MedCrave
Step into the World of Research

International Journal of Hydrology

Review Article

Open Access

CrossMark

The similarities of sustainable marine ecosystem management and circular economy in industry 4.0

Volume 7 Issue 4 - 2023

Chee Kong Yap,[1] Chee Seng Leow[2]

[1]Department of Biology, Faculty of Science, Universiti Putra Malaysia, 43400 UPM, Serdang, Selangor, Malaysia

[2]Humanology Sdn Bhd, 73-3 Amber Business Plaza, Jalan Jelawat 1, 56000 Kuala Lumpur, Malaysia

Correspondence: Chee Kong Yap, Department of Biology, Faculty of Science, Universiti Putra Malaysia, 43400 UPM, Serdang, Selangor, Malaysia,
Email yapckong@hotmail.com; yapchee@upm.edu.my

Received: September 10, 2023 | **Published:** September 29, 2023

Keywords: marine ecosystem, environmental damage, natural resources, anthropogenic input, recycle manner, fertilization, rapid urbanisation, wastes and chemical toxic pollutants

Abbreviations: CE, circular economy; CC, carrying capacity; CPS, cyber-physical systems; IoT, internet of things; ICT, information and communications technology; EA, enterprise architecture; EI, enterprise integration

Background

Sustainable ecosystem management

According to Elliot[1] the 10 tenets of sustainable marine management are shown in Table 1. One of them is economically viable.[1] This tenet is equitable to Circular Economy (CE) which also presents 10 principles in its application. It is necessary to have substantial and enough funding to preserve and improve our sustainable natural resources from the marine ecosystem. Without such funding, the prevention of environmental damage and its ecosystem recovery is almost becoming a big challenge or impossible. We need to plan to manage our marine ecosystem sustainably before it is too late. This economically viable principle is related to CE in the aspect of the economic Carrying Capacity (CC). The economic CC is well related to ecological CC based on the ecosystem concept. Once the CC is exceeded in both economics and ecosystem, stress would be triggered at the early stage and this is the time when good ecosystem management needs to be fully implemented before it is too late.[2] It has become our goal to ensure that the marine system will continue to deliver our economic needs in future. The economic aspects should encompass the price to be paid for monitoring the cause and effect of anthropogenic input into our marine ecosystem.[3]

In eutrophicated marine ecosystems, the economic considerations include the cost of preserving, improving and restoring the polluted ecosystem due to industrial discharges and anthropogenic factors. Reduction of fertilization on the crop could reduce crop production. The benefit is that this can prevent catchment run-off. In summary, it is needed to consider both economic costs and benefits when the application of the preventive measure is implemented.[4]

Circular economy

According to Acciona[5] there are ten principles that define how CE should work (Table 1). It is basically built on three major principles including a) Designing out waste and pollution, b) Keeping products and materials in use, and c) Regenerating natural systems. The industrial processes that reduce waste generation besides recycling and reusing natural resources efficiently and in a recycle manner, have been the basis of CE. The approach of CE to resource efficiency is simply an integration of cleaner production and zero-waste technology. This involves manufacturing industrial companies to support resource optimisation[6] with a goal of waste reduction or even zero waste reduction. It moves and strengthens the transition from non-renewable to renewable energy sources, with a mission to create wealth using CE integrating capitals of environment, social and economics.[1]

Table 1 Comparison of principles among sustainable marine management, circular economy and design principles in Industry 4.0

Ten tenets for integrated, successful and sustainable marine managemen[1]	Ten principles that define how circular economy should work[5]	Four design principles in Industry 4.0[9]
Ecologically sustainable	Waste becomes a resource	Interconnection via Internet of Things or the Internet of People
Technologically feasible	Second use	Information transparency
Economically viable	Reuse	Technical assistance via cyber-physical systems
Socially desirable/tolerable	Reparation	Decentralized decisions via cyber-physical systems
Legally permissible	Recycle	
Administratively achievable	Valorisation	
Politically expedient	Functionality economy	
Ethically defensible (morally correct)	Energy from renewable sources	
Culturally inclusive	Eco-design	
Effectively communicable	Industrial and territorial ecology	

Industry 4.0

According to the Industrial Internet Consortium,[7] Industry 4.0 (I4.0) is defined as "the integration of complex physical machinery and devices with networked sensors and software, used to predict, control and plan for better business and societal outcomes". Cyber-Physical Systems (CPS), the Internet of Things (IoT), Information and Communications Technology (ICT), Enterprise Architecture (EA), and Enterprise Integration (EI), are components which are relevant to I4.0.[8] The I4.0 can simply continue using the components of automation and machinery from the Third Industrial Revolution and improve in further through smart systems. This smart system works efficiently by using big data and CPS, ending with high productivity and low wastage.[9] This is the principle of CE that is connected to I4.0, as it is expected to be affected in ASEAN countries,[10] and has impacted on the business strategy of the value chain Hungary.[11]

According to Hermann et al.,[9] the four design principles in I4.0 (interconnection, information transparency, technical assistance and decentralized decisions) (Table 1) are comparable to the principles of sustainable marine management[1] and CE.[5] Basically, the I4.0 focuses on environmentally sustainable manufacturing such as green products and recyclable products, which is comparable to the principles of CE (Table 1).

