

The role of digital transformation in the circular economy in Vietnam

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Abstract: Digital transformation makes an increasingly significant contribution to the circular economic development in Vietnam. Based on the theoretical basis of the circular economy, the combination of circular economic development and digital transformation can bring significant opportunities and benefits. Vietnam has been implementing digital solid transformation, creating a favorable environment to promote circular economic models to be founded and developed. However, there are still several challenges to be resolved to optimize the impact of digital transformation on circular economic development. Based on an analysis of the role of digital transformation in circular economy development, the article proposes some solutions to promote the application of digital transformation in the process of completing and developing the circular economy in Vietnam soon.

Keywords: Circular economy; digital transformation; role; reality; Vietnam.

1. Introduction

The reality of over-exploitation of natural resources, rapid population growth, and intense climate change creates an inevitable need for each country to transform into a circular economy to ensure more efficient and sustainable socio-economic development. In addition, the explosion of information technology and telecommunications, along with the spread of the Internet and the rapid growth of digital technology, is an essential factor enabling the promotion of circular economy development in countries worldwide (Hedberg & Šipka, 2021).

Similarly, Antikainen et al. (2018) believe that digital transformation helps to optimize the interactions among resources, reduce waste, and create more sustainable industrial values. Therefore, research on the role of digital transformation in the circular economy model helps understand the potential and application of digital technology and identify adequate strategic directions to promote this process. Applying digital transformation to the circular economy in Vietnam is an inevitable trend since this combination brings numerous benefits. Digital transformation and

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circular economy are critical components that must be linked together (Tho & Hang, 2023).

In this context, the study was conducted to clarify the role of digital transformation in the circular economy in Vietnam today, thereby proposing solutions to promote its application in perfecting and developing the circular economy in Vietnam.

2. An overview of the circular economy

The term "circular economy" was first mentioned by Pearce and Turner (1990) when these scholars proposed a new economic model. The new model differed from traditional linear economic ones, where "everything is an input to something else". To date, several concepts of the "circular economy" have been proposed by different authors on a theoretical basis. Kirchherr et al. (2017) summarized one hundred and fourteen concepts of circular economy, thereby suggesting the idea that circular economy is an economic system based on business models that focus on reducing and reusing, recycling and collecting materials in the production/distribution and consumption processes at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (cities, regions, countries and larger). Therefore, sustainable development goals are achieved in the circular economy, ensuring the quality of the natural environment, economic prosperity, and social justice for the benefit of present and future generations.

In Vietnam, Article 142 of the Law on Environmental Protection 2020 affirms that "a circular economy is an economic model which encompasses the design, production, consumption, and services activities aimed at reducing raw materials, extending product life, reducing waste generation, and minimizing adverse impacts on the environment."

Although there are different concepts of circular economy, scholars unanimously agree on its operational mechanisms as well as the benefits that circular economy brings about

(Thao & Binh, 2021; Antikainen et al., 2018; Hedberg & Šipka, 2021), specifically as follows:

(1) For the economy: the circular economy facilitates economic growth through reducing and circulating natural resources to cope with the depletion of natural resources at the input and the situation of environmental pollution at the output and to achieve the goal of economic profit for businesses and the natural environment quality. The circular economy also helps save costs of input materials, minimize fluctuations and risks in production and supply activities, and promote innovation in production and business. At the same time, it also opens up several new job opportunities for local people, especially workers with primary-level and semi-skilled qualifications.

(2) For businesses: The circular economy helps businesses increase their ability to respond and be more flexible with business and natural environment fluctuations. Specifically, these include changes in input materials during the production and business process, market demand change, the emergence of business opportunities and new services such as collection and support services for recycled products, marketing services, and sales services aimed at extending the life cycle of products, remanufacturing parts and components, product refurbishment services. Economical use of natural resources also helps businesses reduce production costs. The circular economy will generate long-term benefits and competitive advantages to help businesses develop sustainably.

