



Digital Twinning and Artificial Intelligence in the Circular Economy: An Exploratory Study on the Digital Twinning Project in Water Management in the Netherlands

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Received :04/02/2025

Accepted :20/05/2025

Published :01/06/2025

Abstract:

This study aims to highlight how digital twinning and artificial intelligence can improve the efficiency of the circular economy, with a focus on the digital twinning project in water management in the State of the Netherlands, and to achieve the objective of the study, the descriptive approach was relied upon through which a deep and comprehensive understanding of how to improve digital twinning and artificial intelligence for the efficiency of the circular economy in the water management project in the Netherlands, and to provide practical recommendations for future projects, while the study found the importance of investing in modern technology to achieve better sustainability. and higher efficiency in the management of natural resources.

Key words: Digital Twinning, Artificial Intelligence, Circular Economy, Water Management

Jel Classification Codes : O32, Q25, Q55, L63

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Introduction:

In light of increasing environmental challenges and natural resource pressure, the circular economy has become one of the main strategies for achieving sustainability and resource efficiency. The world is moving towards more inclusive economic models that focus on recycling, reducing waste, and extending the life of products. In this context, digital twinning and artificial intelligence technologies are emerging as pivotal tools in enhancing the effectiveness of the circular economy, especially in the water management sector.

In this context, the survey of the digital twinning project in water management in the Netherlands is a prominent model. The Netherlands, thanks to its state-of-the-art infrastructure and commitment to sustainability, is one of the pioneers in using these technologies to improve water management. The project seeks to use digital twinning to create digital models of water systems, enabling accurate data analysis, optimizing water consumption, and reducing waste.

This study seeks to explore how digital twinning and artificial intelligence can be used to achieve circular economy goals by evaluating the applications of a water management project in the Netherlands, and identifying the successes, challenges and potential opportunities of this approach.

In order to determine the importance of digital twinning and artificial intelligence studies in the circular economy, this study will answer the following question: **How can digital twinning and artificial intelligence improve the efficiency of the circular economy?**

1. Research methodology

Through this section, the approved methodology and the different tools used in the research will be described, and this section has been divided into sub-sections, which are as follows:

1.1 Hypotheses of the study:

Based on the problem of the study, the following hypotheses were formulated:

Hypothesis one: Digital twinning and AI can improve resource management in the circular economy by providing accurate insights into resource use and recycling.

Hypothesis two: digital twinning and artificial intelligence can contribute to accelerating and improving recycling and reuse processes in the circular economy.

Hypothesis three: Digital twinning and artificial intelligence can foster innovation in product design so that they are more compatible with the principles of the circular economy.

1.2 Objectives of the study:

In our study of this topic, the following objectives can be identified:

- Study the economic and environmental benefits resulting from the use of digital twinning and artificial intelligence in the circular economy.
- Analyze how a digital twinning project can contribute to achieving circular economy goals, such as reducing waste and promoting reuse.
- Analyze how AI can be used to analyze data from digital twinning to predict problems, improve operations, and deliver more sustainable solutions.
- Study how digital twinning is applied in tracking and analyzing water data, and how to use it to improve resource management and reduce waste.
- Identify challenges and obstacles facing the implementation of digital twinning and artificial intelligence in water management.
- Explore how digital twinning can be used in water resources management in the Netherlands.
- Study the applicability of the Dutch experience in other countries and highlight local differences and considerations.
- Provide recommendations to improve the application of digital twinning and artificial intelligence in future water management projects.

1.3 Study Methodology:

In order to answer the problem posed for the study and ensure the validity of the hypotheses, and in order to achieve the objectives of the research, the descriptive approach was relied on, through:

- Describe and analyze how digital twinning and artificial intelligence are applied in a water management project in the Netherlands.
- Documenting and detailing how digital twinning and artificial intelligence are used in current water resources management.
- Analyze the data collected to assess benefits, challenges and best practices.
- Analyze the effectiveness of digital twinning and artificial intelligence in improving water management efficiency.
- Evaluate the extent to which the objectives of the circular economy are achieved through the field application of the project.

Using this approach, a deep and comprehensive understanding of how digital twinning and artificial intelligence can improve circular economy efficiency in a water management project in the Netherlands, and provide practical recommendations for future projects Futurism.

