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The Role of Digital Transformation in the Circular Economy in Vietnamese Enterprises

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Abstract
Solving problems related to scarcity of raw materials, using sustainable energy, minimizing waste in each stage of the product life cycle, and reusing available materials requires significant investment in qualified scientific human resources, increasing the competitiveness of the economy. This is done through the application of digital transformation in the enterprise's production and business process. The author researched 220 Vietnamese businesses to evaluate the role of digital transformation in the circular economy and implement the weekly economic model in businesses that do or do not implement digital transformation. Research results have shown that the level of implementation of the circular economy model in businesses implementing digital transformation is much higher than in businesses that have not implemented digital transformation.

Keywords: Digital Transformation, Circular Economy, Roles, Businesses

1. Introduction

Today, the circular economy (CE) model is a concept advocated by the European Union, China, Japan, the UK and companies around the world. The Ellen MacArthur Foundation points out that applying the CE principle could increase Europe's Gross Domestic Product (GDP) by 11%, with net benefits of around 1.8 trillion euros by 2030, and can save raw material costs up to 1 USD trillion. The circular economy model is also seen as providing the greatest traction for companies to achieve sustainable development which can be realized by innovative CE business models and responsible consumers responsibility. However, there are challenges to CE adoption; For example, operational risk is transferred to the business. When users no longer own the product, the business may have to bear additional maintenance costs and may also lose some users. Additionally, because products in CE are designed for long-term use, they may not be able to accommodate technological improvements, thereby hindering the process.

Digital transformation is a challenge in almost every industry in both breadth and depth, leading to changes in entire production, management and governance systems (Schwab, 2016). With the diverse emergence of digital technology, digital platforms and digital infrastructure structures, there have been groundbreaking changes in businesses (new business models, products/ new services, new customer experiences...) and moreover, each business itself may need to change and innovate to succeed in the digital context (Wenkatraman, 2017) [9].

Solving problems related to scarcity of raw materials, using sustainable energy, minimizing waste in each stage of the product life cycle, reusing available materials, requires significant investment in qualified scientific human resources, increasing the competitiveness of the economy. Furthermore, digital technology can promote CE in businesses. For example, IoT allows companies to remotely monitor product usage, status, and location in real time, track materials through IoT technology, and recycle scrap products, helping to convert change to CE. Based on the use of process analysis and big data processing results in digital transformation, digital data can significantly improve the efficiency of storage, sales and distribution of economic activities in industries, various technologies, equipment, products and services. Furthermore, with digital transformation and the growing need for sustainability, CE needs to utilize more new skills to drive growth. Currently, research has shown that digital technology has great potential in promoting the development of CE. However, the integration of circular economy models and digital technology is a small and rapidly growing field of research, still in its infancy in developing countries around the world.

Therefore, transforming the circular economy model with the implementation of digital transformation is an inevitable task of Vietnamese businesses aiming for sustainable development. With the role of providing many modern techniques, digital transformation is an indispensable information processing channel for business administrators in the process of transforming

the circular economy model. This article focuses on understanding the process of transforming the circular economy model in Vietnamese businesses and recognize the role of digital transformation in providing information to administrators in the process of transforming the circular economy model at these businesses.

2. Theoretical Basis

Introducing the Circular Economy

The concept of circular economy was first mentioned by Pearce and Turner (1990) [8], circular economy is used to refer to a new economic model based on the basic principle "everything is an input to something else", completely unlike the view of the traditional linear economy. According to the Ellen MacArthur Foundation (2013) [2], circular economy describes an economy that is designed and operated with the main goal of minimizing, controlling and eliminating the harmful effects of toxic chemicals and enhancing renewable energy and eliminate waste. Circular economy operates based on the principles of: Design to eliminate waste; Enhance resilience through diversity; Use renewable energy; Think systematically; And waste is also raw material.

According to the United Nations Industrial Development Organization (UNIDO), a circular economy is a closed cycle in which waste is reused and becomes raw materials for production, thereby reducing any negative impacts on the environment, ecosystem and human health. In Vietnam, the concept of circular economy is mentioned in Article 142, Law on Environmental Protection, specifically: "Circular economy is an economic model in which design, production, consumption and services to reduce the exploitation of raw materials, extend product life cycles, limit waste generated and minimize negative impacts on the environment."

So, simply put, circular economy is turning the output waste of one industry into input resources for another industry or circulating within a business itself. Circular economy partly contributes to increasing value for businesses, reducing resource exploitation, reducing waste treatment costs, and minimizing environmental pollution.