(3) For the natural environment: The circular economy has positive impacts on ecosystems; it increases efficiency in agricultural land use, reduces the use of artificial fertilizers, contributes to the natural balance of the soil, optimizes the productivity of agricultural production, minimizes environmental pollution; moves towards a low-carbon economy, especially in heavy industries; reduces greenhouse gas emissions; reduces negative impacts brought on by linear

economic models, and creates long-term resilience for the natural environment.

For the circular economy, the role of digital transformation is demonstrated through the following contents:

First, digital transformation allows businesses to access data related to the resource consumption level of the product, optimizes product life cycles, and facilitates circular systems. Bressanelli et al. (2018) clarified eight roles of the Internet of Things and big data analytics that facilitate the transition to a circular economy, including improving product design, attracting target customers, monitoring and tracking products, providing technical support, providing maintenance services, optimizing product usage, upgrading products, enhancing innovation activities, and ending product life cycle (Hedberg & Šipka, 2021).

With their related cycles and interactions, circular economy systems form large databases. Digital transformation provides new means of accessing this data, helping businesses make decisions regarding product life cycle stages, know how to reuse waste, arrange logistics efficiency, and allocate human resources reasonably. Digital transformation also creates opportunities to build and exploit online distribution channels through which product values can be advertised to customers (Hedberg & Šipka, 2021). In the circular economy, the coordination of physical and information flows plays an important role, similar to the quantity and quality of products and raw materials used in the production, transportation, consumption, and reuse of product processes. Additionally, digital solutions allow circular business models to monitor, control, and automatically optimize resources and material flows. At the same time, the strong relationships of customers and end users will be maintained (Hedberg & Šipka, 2021).

Second, digital transformation also plays a vital role in transitioning from traditional economic models to the circular economy, from essential contributions to operating the circular economy model to promoting the transformation process. Specifically, digital transformation promotes the operation of the circular economy model through monitoring and controlling the usage flow of materials and products, builds an accurate and complete data system to help manage activities, and supports administrators in making effective and timely decisions in production and business activities. Kristoffersen et al. (2020) proposed a "smart circular economy" framework, clarifying the role of digital transformation in the operation of circular economy models, including data conversion level, the ability to optimize resources and data flow. All of these thereby support administrators in making decisions quickly and accurately, helping diagnose problems, reduce risks, and systematically increase the efficiency of the organization's resources through optimal application of information technologies (Chau, et al., 2022).

The application of artificial intelligence (AI) technology in designing and calculating prototype models and running tests, management activities, and the optimization of infrastructure aimed at applying circular models have contributed significantly to promoting the transition to the circular economy. Digital transformation creates favorable conditions for businesses to use resources effectively, minimize energy consumption, control transportation routes, and increase organizations' productivity; support the management and operation of businesses through a transparent data system, thereby helping administrators make effective business decisions and promote the transition to the circular economy (Antikainen et al., 2018).

Third, digital transformation, combined with a circular economy, will help achieve economic development and effective use of

natural capital, reducing waste generation, minimizing negative environmental impacts, and associating with sustainable development. If we focus on promoting circular economic development without combining it with digital transformation, recycling measures will only reach a particular result and cannot develop quickly and strongly; if we only promote digital transformation without combining it with the circular economy, there will be a potential risk of generating a larger volume of waste into the natural environment at a faster rate, quickly destroying it. The circular economy cannot be associated with sustainable development (Hedberg & Šipka, 2021).

Overall, digital transformation contributes to achieving the goals related to waste management, such as waste prevention, reduction, monitoring, classification, collection, transportation, reuse, recycling, and waste treatment at each level in the circular economy model. Thanks to that, many new circular business models and types of goods and services will be created to meet social needs in the new context.

