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IMPACT OF MAINTENANCE ON CIRCULAR ECONOMY

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ABSTRACT

Novel business models that leverage the largely untapped potential of circular economy are gradually emerging in several industries. The widespread use of circular economy has implications for asset management in manufacturing industry, as they bring new challenges and opportunities for managing and maintaining machinery and equipment. The importance of asset management and maintenance for the circular economy is studied in the Tekes funded “Data to Wisdom” project.

Circular economy can be defined as a system which creates value by minimizing waste, energy and the use of natural resources. It also utilises solutions that aim at slowing, closing and narrowing loops of material and energy. These solutions include, for instance, long-lasting design, design for easy disassembly and maintainability, maintenance actions such as repair and refurbishing, reuse, remanufacturing and recycling.

In this paper, we analyse circular economy archetypes from the life cycle management perspective. This is done by comparing circular economy archetypes against the fundamentals of asset management. Opportunities and threats produced by the circular economy for asset management and maintenance are addressed with real cases presented in Sitra’s list of the most interesting companies in the circular economy in Finland.

INTRODUCTION

Asset management (AM) is a “coordinated activity of an organization to realize value from assets” (ISO 55000, 2014). Considering physical assets, AM aims at optimising the life cycle business impact of cost, performance, risk exposures and ensuring the availability, efficiency, quality, longevity and regulatory/safety/environmental compliance (IAM, 2008). Asset

management realises asset value through operation, maintenance and investment activities (Komonen, 2008).

Circular economy (CE) is a system which creates value by minimizing waste, energy and the use of natural resources (Geissdoerfer et al., 2017). CE solutions aim at slowing, closing and narrowing loops of material and energy. These solutions include, for instance, long-lasting design, design for easy disassembly and maintainability, maintenance actions such as repair and refurbishing, reuse, remanufacturing and recycling. Figure 1 visualises the connection between AM and CE.

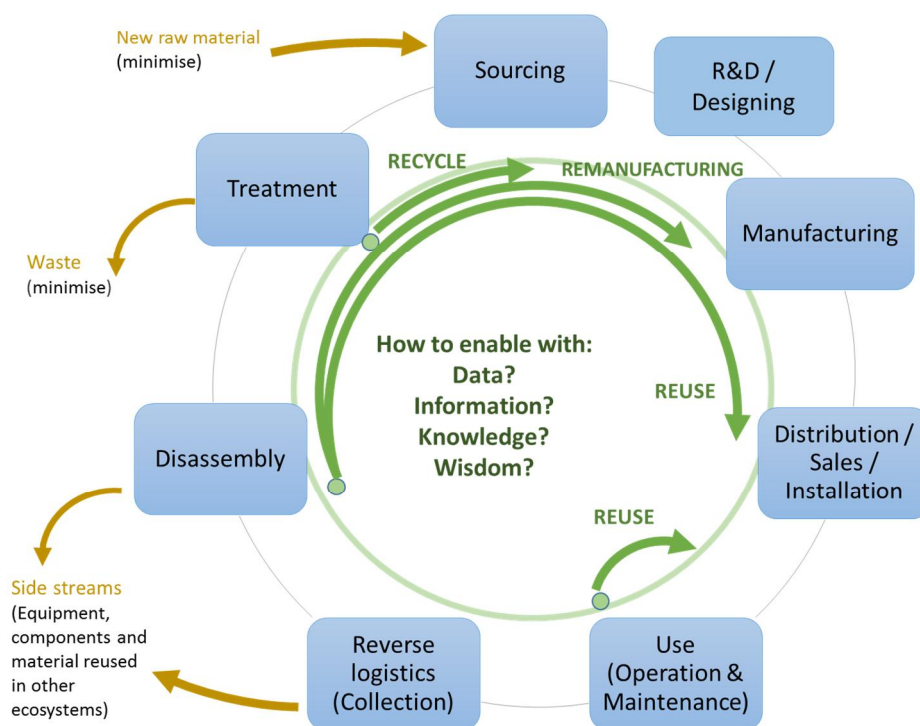


Figure 1. Asset management and circular economy.

From the perspective of CE, figure above illustrates mainly technical cycles such as life cycle of machinery and equipment. AM activities take place in different life cycle phases and feedback loops. Even though the goals of CE, maintenance and AM are largely congruent, the research on the impact of CE on maintenance and asset management has been scarce. Descriptions of CE solutions generally do not consider the opportunities and threats for AM.