2. Digital twinning: concept and applications

Digital twinning is a revolution in sustainability and efficiency, providing ample opportunities for continuous improvement and cost reduction, and the digital twin acts as a bridge between the physical and digital worlds, enabling real-time monitoring, analysis and optimization of systems.

2.1 The concept of digital twinning

Digital twinning is a technique that relies on creating a digital model of a particular physical object or process, so that that object or process can be followed, analyzed, and monitored in real time. The goal of digital twinning is to improve performance, predict problems, and provide valuable insights on how to improve operations. (Rathore, Syed, Dhirendra, Elmahdi, & Spiridon, 2021)

Digital twinning helps improve the performance of systems by providing insights into how objects or processes perform. Digital models can be used to predict potential issues, such as malfunctions or deterioration in performance, contributing to better decisions about maintenance and improvements. (Solman, Julia, Mattijs, Bas, & Simon, 2022)

In the context of smart cities, digital twinning is used to improve the management of urban infrastructure such as energy, water and transport networks, digital models can help improve urban planning and development processes, providing insights on how to improve urban services and reduce problems. (Dang, Mallik, & Huan, 2021)

From these three definitions, digital twinning provides an effective way to see and analyze performance and processes deeper and more detailed, helping to make informed decisions and achieve continuous improvements.

2.2 How digital twinning works in resource management

Digital twinning is a powerful tool in resource management, whether these resources are physical assets such as machinery and equipment, or intangible resources such as energy and water. Digital twinning improves management efficiency and provides valuable insights that help inform decision-making, and here's how digital twinning works in resource management: (Sepasgozar, Felix Kin, Sara, Mona, Liming, & Lu, 2020)

2.2.1 Performance monitoring and analysis: Digital twinning collects real-time data from sensors installed on assets or resources. This data is used to continuously update the digital model, allowing administrators to monitor current performance and track the status of resources.

2.2.2 Efficient resource management: With digital twinning, resources can be managed more effectively by analyzing resource usage data and identifying patterns. Digital models can simulate different scenarios to see the potential effects of certain changes on resource consumption.

2.2.3 Improve planning and decision-making: Digital twinning uses digital model simulation to predict the outcome of different scenarios, which helps in making strategic decisions. Resource planners can use this simulation to experience changes in processes or management strategies without risking negative impacts on actual resources.

2.3 The role of digital twinning in sustainability within the circular economy

Digital twinning is a powerful tool to promote sustainability in a circular economy by improving efficiency, reducing waste, fostering innovation, and supporting sustainable design: (Mügge, Anne, Tessa-, Theresa, & Kai, 2024)

2.3.1 Improve operational efficiency: Digital twinning can analyze the actual performance of a particular system and compare it to the default model. This helps in optimizing operational processes, reducing waste, and saving resources.

2.3.2 Product Lifecycle Analysis: Using digital twinning, the product lifecycle from production to use can be traced to the end of lifespan. This provides valuable information on how to optimize design to reduce waste and increase recyclability.

2.3.3 Develop preventive maintenance strategies: Digital twinning technologies can predict when breakdowns will occur or need maintenance. This reduces the need for reactive maintenance, helping to improve the sustainability of systems and reduce waste.

2.3.4 Improved product design: By simulating performance and predicting product behavior in different conditions, digital twinning technologies can support the design of more sustainable and recyclable products, in line with circular economy principles.

2.3.5 Promoting recycling and reused materials: Digital twinning can track information about materials used in recyclable products and components. This contributes to the development of more effective strategies for recycling and the use of recycled materials.

3. Artificial intelligence in the circular economy

Artificial intelligence plays a pivotal role in promoting the circular economy by improving efficiency, reducing waste, and enhancing sustainability through a range of innovative applications. The circular economy focuses on resource reuse, waste reduction, and sustainability through circular business models.

3.1 The role of artificial intelligence in promoting circular economy concepts

Artificial intelligence can play an important role in promoting circular economy concepts in many ways. The circular economy aims to reduce waste and increase the efficiency of resource use through material recycling and sustainability. Here are some ways AI can support these goals: (Pathan, Edana, Edgar, & Peter, 2023)

3.1.1 Improved resource management: AI can analyze resource consumption data more accurately, helping companies identify more efficient ways to use materials. For example, intelligent systems can forecast demand and optimize production schedules to reduce waste.

3.1.2 Boosting recycling: AI can improve material sorting and recycling through the use of computer vision and machine learning technologies. These techniques help in classifying materials more effectively and improving the quality of recycled materials.