3. Research methodology

The study employs primary and secondary data to clarify the role of digital transformation in the circular economy. Specifically, secondary data is collected from different sources, such as mass media, reliable research, and reports in Vietnam and abroad. Reputable domestic research sources are also used to provide the scenario of circular economy development and the role of digital transformation in circular economy development in Vietnam. At the same time, the primary data are collected through direct interviews with experts in both fields.

After being collected, the data is processed through synthesis, statistics, in-depth analysis, and comparative methods. The author analyzes the secondary data using methods of synthesis, statistics, and analysis in a logical, systematic manner and presents it scientifically in reports

on issues of the circular economy, digital transformation, and the role of digital transformation in circular economic development in Vietnam. Furthermore, to clarify the current status of the circular economy and the role of digital transformation in circular economy development in Vietnam, the author synthesizes the primary data obtained through direct personal interviews, uses software for data processing, and presents the necessary results. Evaluation, analysis, and report writing are conducted based on the results.

4. Research results

4.1. The current status of circular economy development in Vietnam

The depletion of natural resources and environmental pollution have been taking place seriously in Vietnam. From a coal exporting country, Vietnam began to import coal in 2001 and has been a net coal importer since 2015. At the same time, we also have to import many other raw materials to develop the economy, such as crude oil, iron, and steel of all kinds, common metals, plastic raw materials, and auxiliary materials for textiles, garments, and footwear. According to data from the World Bank (WB), Vietnam is one of the largest sources of plastic waste in the world; it is estimated that about 3.1 million tons of plastic waste is generated on land, and the amount of waste dumped in the ocean ranges from 0.28 to 0.73 million tons per year .

These issues have created tremendous pressure on the economy, requiring new economic development models that are effective and responsive to environmental fluctuations and can ensure sustainable development for society. In particular, the circular economy development model is a promising direction aimed at limiting the use of primary resources, maintaining the highest value of materials and products, and ensuring environmental quality and society for sustainable economic development.

Although the circular economy model is

still new in Vietnam, several successful business models have initially implemented it in agriculture, such as the Garden - Pond - Barn model and the Forest - Garden - Pond - Barn model. These models use livestock manure to fertilize crops, serve fish, and use crop products as a food source for livestock; the household biogas digester model combines livestock farming with energy supply and environmental pollution.

In the urban area and industrial sectors, some results have also been achieved in the development orientation towards a circular economy. With capital support from the Swiss State Secretariat for Economic Affairs (SECO) and the Global Environmental Facility (GEF), from 2014 to 2019, the United Nations Industrial Development Organization (UNIDO) collaborated with the Ministry of Planning and Investment to implement the pilot conversion of industrial parks into eco-industrial parks in Ninh Binh, Da Nang and Can Tho. With support from SECO, UNIDO, and the Ministry of Planning and Investment, three industrial parks in Ho Chi Minh City (Hiep Phuoc Industrial Park), Hai Phong (Dinh Vu Industrial Park), and Dong Nai (Amata Industrial Park) continue to be converted to eco-industrial parks in the 2020 – 2023 period. Eco-industrial parks bring many benefits in terms of economy, society, natural environment, and biodiversity; new technologies and business models applied in eco-industrial parks contribute to promoting the circular economy model and green, sustainable industrial growth. Large manufacturing and retail distribution corporations have created anti-plastic and packaging recycling alliances with the participation of businesses in plastic waste recycling programs, such as TH Group, Coca-Cola, La Vie, Nestle, and Nutifood.

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However, developing the circular economy in Vietnam also faces many difficulties and barriers. Many circular economy models in Vietnam are still in their early stages and have not become popular since the legal corridor to encourage circular economy still needs to be completed. For example, the sharing economic model does not have a clear legal basis, and the situation of tax revenue loss still exists due to the State's inability to manage it; policies to encourage circular economy development are unclear and do not provide enough incentives for businesses to implement it. Waste recycling faces numerous difficulties since most of the waste in Vietnam has not been classified at source; the amount of waste generated is large, but recycling activities still stay on a small scale; recycling treatment technology is quite outdated, and landfilling remains the most popular waste disposal method. In many industrial clusters, there are no centralized wastewater treatment plants; some places have wastewater treatment plants, but they need to operate effectively; many production facilities carry out the wastewater treatment by themselves before discharging directly into the environment. Therefore, the quality of wastewater discharged in industrial zones is also a significant issue that needs attention.

