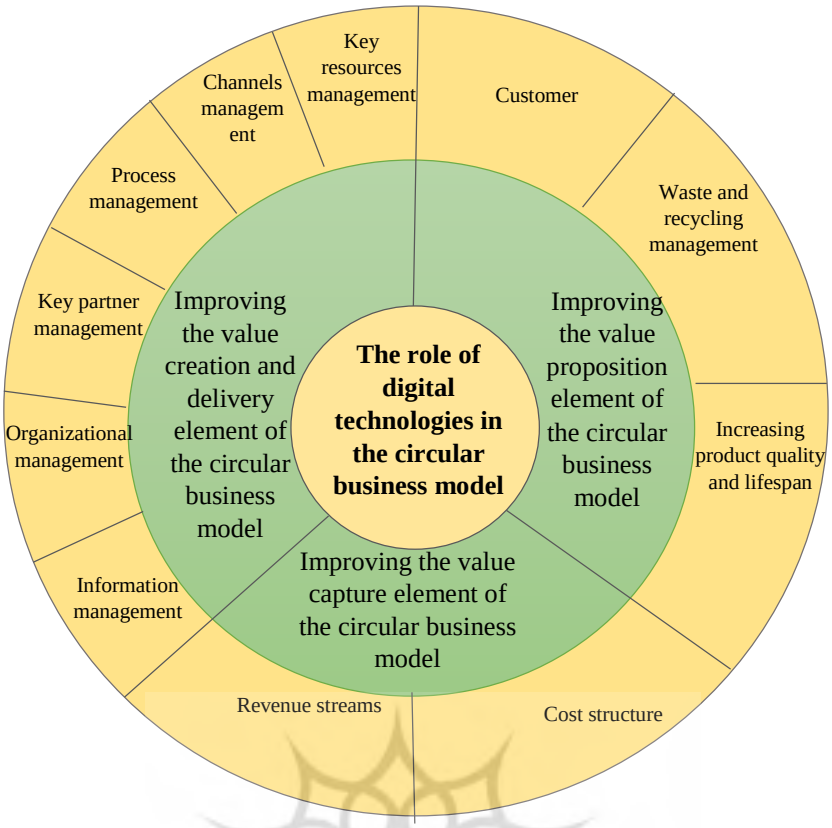

Figure 4. *The model of the role of digital technologies in circular business models*

Conclusion and suggestions

In this research, a proper classification was presented based on the background of the conducted researches with a meta-synthesis approach. For this purpose, first the background of the research in this regard was examined. Then, based on the meta-synthesis approach and the study of 36 valid researches in the field of circular entrepreneurship, 26 codes were identified and these codes were classified into eleven concepts that indicate the role of digital technologies in the circular business model. Finally, the identified concepts were introduced under three components, including improving the element of the value proposition of the circular business model, improving the element of value creation and delivery of the circular business model, and improving the element of value capture of the circular business model.The identified components include following concepts: customer, waste and recycling management, increasing product quality and lifespan, key resources management, channels management, process management, key partners management, organizational management, information management, cost structure and revenue streams. The findings of this study are consistent with and complement the studies conducted by (Kalogiannidis ,2022), Ranta et al ., 2021) and Antikainen et al., 2018).

Today, digital technology is rapidly changing and has led to massive impacts on the social environment and global progress. In addition, due to the increase and improvement of the ability to communicate and share valuable information, new opportunities for businesses to gain competitive advantages are also involved. Also, due to the growing demand to improve the transition towards a circular business model, it is very important to examine the role of digital technologies in the circular business model. Digitalization and the use of digital technologies have the potential to act as a strong driving force in the development of circular business models. It can also accelerate the economic transition towards a circular production system with more efficient and stronger resources. In the following, the role of three components of

improving the value proposition element of the circular business model, improving the element of value creation and delivery of the circular business model, and improving the element of value capture of the circular business model are described. The approaches to implementing digital technology in circular business models are as follows:

The approach of improving the value proposition element of the circular business model:

Digital technologies can improve the value proposition of businesses by designing products and services based on circularity, thereby increasing product quality and lifespan. They also help businesses convert knowledge and customer needs into value, while creating more connected and durable relationships with customers. Additionally, digital technologies can facilitate circular value proposition and waste management and recycling. The integration of digital technologies has provided opportunities for the distribution of knowledge, structure, ownership, and different levels of customization, enabling more connected and durable relationships with customers and end users (Moreno & Charnley, 2016). In fact, digital technologies enable businesses to transform customer needs into value by increasing customer knowledge and utilizing it effectively (Ranta et al., 2021). Also, new digital technologies are needed to promote efficient waste management as a basis for circular entrepreneurship (Dantas et al., 2021) and can play a large role in helping to minimize waste (Antikainen et al., 2018). In fact, by using digital technologies, businesses are able to produce products based on rotational strategies by increasing the quality and longevity of the product, and the possibility of maintaining and maintaining the product longer and producing higher quality products with a longer life cycle. provide more Also, businesses based on circular business models can rent durable products instead of selling products or share products wherever possible (Antikainen et al., 2018).

