Hitachi-AIST Cooperative Research on Circular Economy - Development of a Digital Solution for Realizing both Circular Economy and Carbon Neutrality

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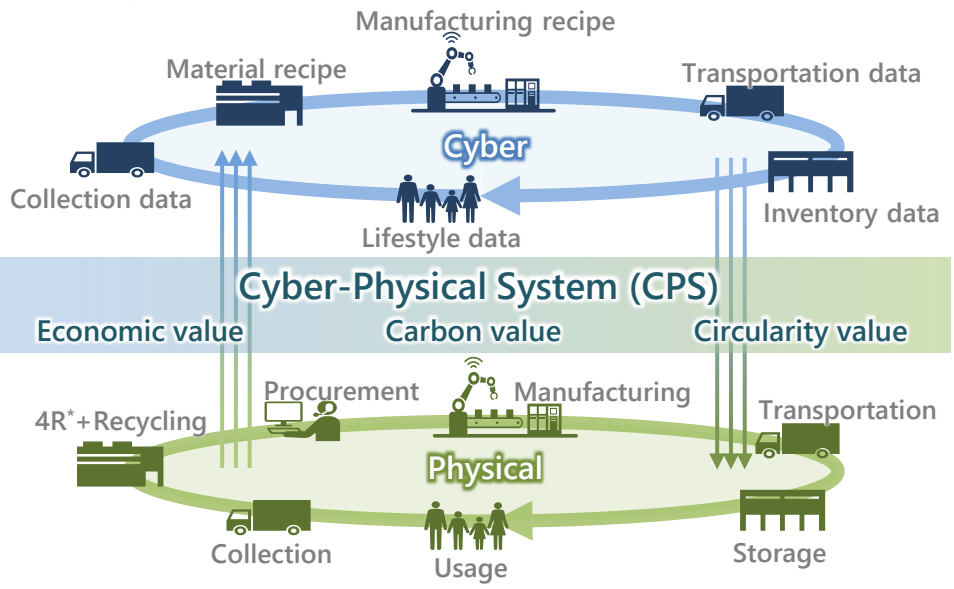
Cyber-Physical System (CPS) for CE & CN

Issues on realization of CE & CN

- **Information sharing and profit sharing with other companies in a life cycle are required, because cooperative business with them is necessary [1][2].**
- **"Circularity," "Carbon Neutrality" and "Economic Growth" should be required in every industries, simultaneously.**

Basic strategy

- **Construct a CPS which visualizes and controls "Material," "Carbon," and "Money" flow based on actual data from the product life cycle.**
- **Optimize circulation flows of 4R(Reuse, Repair, Refurbish, Remanufacturing) + Recycling which are hard to be controlled by a product manufacturer.**



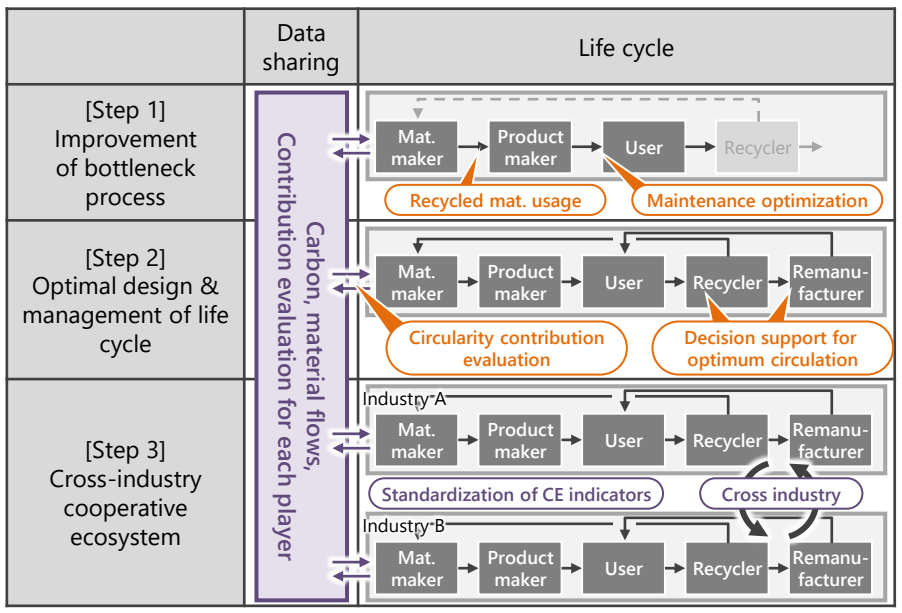
Roadmap of Digital Solutions

Steps for realization of CE & CN in industry field

Step 1: Improvement of a bottleneck process to increase circularity in the existing product life cycle. — **Efforts in each company**