4.2. The current status of digital transformation in circular economy development in Vietnam

According to VINASA (Viet Nam Software and IT Services Association), in 2020, over 92% of businesses in Vietnam were interested in or applied digital transformation in their business activities. However, only nearly 10% of them believe digital transformation has succeeded and

can bring significant value to businesses. The number of small and medium enterprises in Vietnam accounts for 97%, but the current state of innovation and science-technology needs to be qualified enough to carry out digital transformation. In Vietnam, digital transformation is by far an urgent issue that attracts attention from the Government to apply in all areas of life across all provinces and cities, especially the application of digital transformation in circular economy development to ensure green and sustainable development for the socio-economy when the environment and natural resources suffer from lots of threats nowadays. The reality of the role of digital transformation in circular economy development in Vietnam will be analyzed as follows.

Digital transformation is essential in creating motivation to promote circular economic development in the new context. Currently, there are many developing digital technologies such as information technology and communications, network systems, network communications - the Internet of Things (IoT), simulation, data analysis, robotics, virtual reality enhancement, and intelligent tools supporting the public. Especially potential technologies that promote the implementation of the circular economy include mobile phones, machine-to-machine communication technology, cloud computing, social multimedia communications for businesses, extensive data analysis, modular design, advanced recycling, material science and life technology, tracking and monitoring systems, and 3D printing technology. Digital transformation and circular economy are two closely linked components that need to be developed in parallel to create resonance to achieve economic development goals, effective use of natural capital, reduction of generated waste, and reduction of negative impacts on the environment. On the other hand, focusing only on digital transformation or circular economy will lead to unsustainable development impacts. The reason is that if we

only promote the development of the circular economy without integrating the achievements of digital transformation, the circular economy will only be traditional recycling and traditional reuse measures; or if we only develop digital transformation without paying attention to the circular economy, there will be a potential risk of creating large consumption, leading to a large amount of waste generated and affecting the environment quickly and thoughtfully.

Digital transformation will create new circular business models and types of goods and services. The Organization for Economic Cooperation and Development (OECD) defines the types of goods and services that will appear shortly: ecological design, design for recycling and reuse, old goods, refurbishment, repair, and update services, and buying and selling secondary materials and fuels. Businesses can apply digitalization to promote cleaner production, design, and product management that comply with ecological criteria, develop recycling systems, reuse products, and create waste treatment plants that operate effectively based on modern technology and digital transformation. State management agencies can apply digital transformation in activities such as automatic monitoring, data collection, management and analysis, waste source control, effective data use, forecasting support, warning, and timely response to unusual incidents. Local governments can also develop economic activities related to the circular economy, such as rental services, design, repair, and refurbishment, to create jobs and increase income for local people.

Digital transformation contributes to developing the agricultural circular economy. Digital transformation in agriculture is the process of changing the traditional agricultural production model to the agricultural model that uses technical technology as the foundation, applying technology to all agricultural production activities, maximizing

raw materials and waste by-products to recycle into products or input materials, creating a circular mechanism in production, contributing to environmental protection, forming a circular and sustainable Economic model in the future. Digital transformation in agriculture reduces production costs, minimizes environmental pollution, and effectively utilizes waste by-products of the production process. At the same time, it is possible to combine with the tourism industry to develop an agroecological tourism model to create a circular economy model. Therefore, to develop the circular agricultural economy, it is necessary to promote digital transformation and apply scientific and technological achievements to the agricultural economic production model.