Therefore, our aim is to analyse circular economy archetypes from the life cycle management perspective. We compare circular economy archetypes against the fundamentals of asset management described in ISO 55000 (2014). Opportunities and threats produced by the circular economy for asset management and maintenance are addressed with real cases

presented in Sitra’s list (Sitra, 2017) of the most interesting companies in the circular economy in Finland.

OPPORTUNITIES AND THREATS OF CIRCULAR ECONOMY FOR MAINTENANCE

The impact of maintenance and asset management on CE can be viewed through the four asset management fundamentals: 1. *value* that is provided to the organisation, 2. *alignment* of plans and activities, 3. *leadership* and culture that ensures that employees in the organisation have clear role and responsibilities and are competent and empowered, and 4. *assurance* that assets fulfil their purpose (ISO 55000, 2014). Sitra (2017) classifies CE solutions into five categories: product-life extension, product as a service, sharing platform, renewability, and resource efficiency and recycling. Other often referred classifications are presented in Bocken et al. (2016) and Lacy and Rutqvist (2015).

Table 1. Impact of maintenance on CE solutions.

CE model/example	Threats	Opportunities
<p>Renewability</p> <p>Closing resource loops</p> <p>Example</p> <p>St 1: Petrol substitute from organic waste</p> <p>Asset type</p> <p>Fleet of production units</p>	<p>Value</p> <p>Treatment of hazardous materials and occupational safety</p> <p>Potential quality challenges for the end product (heterogeneous raw material)</p> <p>Uncertainty about the durability of machinery and equipment due to changing characteristics of raw material and lack of usage history data</p> <p>Alignment, leadership & assurance</p> <p>More actors and stakeholders in the value chain increase the complexity of the production system and the organisation and cause new challenges for decision-making, leadership and the assurance of performance</p> <p>Demand for interoperability of technical and information systems of different actors in the ecosystem to show the sustainability of products</p>	<p>Value</p> <p>Several small production units increase delivery reliability in comparison to one large unit</p> <p>Fleet of production units may have a common spare part stock</p> <p>Alignment, leadership & assurance</p> <p>Increased control and flexibility for the execution of planned shutdowns due to small production units</p> <p>Accumulated fleet data can be used to support the assurance of the machinery reliability</p>
<p>Product-life extension</p> <p>Slowing resource loops</p> <p>Example</p> <p>Valtra: Remanufacturing tractor gearboxes</p>	<p>Value</p> <p>Recognizing when it is not feasible to extend the lifetime of gearboxes</p> <p>Alignment, leadership and assurance</p> <p>In order to use the concept, there is a need for extensive information about the utilization, condition and location of machinery</p>	<p>Value</p> <p>Using same equipment for remanufacturing reduces costs (e.g. reduction of new materials and energy consumption in production)</p> <p>Alignment, leadership and assurance</p> <p>Predictive maintenance enables early detection of wear/defects before failure occurs</p>

Asset type Tractor gearbox	Remanufactured machinery needs to be compliant with the requirements New kind of life cycle phases (due to remanufacturing) require the implementation of new assurance processes	Remanufacturing demands an advanced performance monitoring and support processes to be successful. This enables indirect benefits such as decreased failures and disturbances, and new service opportunities
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CONCLUSIONS

Asset management and maintenance play a major role when CE solutions are implemented and targeted strategic objectives are pursued. Challenges related to the maintenance of machinery increase due to the heterogeneous materials. Additionally, CE solutions increase the need for data of usage history. On one hand, the implementation of CE solutions often requires the renewal of the data collection and analysis. On the other hand, increased utilisation of fleet data enables more efficient decision-making in AM activities.

REFERENCES

Geissdoerfer, M., Savaget, P., Bocken N.M.P. and Hultink, E.J. (2017) The Circular Economy - A new sustainability paradigm? *Journal of cleaner production*, 143, pp. 757-768.

Bocken, N.M.P., de Pauw, I., Bakker, C. and van der Grinten, B. (2016) Product design and business model strategies for a circular economy. *Journal of Industrial and Production Engineering*, 33:5, pp. 308-320.

IAM (2008) Institute of Asset Management. London.

ISO 55000 (2014) Asset management standard.

Komonen, K. (2008) A Strategic Asset Management Model: A framework of a plant level model for strategic choices and actions. Proceedings of Euromaintenance 2008 Conference on asset management & production reliability, Bryssel, 8 - 10 April 2008, pp. 1-10.

Lacy, P. and Rutqvist, J. (2015) *Waste to Wealth: The Circular Economy Advantage*. Palgrave Macmillan.

Sitra (2017) The most interesting companies in the circular economy in Finland. Available at: <https://www.sitra.fi/en/projects/interesting-companies-circular-economy-finland/>.