Introducing Digital Transformation

Digital transformation is defined as "the most profound and rapid transformation of operations, processes, capabilities and business models to take advantage of changes in digital technologies and their impac in a prioritized and strategic way" (Hamidi *et al*., 2018) [4]. The enablers of digital transformation are cloud computing, mobile computing, fog computing, big data, data science, business analytics, social computing, the Internet of Things, systems virtual reality, etc. At the heart of digital transformation are changes within and between organizations and their transformations at different levels including governance, strategy, people, leadership, culture and technology (Heilig *et al*., 2017) [5]. In Vietnam, digital transformation is helping businesses easily collaborate and share data between customers, manufacturers, suppliers and other parties in the supply chain. Digital transformation improves productivity and competitiveness, enables the transition to a digital economy, and provides opportunities to achieve economic growth. Digital transformation changes business operations at many different levels and changes the entire production, management and governance system. New products, new services, new models, etc. are factors that help businesses increase their competitive advantage in the market. Ketter (2012) [6] affirms that in the context of digital transformation, the challenge for organizations is how fast and how far they can go on the digital transformation path. Innovation is important because it allows companies to make quick, flexible decisions to respond to immediate needs and market changes. Innovation and sustainability go hand in hand, ensuring business goals by creating tomorrow's solutions and technologies with positive socio-economic impact.

The Role of Digital Transformation in the Circular Economy

According to research by Kristoffersen and colleagues (2020) [7], digital transformation is an important factor contributing to the operation of the circular economy model through monitoring and controlling the flow of materials and products; building a healthy data system helps management activities and supports people in making decisions in all stages of production and business activities.

Kristoffersen and co (2020) [7] have developed a "smart circular economy" framework to describe the role of digital transformation in the operation of the circular economy model. The main factors to build the framework include: Data transformation levels, Resource optimization capabilities, Data flow processes. Accordingly, "Data Transformation Level" describes the process of converting from raw data to information using information technology (IoT). Information is processed and analyzed to provide highly accurate and practical solutions to support people in the decision-making process. Next, "Resource optimization ability" provides a comprehensive picture of resources, thereby pointing out problems and root causes to provide solutions as well as predict trends. On that basis, provide solutions to optimize resources. "Data flow" describes the process of using information technology to collect, synchronize data and support data analysis and processing. The "smart circular economy" framework will help people make decisions quickly and accurately, help diagnose problems, reduce risks, and systematically increase the efficiency of organizational resources through apply information technology.

The application of artificial intelligence technology can promote the transition to a circular economy as well as promote innovation right from the early stages of production and business activities such as design, calculating prototype models, running tests to operating operations, optimizing infrastructure for organizations applying circular models (Ellen MacArthur, 2019) [3]. Digital transformation in general and technology in particular create favorable conditions for businesses to use resources effectively, promoting the transition to a circular economy model. Smart solutions have helped reduce energy consumption, control transportation routes and increase organizational productivity. Digital transformation supports the management and operations of businesses through a transparent data system, from which people have a basis to make effective business decisions (Antikainena *et al*., 2018) [1]. The combination of technology and circular economy models is encouraged to be applied to new business models of corporations in all fields of industry. This combination not only brings economic benefits but also social and environmental benefits.

3. Research Methods

To find out the current status of implementing the circular economy model and evaluate the role of digital transformation for Vietnamese businesses moving towards a circular economy, the author developed a questionnaire for the survey.

Select sample and survey subjects: The survey was built a questionnaire on Google Forms, sent it to accountants and business managers via email using a convenient sampling method, and sent it to friends, relatives, and partners. The number of survey questionnaires distributed was 250, sent to 250 enterprises, and the number of votes collected was 220 from 220 enterprises, reaching 88%. All receipts meet the required information requirements.

The structure of the questionnaire is divided into 3 parts:

Part 1: General information about interview subjects

Part 2: Assessing the implementation of circular economy in businesses

To evaluate the level of circular economy development, inherited from Neri's research (2023), the author uses a 4-level Likert scale: 1-We are currently evaluating the implementation of the circular economy model complete; 2-Currently we are implementing a circular economy model; 3-We deployed in less than 3 years; And 4-We have been implementing the circular economy model for more than 3 years.

Part 3: Assessing the role of digital transformation in the circular economy in Vietnamese businesses

This section includes questions to evaluate the role of digital transformation in the circular economy in Vietnamese businesses. The author uses a 5-level Likert scale: 1-Not important; 2-Less important; 3-Normal; 4-Important; 5-Very important.