Vietnam's development orientation for 2021 - 2030 is to develop agriculture based on digital transformation and the linkage between domestic and international markets. Therefore, Vietnamese agriculture must enhance its competitive advantage and adapt to new conditions by applying innovative technology to agricultural production activities. It is promised that the application of advanced livestock techniques, the use of robots, satellite data, and drones will soon become popular and bring green results.

However, climate change and its consequences on weather patterns have an increasing impact, making the salinity more serious; farmers' access to technology is still limited; the investment of technology in agricultural production is initially expensive, and the process of accessing resources to develop agriculture faces lots of difficulties; farmers seriously lack information about the market, standards and sales channels, so the situation of "good harvest but low price" still happens quite often. People are still not aware of digital transformation, how to implement it, or the benefits digital transformation brings. These facts greatly influence the digital transformation process to circular economy

development in Vietnam.

Digital transformation plays a role in promoting the industrial waste management system to operate accurately and professionally. Currently, organizations operating in the environmental sector and state management agencies submit environmental reports in paper or soft copy one to four times per year to state management agencies on the following contents: management of imported and exported scrap, the volume of scrap generated, periodic environmental monitoring and supervision; composition, characteristics, and volume of waste (hazardous or non-hazardous; type of waste: solid, liquid, gaseous). According to Circular 36/2015/TT-BTNMT, vehicles transporting hazardous waste must have a Global Positioning System (GPS) connected to an online network to determine the location and record the transport itinerary. According to Decree No. 53/2020/ND-CP, the management and collection of wastewater environmental protection fees is done by inputting data into software. In general, except for vehicles transporting hazardous waste and declaring environmental protection fees for wastewater, environmental report activities for industrial waste management apply only the utmost basic level of digital transformation with office software.

The Party and State of Vietnam have several guidelines and policies on the role of digital transformation in developing the country's circular economy. The Politburo issued Resolution No. 55-NQ/TW dated February 11, 2020, on the orientation of Vietnam's National Energy Development Strategy through 2030, with a vision toward 2045, which affirms the priority of developing renewable energy and building power plants that use waste to protect the environment and develop the circular economy. Directive No. 36/1998/CT-TW, dated June 25, 1998, of the Politburo aims to strengthen environmental protection in the period of industrialization and modernization of the country, focusing on supporting the

application of clean technology with low material consumption. The Prime Minister approved the Scheme on "Development of Vietnam's environmental industry toward 2025" to form an environmental industry that can meet circular economic models in a new context; in 2020, the Prime Minister also approved "the National Action Plan on Sustainable Consumption and Production from 2021 to 2030". In addition, many guidelines, programs, and policies of the Party and State are focused on digital transformation in circular economy development.

Results of direct personal interviews with circular economy and digital transformation experts working in Vietnam on the current status of circular economic development and the application of digital transformation in circular economy development in Vietnam are shown as follows:

Many Vietnamese enterprises need to pay attention to digitalizing their data and figures. Businesses with foreign elements may digitize or partially digitize data. Managing and sharing information between departments of multiple organizations within the same unit are often done via social networks (Zalo, Viber, and Messenger) and email. Excel software is essential for statistics, analysis, and data processing. Manufacturing enterprises must declare the volume of treated and recycled waste (scrap) and periodically report to state management agencies; however, data on recyclable waste only focuses on high-value types such as copper, aluminum, paper, and plastic. Small and medium-sized enterprises often need to pay more attention to statistics and the process of recycling some low-value waste generated during the production process, such as ash and slag from boilers, oil furnaces, and waste incinerators. Some large manufacturing corporations have environmental audit systems for the entire supply chain, so recyclable waste flows are controlled throughout the supply chain regarding volume, quality, and recycling.

Data digitalization at many state management agencies has not yet been implemented even though the Prime Minister approved Decision No. 749/QĐ-TTg dated June 3, 2020, on "National digital transformation program to 2025, orientation to 2030". Currently, some state management agencies have to outsource inputting data from paper reports into Excel files to consulting units and external workforce at different times. Since the digitalization activities have not been synchronized, data sources on the environment, such as waste generation, storage, and waste treatment from provinces and cities, have yet to be effectively utilized for state management agencies to make timely and accurate decisions.

