

THE RELATIONSHIP BETWEEN INDUSTRY 4.0 AND CIRCULAR ECONOMY :

A SUSTAINABLE HEALTHCARE SECTOR PERSPECTIVE

TANYALAK KAWICHA

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Introduction

The rapid increase in population and economic growth has led to a higher demand for resources, while resources are nearing depletion. This has given rise to the concept of the Circular Economy as a new alternative to develop the country's economy toward sustainability. At the same time, the Circular Economy focuses on maximizing the use of resources through recycling, reusing, and reducing waste, which helps minimize environmental impacts and ensures sustainable resource use in the healthcare sector. For example, developing medical equipment that can be reused, reducing the use of environmentally harmful materials, and efficiently managing medical waste will help reduce waste volume and enhance sustainability in healthcare operations.



Methodology

Currently, the concepts of Industry 4.0 and Circular Economy are gaining widespread attention across various sectors, especially in industries and businesses seeking to leverage technology and innovation to improve efficiency and reduce environmental impact. Industry 4.0 refers to the use of digital technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), robotics, and automation in manufacturing processes to make them smarter and more interconnected. On the other hand, Circular Economy focuses on creating value from existing resources by reusing waste and used materials through recycling and designing products that can be reused.

However, despite both concepts being applied in many sectors, there is still limited research on the link between Industry 4.0 and Circular Economy from the perspective of sustainability, particularly in healthcare. Studying this relationship is crucial to enhancing our understanding of how these two concepts can work together to improve the effectiveness and sustainability of healthcare services.[3]



Circular Economy

Figure 1: The relationship between the flow of materials in a circular economy consists of two main cycles: (1) the technical cycle, which involves the circulation of products and materials through processes such as reuse, repair, remanufacturing, and recycling, and (2) the biological cycle, which involves the circulation of minerals and nutrients from biodegradable materials that are returned to nature. Implementing circular economy principles thus enhances the efficiency of production and consumption while reducing environmental impacts in both industrial and agricultural sectors. [3]

