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Product Lifetime-Extending Interventions: Measuring Circular Economy Impact

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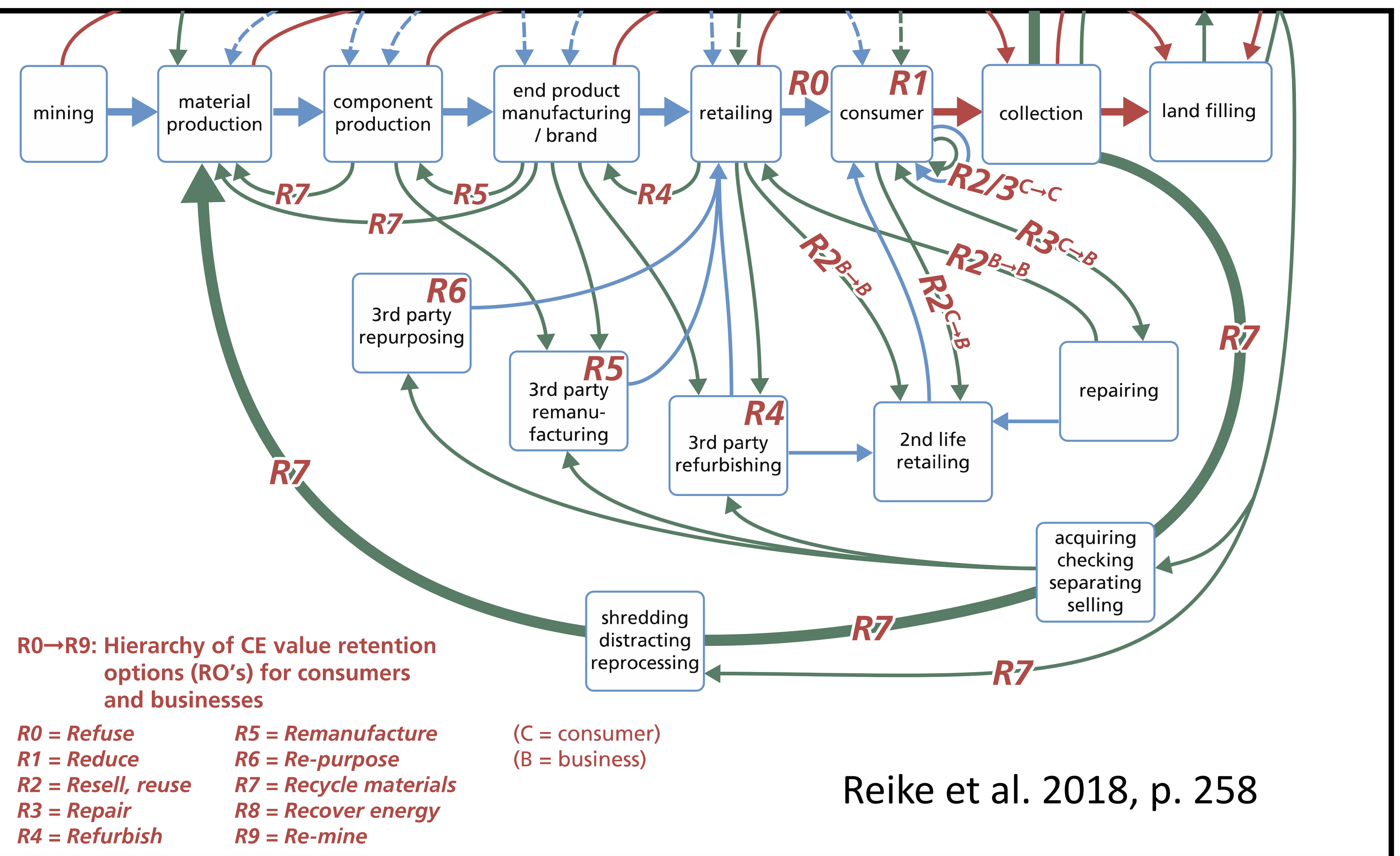
Small loop circularity

Circular Economy: "… industrial economy that is restorative or regenerative by intention and design" (Ellen MacArthur Foundation, 2013).

Repairs (R3) is considered a "small loop" value retention option, providing high ecological value (Reike et al., 2018).

However, some repairs are very asset-intensive processes, requiring a functioning **service supply chain.**

- ***"Right to repair"*** vs. **planned obsolescence**.
- Value retention of repair becomes unclear: who benefits, who loses out, what is the effect on the circular economy?