3.1.3 Predict equipment failures: AI can analyze performance data and predict necessary maintenance times, helping to improve equipment life and reduce waste from unexpected failures.

3.1.4 Circular product design: AI can be used to design new products that are in line with circular economy principles. It can help develop new materials that are easily recyclable or improve product design to facilitate their disassembly and reuse.

3.2 AI-powered smart policies to support the circular economy

AI-powered smart policies can be highly effective in supporting and promoting circular economy principles. Here are some examples of how AI can be applied in formulating and implementing policies that support the circular economy: (Roberts, Joyce, Ben, Josh, Gilbert, & Prathm, 2024)

3.2.1 Data analysis to support decision-making: AI can analyze large amounts of data related to resources, products, and waste to identify usage patterns and make policy recommendations. For example, resource consumption data can be analyzed to identify areas that need to be improved or supported by policies.

3.2.2 Development of waste management policies: AI can be used to improve waste collection and sorting processes, facilitating the implementation of recycling policies more effectively. Smart systems can accurately identify waste types and locations, improving transportation and treatment processes.

3.2.3 Enhance transparency and monitoring: AI can support policies related to transparency in the supply chain by accurately tracking and managing materials. AI-based tracking systems can be developed to monitor the flow of materials and products from production to consumption and recycling.

3.2.4 Environmental Impact Assessment: AI can be used to accurately assess the environmental impact of products and processes, which can help develop policies that reduce negative environmental impact. AI can analyze product lifecycle data to make recommendations on how to reduce environmental impact.

3.3 Artificial intelligence and improving efficiency in the circular economy

Artificial intelligence can play a pivotal role in improving efficiency within the circular economy in several innovative ways. The circular economy focuses on reducing waste and increasing the efficiency of resource use through recycling, reuse, and recycling of materials. Here's how AI can contribute to these goals: (Noman, Umma, Tahmid, & Haque, 2022)

3.3.1 Optimization of manufacturing and production processes

- Smart Design: AI can help design products that are more resource-efficient and easily recyclable. AI models can be used to analyze product designs and deliver improvements that reduce waste and increase dismantlability.
- Predictive maintenance: AI can predict downtime and maintain equipment before problems occur. This reduces unexpected downtime and improves the efficiency of production processes, reducing waste from breakdowns.

3.3.2 Improved resource management

- Data analysis: AI can accurately analyze resource consumption data to identify patterns and trends, helping to optimize material use and reduce waste.
- Demand forecasting: AI can be used to improve product demand forecasting, helping to improve inventory management and reduce waste due to overproduction.

3.3.3 Enhancing recycling processes

- Waste sorting: AI can use computer vision technologies to identify different types of materials during waste sorting, improving the efficiency of the recycling process.
- Improve the quality of recycled materials: AI can improve processing and refining processes to make recycled materials more quality and usable in new products.

3.3.4 Facilitate disassembly and reuse

- Composition analysis: AI can analyze the internal composition of products to determine the best ways to disassemble and reuse them. This helps in designing products that are easier to disassemble and assemble again.
- Development of reuse systems: AI can help develop new systems and services to facilitate the reuse of products and materials, enhancing the economic cycle of materials.

4. Circular economy in the water sector

The circular economy in the water sector is a concept that aims to achieve sustainability through the use of water resources in an efficient and renewable manner, while minimizing losses and pollution.

4.1 The concept of circular economy and how to apply it in water management

A circular economy is an economic model that aims to reduce waste and reuse resources sustainably. Unlike the traditional linear economy which relies on extracting resources, manufacturing products, consuming and then disposing of them, the circular economy focuses on retaining value within the system for as long as possible. This is done through strategies that include recycling, reuse, repair, and regeneration, thereby reducing the environmental impact and avoiding the depletion of natural resources.

The application of circular economy in water management includes using water more efficiently, reducing waste, and achieving water reuse and treatment at the lowest cost and lowest energy consumption. Here are some of the mechanisms for its application: (Liu, Longjian, & Miying, 2021)

- Water reuse: Treated wastewater can be reused for non-potable purposes such as agricultural irrigation, industrial cleaning, or even factory cooling. This reduces dependence on fresh water.
- Rainwater collection: Rainwater can be collected and stored for use in domestic or agricultural purposes, reducing pressure on traditional water sources.
- Improve water use efficiency: Through technologies such as drip irrigation and smart sensor systems, water use efficiency in agriculture can be improved, leading to reduced losses.
- Environmental remediation techniques: The use of plants and natural solutions to purify water in a sustainable manner reduces the need for chemical treatments and energy.
- Energy extracted from wastewater: Some facilities reuse biowaste produced from water treatment plants to generate energy, reducing reliance on traditional sources of energy.