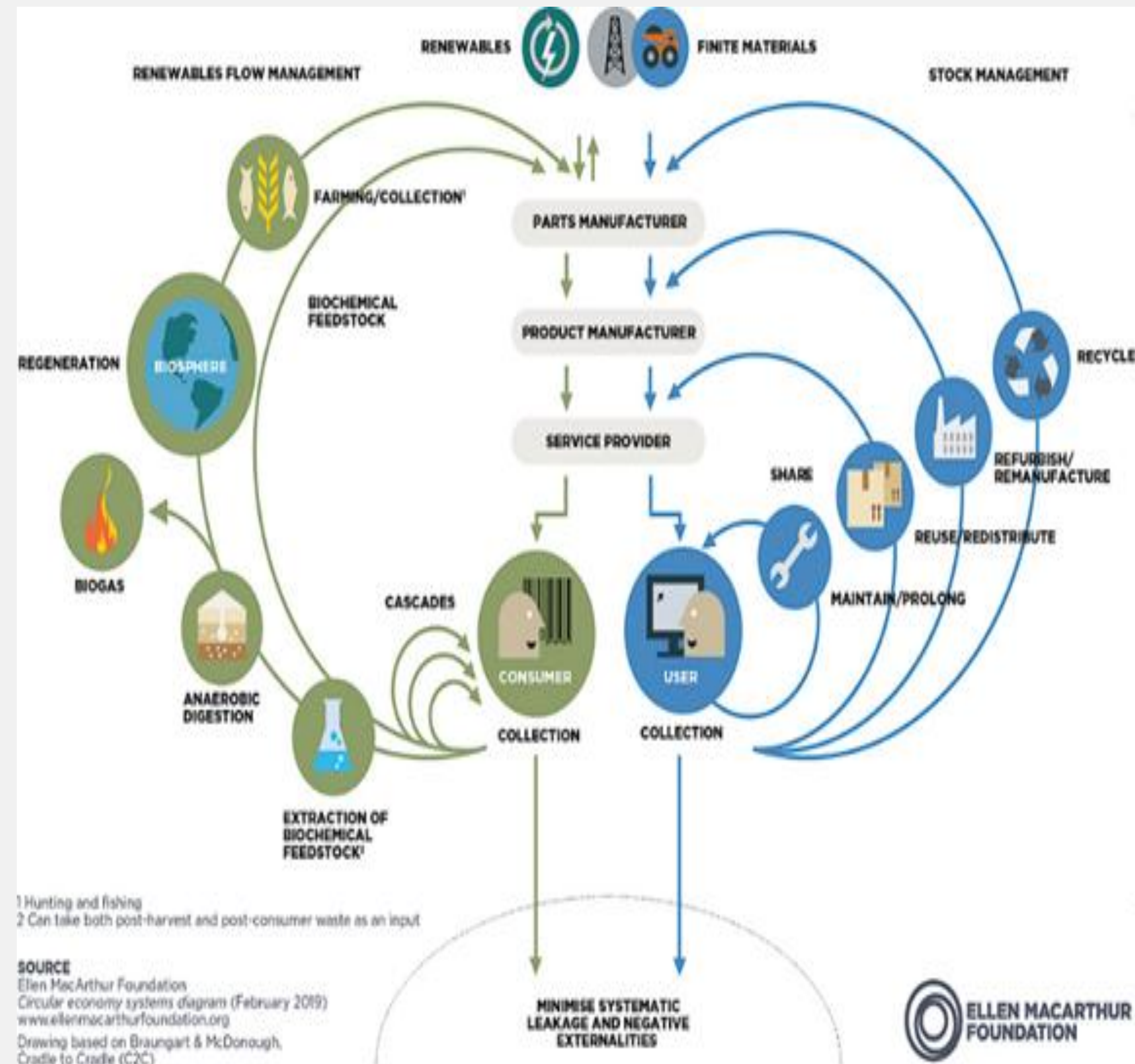
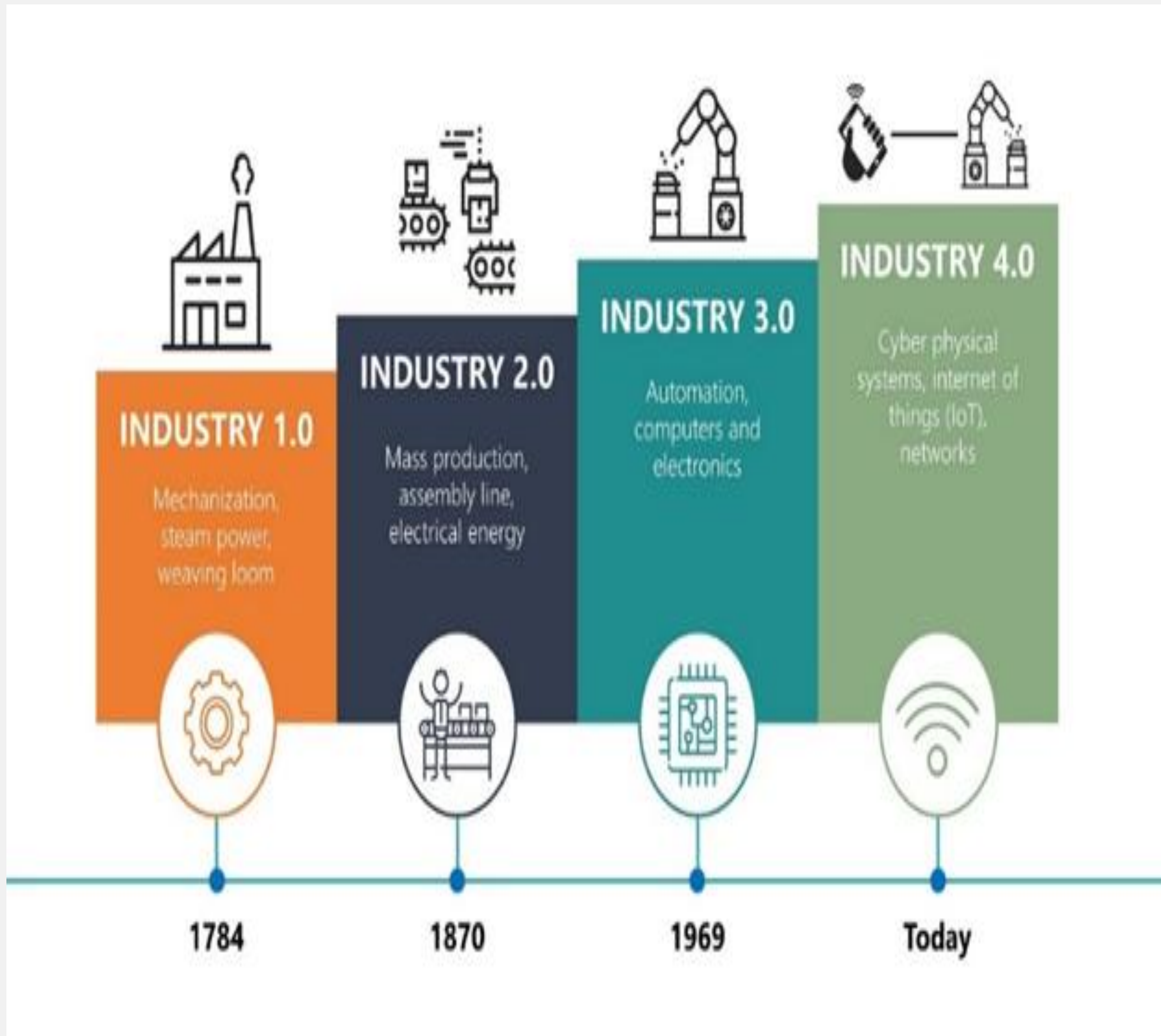