The approach of improving the value creation and delivery element of the circular business model:

Digital technologies can improve the creation and delivery of circular value of businesses by creating value through key resource management, key partner management, channel management, activity and process management, organizational management, and information management. In businesses based on circular business models, coordinating the flow of materials and information is very important. Information related to the quantity and quality of products and the contents of their raw materials should be collected and stored (Moreno & Charnley, 2016). The use of digital technologies makes it possible to solve the problem of managing the flow of information in a business and to ensure their correctness and accuracy. In fact, information related to products and services plays an essential role in organizing the production and consumption cycles needed to implement circular models (Bigliardi & Filippelli, 2021). In fact, by using digital technologies, businesses will be able to track the entire life cycle of a product and confirm all stages from the supply of raw materials to the final stage of the product's life. A fixed certification cycle at each stage of the cycle can act as a guarantee for reliability and solve the problem of perceived risk associated with the use of recycled, remanufactured or reused products (Kouhizadeh et al., 2020). The introduction of digital technologies and the Internet of Things has the potential to reduce the use of resources and facilitate circular systems (Moreno & Charnley, 2016) and enables the more efficient use of fewer resources and the possibility of reducing energy consumption (Antikainen et al., 2018). Therefore, digitalization strengthens circular business models by helping to close the loop, slow down the material loop, and narrow the loop by increasing resource efficiency (Antikainen et al., 2018). In addition, digitalization provides opportunities for virtualization of distribution channels and value can be delivered to

customers through digital channels, for example online stores and digital products; This can lead to the reduction of environmental effects and circular business models (Lewandowski, 2016). Digitalization also enables more efficient processes in businesses (Antikainen et al., 2018) and helps to improve operations and processes (Lopes de Sousa Jabbour et al., 2018).

The approach of improving the value capture element of the circular business model:

Digital technologies can improve business value capture by improving internal processes that minimize transaction costs and save costs, as well as long-term profitability and increase revenues or new revenue streams. By adopting digital technologies by businesses, they can help reduce their costs by regenerating resources (Rehman Khan et al., 2022). Such benefits promise long-term efficiency and social, economic and environmental sustainability (Rehman Khan et al., 2022). Also, digitalization minimizes transaction costs (Antikainen et al., 2018). In fact, the use of digital technologies accelerates fundamental improvements to create value and capture through a circular business model by reducing costs and increasing revenue (Ranta et al., 2021). In general, digital technologies enable fundamental improvements in the circular entrepreneurship perspective, enabling the closure of resource flows and the creation of value and absorption through the business model by reducing costs and increasing revenue (Ranta et al., 2021).

The findings of this research can provide valuable insight to managers and policy makers who seek to improve circular entrepreneurship and increase sustainable and circular entrepreneurship at the community level. In addition, this research can be used in more practical levels by the actors who accompany in the entrepreneurial ecosystem. In fact, the role that digital technologies play in the circular business model should be clearly considered to help the transition from linear business models to circular business models. As a result, circular entrepreneurship has become one of the high-priority choices of entrepreneurs due to its many benefits. In fact, based on the results of this research, in order to achieve circular entrepreneurship, businesses should change their business model by changing and adapting the three elements of the business model to the three elements of the circular business model, i.e., circular value proposition, circular value creation and delivery, and circular value capture.

In relation to the practical suggestions of the research to sustainable and environmentally friendly businesses, it can be said that the use and exploitation of digital technologies can be a catalyst for changing business models from linear to circular business model and greatly facilitate this process. In fact, to business managers who have not yet implemented digital technologies to improve the circularization of their business model, it should be stated that the implementation of digital technologies is necessary to get value from circular entrepreneurship. In fact, it can be said that digital technologies alone mainly facilitate the absorption and acquisition of value through cost reduction and limitation, and the use of digital technologies in business management is very beneficial. Small businesses and startups are especially suitable for implementing products or services based on digital technologies. In fact, although some strategies of circular business models can be used without the help of digital technologies, it has been proven in practice by businesses that to achieve the goal of a circular business model using digital technologies is much easier and can be implemented successfully. However, it is better for these types of businesses to offer products to their customers that are at the "generally accepted technology level". Business managers are also advised to use technologies to optimize reverse logistics processes, the possibility of collecting, refurbishing and selling used products.

In relation to policy proposals, it can be stated that the facilities for facilitating the use and application of these technologies with

appropriate training and building capacity at commercial and individual levels, effective policies, action plans and financing mechanisms from governments provide. In fact, training and capacity-building activities can increase awareness of circular entrepreneurship both in businesses and for individuals, leading to further development and support of digital technologies.

Among the limitations of the present research, it can be mentioned that the selected researches were limited to the Persian and English language group. In this regard, future research can be the study of consumer behavior of products and services of circular business models. In addition, future research can focus on analyzing the effectiveness of consumer incentives in making their behavior more compatible with the principles of circular entrepreneurship.

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