By integrating these strategies, water management can be transformed into a circular system that reduces waste and increases the efficiency of water resource use in various sectors.

4.2 Challenges in the application of the circular economy in the water sector

The implementation of the circular economy in the water sector faces many challenges that require innovative solutions and cooperation between various entities. Prominent among these are outdated infrastructure that hinders the use of modern technologies, high upfront costs of projects, and societal challenges such as the acceptance of wastewater reuse. There are also technical challenges related to the development of effective treatment methods, and a lack of updated legislation that supports the application of the circular economy. Despite these challenges, overcoming them can bring significant environmental and economic benefits, all of these challenges can be presented in detail as follows: (Liu, Longjian, & Miying, 2021)

- Legacy infrastructure: Many cities and regions rely on outdated water infrastructure, making it difficult to apply new technologies such as water reuse or efficient water treatment.
- High initial cost: The implementation of circular economy projects requires significant investments initially, whether in the construction of new treatment plants or the modernization of water networks. This cost may be a hindrance for some governments or businesses.
- Community acceptance: Some people are still unreceptive to the idea of reusing treated wastewater, even in non-potable applications. This may hinder the implementation of some projects.
- Technical challenges: Technologies such as desalination, environmental treatment, and water reuse need continuous technical developments to make them more efficient and less expensive. Currently, these solutions may not be available in some regions due to technical complexities.
- Waste Management: Wastewater treatment may produce waste or side materials that need to be effectively managed so as not to cause environmental damage, such as contaminated silt that may contain chemicals or heavy metals.

4.3 Water reuse and recycling of water resources within the framework of the circular economy

Water reuse and recycling of water resources within the framework of the circular economy is a process that aims to achieve sustainability through the efficient use of water resources and reduce loss and waste, the circular economy depends on recycling resources, including water, rather than consuming them excessively and disposing of them, and the main elements of water reuse in the circular economy are: (Castellet, Vicent, & Francesc, 2022)

- **Reuse greywater:** Water from domestic activities such as washing and bathing can be treated and used for irrigation or cleaning rather than disposal.
- **Wastewater treatment:** Wastewater treatment to become usable in agricultural irrigation or even in industrial processes.
- **Rainwater harvesting:** Rainwater collection and storage for use for purposes such as irrigation or industrial cooling, reducing pressure on traditional water sources.
- **Desalting techniques:** Development of technologies for desalination of seawater or saline water for use in agriculture or industrial consumption.

5. Digital Twinning Project in Water Management in the Netherlands:

The Netherlands is one of the leading countries in water management due to its long history in dealing with environmental challenges associated with rising water levels, floods, and droughts, hence the idea of the digital twinning project in water management as a modern innovation based on digital technology and artificial intelligence to meet these challenges and improve the sustainability of water resources.

5.1 Project Submission

Digital twinning is a concept based on the creation of an accurate virtual model (digital twin) that reflects the physical infrastructure of water networks and associated facilities, such as treatment plants, dams and rivers. This digital twin enables real-time data collection and analysis through the use of technologies such as the Internet of Things (IoT) and artificial intelligence, providing accurate and comprehensive insights into the performance of the aquatic system and allowing data-driven decisions to improve operations. (Solman, Julia, Mattijs, Bas, & Simon, 2022)

The Digital Twinning in Water Management project in the Netherlands is an advanced initiative aimed at improving water management efficiency using artificial intelligence and digital modeling techniques, the Netherlands relies heavily on this technology due to its long history of dealing with water challenges, including floods and rising sea levels. (Matos, Bruno, Gamze, Tom, Janne, & Bauke, 2022)

5.2 Project objectives

The aim of the Digital Twinning in Water Management project in the Netherlands is to improve the efficiency and sustainability of water resources management by employing advanced digital technologies such as artificial intelligence and the Internet of Things. The project pursues the following objectives: (Hesselink, Faridaddin, Yvonne, & Hans, 2024)

5.2.1 Improve water use efficiency and reduce waste: The primary objective is to improve the use of water resources by monitoring and assessing water consumption in real time using digital twinning, this allows for the rapid identification of leaks and water waste and immediate action to reduce waste.