Figure 1: Butterfly Diagram (Source: Ellen MacArthur Foundation [4])

Industry 4.0



Industry 4.0 is a concept that has emerged in the present era to describe a new industrial revolution, which utilizes digital technologies as key tools to improve manufacturing processes and operations across various industries. This concept is inspired by the approaches to industrial development that have evolved over different historical periods.

Figure 2: The Industrial Revolution (Source: Enerco Energy Solutions LLP [5])

Circular Healthcare

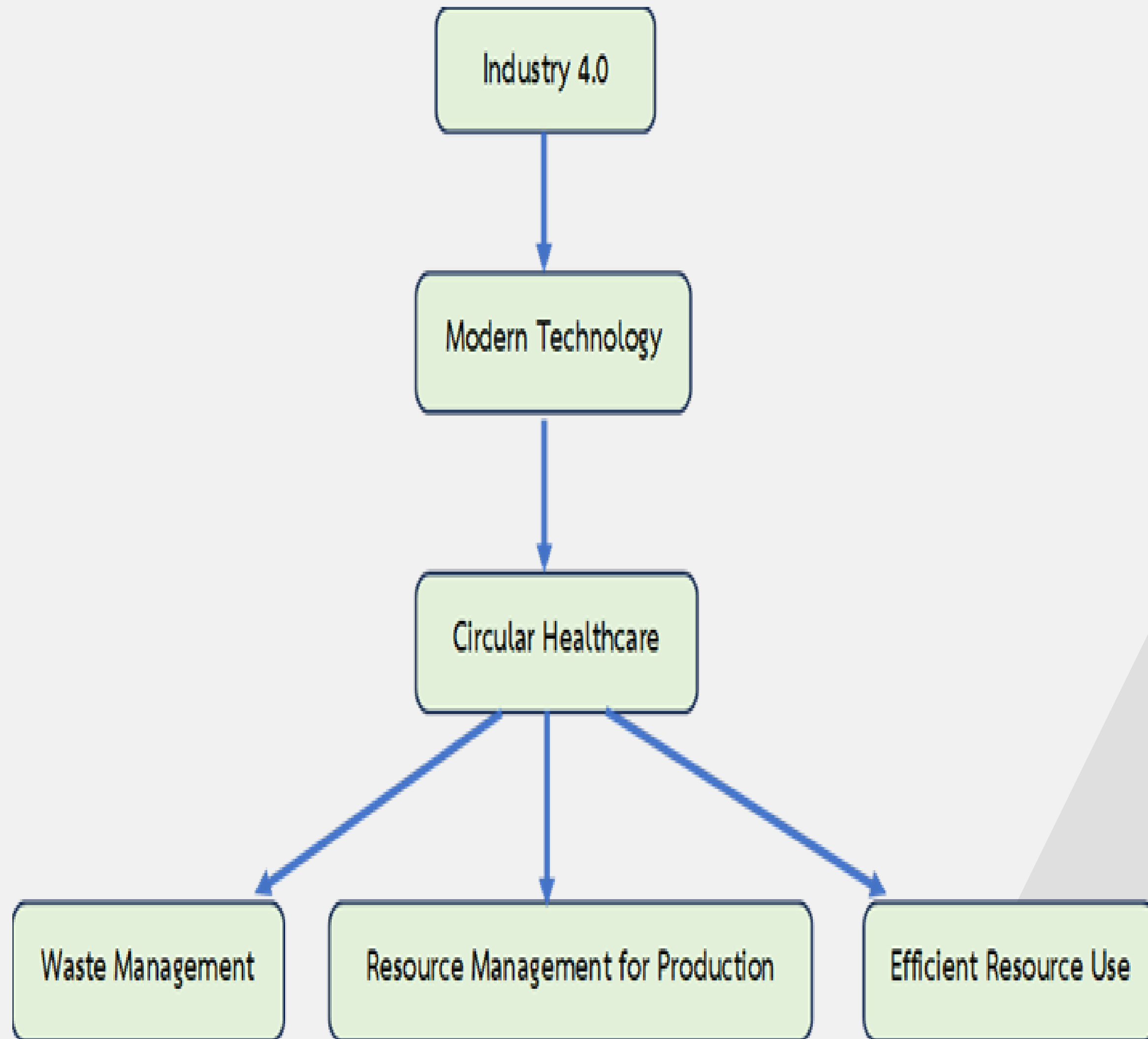


Figure 3: Circular Healthcare (ที่มา: M. Javaid, A. Haleem, I. Haleem Khan et al) [6]