4. Research Results

4.1 Implementing Circular Economy in Vietnamese Businesses

Table 1: Situation of implementing circular economy

	N	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
Design products to reduce resource consumption	220	2	4	3.69	.102	.545
Reusable product design, sanctions, and material recovery	220	1	4	3.10	.134	.933
Reduce energy consumption	220	2	4	3.17	.157	.858
Reduce pollutant emissions	220	2	4	3.24	.134	.739
Green packaging and distribution	220	2	4	3.32	.150	.823
Circular management, and continuous monitoring	220	1	4	2.57	.214	1.180
Special training for recognition of environmental issues in internal operations	220	1	4	3.15	.203	1.125
Select suppliers using environmental criteria	220	1	4	2.55	.180	1.021
Recycle products after their expiration date as a business model	220	1	3	2.00	.144	.756
Recycle raw materials and scrap for production	220	1	4	3.02	.217	1.165
Valid N (listwise)	220					

Through the survey results, the level of implementation of the circular economy model is shown in Table 1. All surveyed companies have implemented at least one activity in the circular economy model, but not Is there any company that has carried out all the activities in the questionnaire. Furthermore, some circular economy model practices are implemented very little by businesses, especially the activities of selecting suppliers using environmental criteria and recycling products after their expiration date such as a business model with mean of 2.55 and 2.00 respectively. For the circular economy model practices that have been implemented, the average level of implementation is from 2.00-3.69, so most Vietnamese businesses have implemented the circular economy model in their businesses but it is still in the implementation phase, and some businesses have been implementing it for over 3 years.

4.2 Awareness of the Role of Digital Transformation in the Circular Economy in Vietnamese Businesses

The results of assessing the role of digital transformation in the circular economy show the average value of awareness of the importance of factors in digital transformation (internet of things, big data analysis, cybersecurity, cloud computing) have similar values, ranging from 3.04 to 3.34. Among them, two contents rated as more important are big data analysis and network security with a mean of 3.34. Cloud computing content alone is rated as the lowest important content in the circular economy with a mean of 3.04.

Table 2: Statistics describing the role of digital transformation in the circular economy

	N	Minimum	Maximum	Mean	Std. Deviation
Internet of Things (IoT)	220	1	5	3.07	1.045
Big Data/Big Data Analytics	220	1	5	3.34	1.047
Network security	220	1	5	3.34	.877
Cloud computing	220	1	5	3.04	1.036
Valid N (listwise)	220				

4.3 Differences in Implementing Circular Economy for Businesses that are Implementing Digital Transformation and Businesses that have not yet Implemented Digital Transformation

Table 3: Current status of applying circular economy compared to implementing digital transformation

CE	DE	N	Mean	CE	DE	N	Mean
Design products to reduce resource consumption	No	76	3.19	Reusable product design, sanctions, and material recovery	No	76	3.00
	Yes	144	4.07		Yes	144	4.00
Reduce energy consumption	No	76	2.31	Reduce pollutant emissions	No	76	2.50
	Yes	144	3.22		Yes	144	3.45
Green packaging and distribution	No	76	2.31	Circular management, and continuous monitoring	No	76	2.50
	Yes	144	3.22		Yes	144	3.25
Special training for recognition of environmental issues in internal operations	No	76	2.31				
	Yes	144	3.68				

The results of the study evaluating the difference in implementing circular economy for businesses that have applied digital transformation and businesses that have not applied digital transformation are shown in Table 3. The data obtained shows that there is a clear difference in the level of implementation of the circular economy model. Activities in the circular economy model, including Product design to reduce resource consumption; Designing reusable products, sanctions, and material recovery; Reduce energy consumption; educe pollutant emissions; Green packaging and distribution; Circular management, and continuous monitoring; and special training for recognizing environmental issues in internal operations are all conducted more in businesses that have applied digital transformation to their production and business processes.

5. Conclusion

Digital transformation is the integration of digital technologies into all areas of a business, leveraging technologies to fundamentally change operations, business model and deliver new values to its customers as well as accelerate business operations. The development of the 4th Industrial Revolution with the explosion of digital technology based on IOT today is the inspiration and driving force for promoting circular economic development. Survey results of 220 Vietnamese businesses show that businesses have initially converted to a circular economic model to replace the linear economic model to develop businesses towards sustainable development. Managers of surveyed businesses are also aware of the importance of digital transformation in the circular economy.

Based on the benefits and relationships between digital transformation and the circular economy, perfecting institutions, policies, laws and coordination and operating mechanisms according to systematic and effective principles is important and necessary. Promoting digital transformation and applying digital technology achievements should be considered one of the main solutions of the National Action Plan to implement a circular economy. It is necessary to promote innovation throughout the system to form, develop and link circular economy initiatives based on technical, commercial technology and legal impulses. Decision 687/QD-TTg dated June 7, 2022 approved the Circular Economy Development Project in Vietnam and this Project is one of the first important efforts to determine the roadmap, requirements and regulations. Circular economy development direction in Vietnam. Vietnam can access and apply the latest technological advances, associated with digitalization and industrial revolution 4.0 solutions. In particular, optimizing production links, input-output relationships between goods and services, and between components in the circular economy model can rely on 4.0 technologies, including big data, internet of things, etc.

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