The connection between Circular Economy and Industry 4.0

According to the most recent review by Dev et al.,[12] the relationships between CE and I4.0 were addressed by the case-based model. This model could affect the outputs of the economy. They stated the need to stay focused on the overall costs of the socially prompted operations. Fedotova et al.[13] suggested that the elementary ways of public regulation of the informatization processes in Russian society have provided a space to amend some target indicators to full digitalization transformation in the future of all sectors of the Russian economy, operating based on the philosophy of I4.0. Rajput and Singh[14] pinpointed CE, and others (such as Service and Policy Framework) were the sizable enablers of connecting CE and I4.0.

The close relationship between CE and I4.0 should be able to create awareness amongst the public consumers, policymakers and company executives.[15] According to UNEP (2017), the use of these materials almost tripled from 1970 (26.7 billion tonnes) to 2017 (84.7 billion tonnes). Demands for non-renewable resources and energy (minerals, ores, biomass, and fuels) continue to expand in line with the momentum of rapid urbanisation, industrialisation and enhanced economic growth in developing countries. The consumed resources and energy could end up as wastes and chemical toxic pollutants. Consequently, this uncontrolled mismanagement of chemical wastes would negatively impact economic growth (MITI, 2018). The CE relating to circular ecosystem should go together with implementing I4.0, with a goal of zero waste production. In a CE system, material and nutrient losses can be reduced through landfills. The CE generates new opportunities and needs for business.[16,17]

Concluding remarks

In conclusion, the closeness and similarity of principles between sustainable marine ecosystems and CE do bring a notion that CE is related to the sustainability of resources that would empower the creation of a good economy for a nation. It is no doubt the gross domestic products of a country are highly dependent on the CE which is linked to I4.0. We need an economy that can circulate like the cycling of nutrients in an ecosystem. We can get the recycled nutrients necessary to sustain the resource marine ecosystem, which is the economic capital needed for wealth creation in a country. Predictably, the governance, policy-makers and industrial executives are playing a decisive role in the future of CE in connection with I4.0 in sustaining the marine resourceful coastal ecosystem, especially in developing countries. However, the differences in such a connection between developed and developing countries merit further investigations in the future.

Acknowledgments

None.

Conflicts of interest

The author declares there is no conflict of interest.

References

1. Elliott M. The 10-tenets for integrated, successful and sustainable marine management. *Marine Pollution Bulletin*. 2013;74(1):1–5.
2. Yap CK, Leow CS. Social factors for coastal management: A short review and some insights. *Global Journal of Civil and Environmental Engineering*. 2019;1(1):01–07.
3. Borja Á, Elliott M. Marine monitoring during an economic crisis: the cure is worse than the disease. *Marine Pollution Bulletin*. 2013;68(1–2):1–3.
4. Pascual M, Borja A, Franco J, et al. What are the costs and benefits of biodiversity recovery in a highly polluted estuary? *Water Research*. 2012;46:205–217.
5. Acciona. *What is circular economy?* 2019.
6. Di Maio F, Rem PC. A Robust Indicator for Promoting Circular Economy Through Recycling. *Journal of Environmental Protection*. 2015;6:1095–1104.
7. Industrial Internet Consortium. *A Global Industry First: Industrial Internet Consortium and Plattform Industrie 4.0 to Host Joint IIoT Security Demonstration at Hannover Messe 2017*. 2017.
8. Lu Y. Industry 4.0: A survey on technologies, applications and open research issues. *Journal of Industrial Information Integration*. 2017;6:1–10.
9. Hermann Mario, Tobias Pentek, Boris Otto. *Design Principles for Industrie 4.0 Scenarios*. Paper presented at 2016 49th Hawaii International Conference on System Sciences (HICSS), Koloa, HI, USA, January 5–8, 2016. p. 3928–37.
10. Anbumozhi V, Kimura F. Industry 4.0: What Does It Mean for the Circular Economy in ASEAN? In: Anbumozhi V, et al., editors. *Industry 4.0: Empowering ASEAN for the Circular Economy*. Economic Research Institute for ASEAN and East Asia, 2018. p. 1–410.
11. Nagy J, Oláh J, Erdei E, et al. The Role and Impact of Industry 4.0 and the Internet of Things on the Business Strategy of the Value Chain—The Case of Hungary. *Sustainability*. 2018;10(10):3491.
12. Dev NK, Shankar R, Qaiser FH. Industry 4.0 and circular economy: Operational excellence for sustainable reverse supply chain performance. *Resources, Conservation and Recycling*. 2020;153:104583.
13. Fedotova GV, Buletova NE, Ilysov RH, et al. The Guidelines of Public Regulation in Terms of Digitalization of the Russian Economy with the Industry 4.0 Tools. *Lecture Notes in Networks and Systems*. 2020;87:846–855.
14. Rajput S, Singh SP. Connecting circular economy and industry 4.0. *International Journal of Information Management*. 2019;49:98–113.

15. MITI (Ministry of International Trade and Industry). *Industry 4WRD: NATIONAL POLICY ON INDUSTRY 4.0*. ISBN 978-967-13593-6-5. 2018.

16. EIT (European Institute of Innovation and Technology) Raw Materials (2017), *Circulator*, 2017.

17. Maresova P, Soukal I, Svobodova L, et al. Consequences of Industry 4.0 in Business and Economics. *Economies*. 2018;6(46).

Citation: Kong Yap C, Seng Leow C. The similarities of sustainable marine ecosystem management and circular economy in industry 4.0. *Int J Hydro.* 2023;7(4):185–187. DOI: 10.15406/ijh.2023.07.00355