Figure 3: The relationship between Industry 4.0 and waste management, raw material management in production, and the efficient use of resources not only provides a way to reduce costs and improve efficiency in the healthcare sector but also plays a crucial role in protecting public health by reducing the risks of pollution and exposure to harmful substances. Furthermore, it helps promote cleaner and safer environments in hospitals and healthcare facilities, which are key factors in patient recovery and care.

Results

Circular Economy in the Healthcare Sector In the healthcare sector, the circular economy can be applied in several areas, such as

1. **Medical Waste Management:** Medical waste generated from the use of medical materials, such as used syringes or disposable equipment, can be recycled or reused to avoid disposing of waste that may harm the environment.
2. **Efficient Use of Materials and Resources:** Reusable medical devices or equipment made from eco-friendly materials help reduce the use of resources required for new production and minimize waste.
3. **Sustainable Patient Care:** The development and use of medications or vaccines that can be produced and distributed without harming the environment help reduce dependency on limited natural resources.

Building a Sustainable Healthcare Sector through the Integration of Industry 4.0 and the Circular Economy in Various Aspects:

1. **Increasing Efficiency and Reducing Costs:** The use of digital technologies improves the efficiency of production and resource management in the healthcare system. Meanwhile, adopting the circular economy can help reduce the costs of waste management and materials used in hospitals or healthcare facilities.
2. **Environmental Protection:** Reducing waste and increasing recycling will help minimize pollution caused by medical activities and contribute to the conservation of natural resources.
3. **Sustainable Development:** The integration of technology and sustainable resource management will create opportunities for the development of the healthcare sector that not only meets the current needs of patients but also remains flexible and capable of long-term growth.

Conclusions and Recommendations

This article focuses on studying academic papers regarding the relationship between Industry 4.0 and the circular economy in creating a sustainable healthcare sector. The integration of digital technologies with the principles of the circular economy can enhance resource management efficiency, reduce waste, and improve medical services, making them more sustainable and cost-effective in the long term. Furthermore, the use of advanced technologies and recycling in the healthcare industry will be key tools in creating a sustainable future. Industry 4.0 and the circular economy will play an important role in improving the healthcare sector by making it more efficient, environmentally friendly, and better able to meet the needs of patients in a more targeted and sustainable manner.

Recommendations

There should be further studies on the limitations of applying Industry 4.0 and the circular economy to the healthcare sector, in order to gain insights for developing and adapting these approaches to unlock their full potential, and to enhance the sustainability and efficiency of the healthcare system in the future.

Contact

Tanyalak Kawicha

0865 / /4 /4 /



tanyalak-k@rmutp.ac.th

Faculty of Engineering
Department of Industrial Engineering for Sustainable Development
Rajamangala University of Technology Phra Nakhon
Thailand

References

- [1] Ratima Kochanant. *Circular Economy*. Bangkok: Academic Division, Secretariat of the House of Representatives. 2019.
- [2] National Science and Technology Development Agency. *Action Plan for Driving National Development with the BCG Economic Model (2022–2027)*, 2022. Retrieved from <https://plan.msu.ac.th/public/uploadsDoc/9bf26702-8e61-437c-8c43-b3095833f9a1.pdf>.
- [3] Office of Industrial Economics. *Study Report on the Promotion and Development of the Circular Economy*, 2023. Retrieved from <https://uploads.tpsso.go.th/67-pdf>.
- [4] Department of Trade Policy and Strategy, Ministry of Commerce. *Study Report on Approaches for Promoting and Developing the Circular Economy*. Nonthaburi: Department of Trade Policy and Strategy, 2023.
- [5] Ellen MacArthur Foundation, Gravis L, editor. *Industry 4.0 & the Water Sector*. 2020. Retrieved from <https://waterfm.com/industry-4-0-the-water-sector>.
- [6] M. Javaid, A. Haleem, I. Haleem Khan et al. *Industry 4.0 and Circular Economy for Bolstering the Healthcare Sector: A Comprehensive View on Challenges, Implementation, and Futuristic Aspects*. Biomedical Analysis 1, 2024, pp. 174–198.