5.2.2 Risk Forecasting and Water Crisis Management: The digital twin helps predict future risks such as floods, droughts, and pollution, by analyzing data collected from water networks, the project is used to anticipate these environmental events and take the necessary preventive measures in a timely manner, reducing the impact of crises on infrastructure and population.

5.2.3 Improved maintenance and operational processes: The project aims to reduce operational costs and improve maintenance efficiency By predicting necessary and preventive maintenance times, the digital twin can analyze the performance of the infrastructure and identify any malfunctions that may require urgent maintenance before damage occurs.

5.2.4 Promoting environmental sustainability: The project aims to support the sustainability of water resources by improving water quality and reducing energy consumption in water treatment, digital twinning is a powerful tool to reduce the environmental footprint of water management operations through more efficient techniques in handling natural resources.

5.2.5 Supporting data-driven decision-making: The project provides a large and accurate database on the state of water resources and infrastructure, enabling the government and stakeholders to make informed strategic decisions on policies and actions related to water management at the national level.

5.2.6 Increased collaboration between different sectors: The project contributes to strengthening cooperation between government agencies, research institutions, and private companies, accelerating the creation of advanced solutions to improve water management, and contributing to the implementation of more effective and sustainable policies.

5.3 Techniques used in the project:

The Digital Twinning Project in Water Management in the Netherlands relies on a set of advanced technologies that work in an integrated manner to improve water resources management and achieve efficiency and sustainability. Among the most prominent technologies used in the project: (Matos, Bruno, Gamze, Tom, Janne, & Bauke, 2022)

5.3.1 Digital Twin Technology: Digital Twinning is a virtual digital version of the physical infrastructure of water networks, fed with live data from sensor and simulation systems to provide accurate insights into the performance of the water system in real time, the benefit of which lies in the project:

- Monitoring water networks and treatment plants.
- Improve maintenance by predicting breakdowns before they occur.
- Provide accurate data to support strategic decision-making.

5.3.2 Artificial Intelligence (AI): Artificial intelligence is used to analyze big data collected from water systems and determine patterns and forecasts, and the benefit of it lies in the project:

- Predict hazards such as floods or water leaks.
- Improve water efficiency and reduce waste.
- Develop innovative solutions to address water management challenges.

5.3.3 Internet of Things (IoT): Smart sensors are used in pipes, treatment plants, and water bodies to collect data related to water flow, quality, and pressure, and the benefit of it lies in the project:

- Collect real-time data on the state of water and infrastructure.
- Provide an accurate view of the state of the water system.
- Support digital twinning with real-time information for analysis.

5.3.4 Big Data: Big data analysis is used to process large amounts of information extracted from IoT devices and digital twin models, the benefit of which lies in the project:

- Improve the ability to make data-driven decisions.
- Analysis of future patterns of consumption or water crises.
- Support the development of long-term water resources management strategies.

5.3.5 Cloud Computing: Cloud computing is used to store and process big data generated by sensors and artificial intelligence systems, and the benefit of it lies in the project:

- Improved access to data from different locations in real time.
- Deliver high processing power for complex data analysis.
- Provide a secure environment for efficient data storage and management.

5.3.6 Modeling and Simulation: Digital models are used to analyze water flow, consumption, and predict future scenarios such as floods or droughts, and the benefit of the project lies:

- Provide an integrated view of the impact of various factors on water networks.
- Support emergency response strategies by simulating crisis scenarios.
- Improve long-term planning for water management based on simulated data.

5.3.7 Remote sensing techniques: Remote sensing systems are used to monitor large or

complex water areas that are difficult to reach directly, and the benefit of them lies in the project:

- Collect information on water quality and levels in large areas.
- Provide live data from multiple locations to support the digital twin.
- Reduce the need for frequent manual inspection of water areas.

5.3.8 Geographic Information Analysis (GIS): Geographic Information Systems (GIS) technology is used to analyze spatial data related to water and infrastructure, and the benefit of the project lies:

- Track water flows and distribution across different regions.
- Linking geographic information with digital twin data for comprehensive analysis.
- Improving spatial planning for water resources management.