5. Solutions and conclusion

In order to promote the application of digital transformation in the process of completing and developing the circular economy in Vietnam in the coming time, several recommendations to the Government are proposed as follows:

Firstly, institutionalization and improvement of the legal environment system should be promoted, and transparent policies and synchronizing support policies should be implemented to perfect and develop the circular economy. Technical and environmental standards and tax tools are necessary to limit the overuse of resources and waste in the production and business process. The State needs to build a roadmap to develop the circular economy for each specific stage and identify the goals to be achieved and specific regulations for each stage, which are associated with the roles and responsibilities of relevant parties. The State must also integrate the circular economy immediately from the beginning stages of building strategies, plans, programs, and economic development projects. At the same time, it encourages the development of the circular economy through a system of synchronous support policies on credit incentives, tax

exemptions, planning, and supporting production premises in industrial zones and clusters specific to the waste recycling industry. In addition, the State needs to launch programs to encourage the implementation of a circular economy associated with technology development, digital economy, and industrial revolution 4.0 to take advantage of and maximize new circular initiatives that may appear from the development of technology.

Secondly, all economic sectors should be encouraged to participate in waste recycling, apply digital technology to connect businesses with recyclable industrial waste recycling businesses, and create a waste collection system and industrial waste market to increase the proportion of recycled waste gradually. Encouraging businesses to participate in the circular economy, production, and business associated with environmental protection; making clear and strict regulations on the treatment of waste generated by businesses; strictly handling violations.

Thirdly, promoting the introduction of regulations on a roadmap to replace fuels and products using hazardous materials and single-use products with environmentally friendly fuels and materials, multiple-use products, extending the product's useful life, and applying scientific and technological achievements of the 4.0 industrial revolution to solve this problem. Offering practical solutions to collect and classify household waste at source, expanding manufacturers' responsibility, and promoting new markets related to the recall and recycling of plastic, paper, metal, and the market providing recycled products. Making policies to stimulate the development of renewable and biomass energy, energy from waste incineration, and limiting the use of materials that are difficult to recycle.

Fourthly, supporting and promoting businesses to firmly apply the achievements of digital transformation in logistics activities and supply chain management in domestic

agriculture to join the global supply chain and promote adequate circulation of goods and raw materials domestically, between provinces, focal points, and distribution centers. Hence, agricultural, forestry, and fishery products of Vietnamese origin from domestic and foreign enterprises gain a competitive advantage in the international market and can meet strict quality standards as well as plant quarantine standards of other countries.

Fifthly, communicating and educating about the circular economy through training programs at all levels to build complete and proper awareness for future generations in their development process, thereby contributing to social development in the future. Developing communication programs with attractive and easy-to-understand content to inform and spread to people and the business community about the benefits of the circular economy and raising people's and businesses' awareness in protecting the environment, effectively using natural resources or classifying waste and handling waste treatment in daily life as well as in production and business activities. At the same time, it is necessary to emphasize the role of digital transformation in circular economy development in Vietnam.

In conclusion, the overexploitation of natural resources and environmental pollution have occurred in Vietnam. This reality has created tremendous pressure on the economy, requiring a new economic development model that is effective, responsive to environmental fluctuations, and ensures sustainable development for society. Therefore, the circular economy development model is a promising direction and an inevitable development trend. The application of digital transformation in the circular economy in Vietnam remains an inevitable trend thanks to the great benefits generated by this combination. Digital transformation plays a vital role in creating motivation to promote circular economy development in the new context, contributes to

creating new circular business models and new types of goods and services, and develops a circular agricultural economy. At the same time, digital transformation exerts a role in promoting the system of industrial waste management to operate accurately and professionally.

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