Step 2: Optimal design and management of a product life cycle which increase economy, circularity, and carbon neutrality.

Step 3: Cross-industry cooperative ecosystem for total optimization of society. — **Target of this lab.**



Solution Ideas

Challenges to realize CE & CN by digital solution

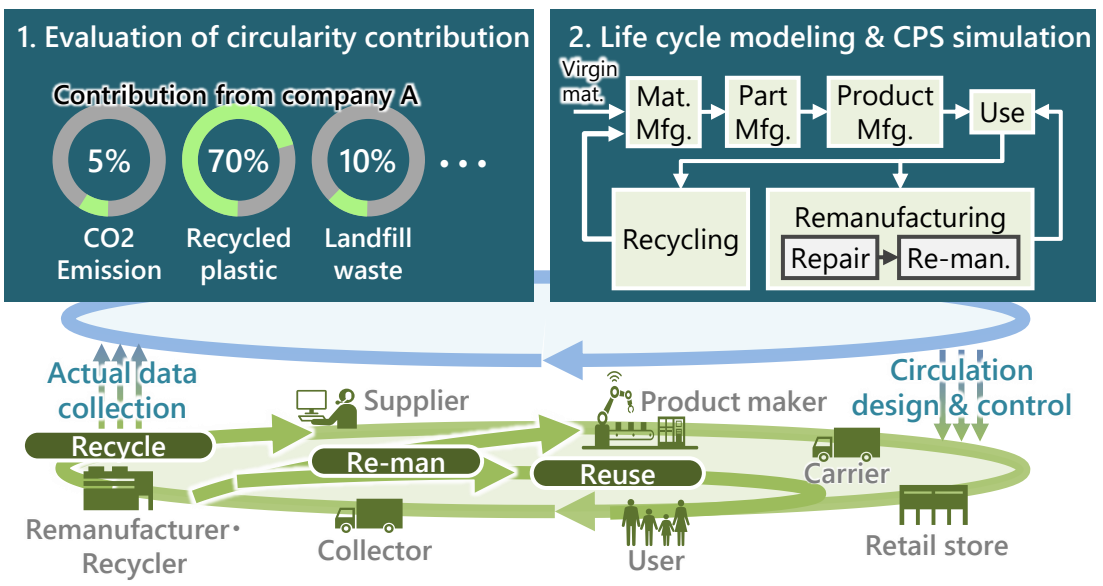
- **Incentive design for partner companies in a product life cycle to help them engage CE & CN activities willingly.**
- **Design and selection of circulation ways in consideration with business circumstances to maximize both economic value and environmental value.**

1. Evaluation of circularity contribution

Quantify circularity contribution of each partner company for transparent profit sharing based on actual data.

2. Life cycle modeling & CPS simulation

Design an optimal circulation flow in each product life cycle, and tune up the circulation flow by monitoring an actual state based on a CPS simulation.



Conclusions and Outlook

- **We propose the concept of CPS, a digital solutions that visualizes and controls the flow of material, carbon, and money, and optimizes the circulation flow of 4R + Recycling.**
- **Roadmap for digital solutions toward CE is proposed. We focus on optimal design and management of product life cycle.**
- **"Evaluation of circularity contribution" and "Life cycle modeling & CPS simulation" are proposed as solution ideas.**

[REFERENCE]
1. Moritz JR, Moritz P (2022) Advancing the circular economy through information sharing: A systematic literature review, J Clean. Prod. 369: 133210
2. Catena-X Operating Model, https://catena-x.net/fileadmin/_online_media_/CX_Operating_Modelv2.1_final.pdf (2023 Oct.)