5.3.9 Machine Learning: Machine learning techniques are used to develop models based on historical and current data to predict future events, such as water consumption or malfunctions, and the benefit of which lies in the project:

- Improve the accuracy of forecasts about the behavior of the aquatic system.
- Provide recommendations on how to improve the efficiency of operations.
- Automatic learning from past data to improve maintenance and management strategies.

5.3.10 Geotechnical Technology: Used in quality control of water-related infrastructure such as dams and underground tunnels, the benefit of which lies in the project:

- Improve understanding of changes in soil or water structures.
- Enhance the sustainability of infrastructure.
- Provide insights into geological hazards that may affect water networks.

5.4 Examples of digital twinning projects in water management in the Netherlands

In the Netherlands, several projects based on digital twinning in water management have been implemented, where these advanced technologies have helped improve the efficiency of water resources, predict risks and enhance sustainability, here are some notable examples: (Ina, 2024)

5.4.1 Waternet project in Amsterdam: Waternet is one of the leading examples of the use of digital twinning in water management, aiming to improve water distribution and wastewater treatment in the Amsterdam area.

5.4.2 Deltares Flood Prevention Project: The Deltares Institute is working on a digital twinning project aimed at simulating water flow and preventing flooding in coastal and low-lying areas. The project focuses on improving flood prevention strategies using live data and digital models.

5.4.3 "Smart Water Management" project in Rotterdam: In the city of Rotterdam, a digital twinning project is being implemented aimed at effectively managing rainwater and sewage networks. The city faces significant challenges in dealing with the large amounts of water resulting from heavy rainfall, and the project aims to improve rainwater management and reduce flooding.

5.4.4 "Digital Water City" project: The Digital Water City project, which is being implemented in several European cities, including the Netherlands, aims to promote the use of digital twinning to improve urban water management. The project includes advanced models to track water flow and quality across urban water systems.

5.4.5 Aquasuite project in the Netherlands: Aquasuite is an integrated digital system that uses a digital twin to manage water networks in several regions of the Netherlands. The system monitors and analyzes data on water quality, flow, and pressure in pipes.

5.4.6 BlueCanopy Surface Water Management Project: The BlueCanopy project aims to improve surface water management in rural and urban areas. The project uses the digital twin to analyze river and stream flows and to predict floods or water shortages.

6. Conclusion

In conclusion, the study on "Digital Twinning and Artificial Intelligence in the Circular Economy: An Exploratory Study on the Digital Twinning Project in Water Management in the Netherlands" showed how modern technology can fundamentally transform the management of natural resources and enhance the efficiency of the circular economy.

6.1 Results

- Digital twinning, combined with artificial intelligence, provides accurate and comprehensive insights into the performance of water systems, contributing to improved resource management and reduced waste, digital technologies can provide live data and advanced analysis that can be used to guide management strategies more effectively.
- By integrating digital twinning into water management, the sustainability of resource use is improved and the resilience of systems to environmental changes is enhanced. Digital twinning provides tools to analyze data over time, helping to balance resource consumption with environmental needs.
- Cost savings: Experiments show that digital twinning can lead to significant cost savings by improving maintenance and avoiding costly breakdowns. Data analysis helps identify problems before they occur, reducing the costs associated with emergency repairs.
- The Digital Twinning Project in the Netherlands is an example of how new technologies can be integrated into water management, opening up new avenues for innovation in the circular economy. This experience could inspire other countries to adopt similar technologies, enhancing global efforts towards achieving the Sustainable Development Goals.
- Despite the many benefits, there are challenges related to the initial cost of adoption and the integration of the system with existing infrastructure. However, the Dutch experience provides a valuable model of how these challenges can be overcome through strategic planning and investment in technology.
- The Digital Twinning Project in the Netherlands provides advanced analysis tools that enable the collection and processing of accurate data on water systems. This data enhances the ability to make informed decisions on water management, leading to improved performance and operating efficiency.

This study is an important step towards understanding how digital twinning and artificial intelligence can be used to improve performance in the circular economy. The results reflect the importance of investing in modern technology to achieve better sustainability and higher efficiency in natural resource management, and the Digital Twinning in Water Management project in the Netherlands is an important step towards achieving smarter and more effective water resources management, this project is an example to be followed and can inspire more countries and bodies to adopt advanced technologies in their efforts to improve water management and promote environmental sustainability.

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