Reike et al. 2018, p. 258

Measurement challenge for product lifetime-extending interventions

Conventional repair relies on *static asset management*: Large final batch of parts for spare parts when last equipment production orders; *spare parts inventories limits how long equipment can be repaired*

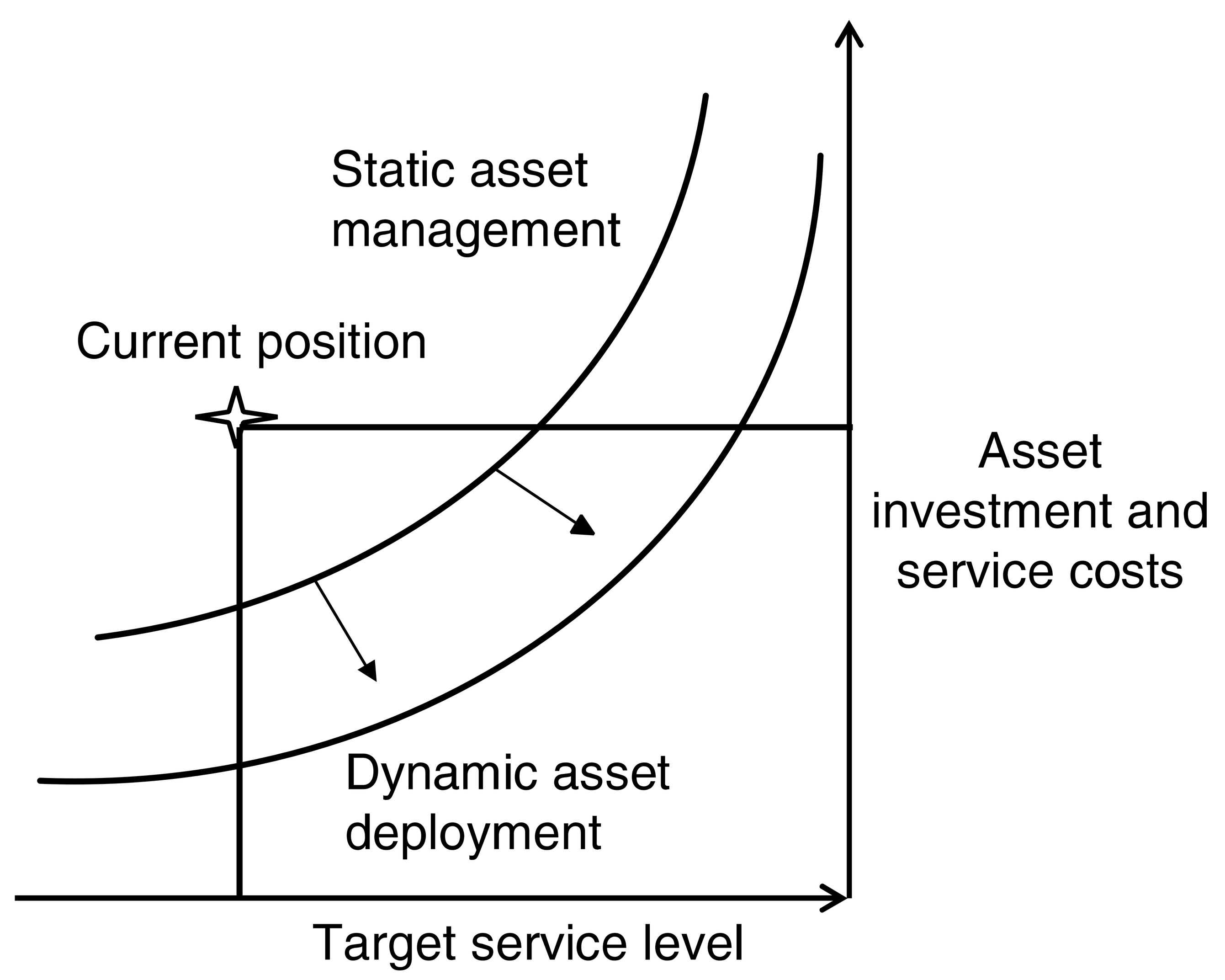
- Difficulty to forecast spare parts demand results in sub-optimal service level and costs

Digitalized repair (3D printed spare parts) enables more *dynamic asset management*: spare parts on demand; *equipment can be repaired indefinitely*

- ***"Right to repair"*** facilitated by dynamic (digital) assets.

However, from a Circular Economy perspective there are **no indicators that readily captures the impact**

- Material Circularity Indicator (MCI) measures how cyclical material flows are, not how efficiently product-lifetime extending interventions are
- Combination Metric (CM) considers both longevity (life-cycle) and circularity, but not cost
- Life-cycle Assessment (LCA) can account for all relevant differences, but requires extensive and detailed scenarios and information



Cohen et al., 2006, p. 262

Findings and further research

We need to develop circular economy indicators focused on repairs

- Current circular economy indicators are focused on large loops, such as recycling.
- Existing indicators lack capability in identifying important aspects, such as repairability and required assets (service supply chain).
- Previous research puts too little emphasis repairs in comparison to refurbishments.

We need to design economic incentives for manufacturers, in addition to giving users the "right to repair"

- Inherent conflict of interests between the manufacturer and the end customer related to repairs: regulation countering planned obsolescence circumvented by manufacturers.
- Economic mechanisms (similar to emissions trading) needed to align the interests of the manufacturer and the user

Future research

- Heuristics for gained and lost value of interventions for repairs, right to repair, and countering planned obsolescence
- Role of regulation and economic incentives.

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