

AN EXTENDED MATURITY MODEL TO INTEGRATE DIGITIZATION AND SUSTAINABILITY-RELATED MEASURES IN SMALL AND MEDIUM-SIZED MANUFACTURING ENTERPRISES

Marian Süße¹, Marc Münnich¹, Maximilian Stange¹, Lukas Roth¹, Steffen Ihlenfeldt^{1,2}

¹ Fraunhofer Institute for Machine Tools and Forming Technology IWU, Chemnitz, Germany
² Institute of Mechatronic Engineering, Technische Universität Dresden, Dresden, Germany

Background

- In industrial manufacturing digitization is current necessity to stay competitive but at the same time industry is a major source of greenhouse gas emissions [1].
- Manufacturing industry, especially in Germany with a predominant share of SMEs, requires support and guidance in order to cope with multidimensional requirements.

Questions

- How may manufacturing companies receive an easily generated overview on their current level and aspired status regarding digitization and sustainability?
- How can existing maturity models be combined and adapted in order to build a modular and flexible assessment tool?

Previous Work

- The base is provided by the "Industry 4.0 Readiness Model" which was developed by three consulting firms an online self assessment tool [2].
- A second and more detailed model has been published as an Industry 4.0 guideline by the German association for machining [3] was been extended and applied for digitization maturity assessment by Langer et. al. [4].
- Finnerty et al. [5] extensively reviewed energy management maturity models. They suggest that research and implementation are still in an early stage.
- Pigosso et al. [6] propose an eco-design maturity model which comprises management strategies for manufacturing companies. Several aspects are specified for further investigation such as the inclusion of organizational factors.

Results

Preparation

Analysis

Creativity

Initialization

Transfer

Dimension	Category	Area
Technology	Production	Data processing
		Machine to Machine communication
		...
	Product	Integration of sensors and actors
		Business models
		Product-related IT Services
		...
	Organization	Digitization strategy
		Investment budget for digitization
		...
Personnel		Knowledge in digitization
		On-the-job training
		...

Area	Assessment [0-4]	
	0	4
Strategic Implementation of Sustainability	Qualitative and nominal tracking	Extensive company mission statement
Supplier Management	Only monetary KPIs	Shared sustainability KPIs
Sustainability targets of customers	No specific requirements	Sustainability integrated into procurement systems
Sustainability Reporting	No sustainability reports	Integrated reporting
Certification	No certificates	Established certificates (e.g. science-based targets)
Employee Motivation	Reactive behaviour	Own initiative
Corporate Culture	No relation to sustainability, no incentives	Target-oriented incentives, sustainability attraction programmes

Workshop Structure

Maturity Model Base

Maturity Model Extension

References

- [1] Gutowski, T. G., Allwood, J. M., Herrmann, C., & Sahni, S. (2013). A global assessment of manufacturing: Economic development, energy use, carbon emissions, and the potential for energy efficiency and materials recycling. *Annual Review of Environment and Resources*, 38 (1), 81–106.
- [2] Goericke D, Lichtblau K, Stich V. Industry 4.0 Readiness Online Self-Check for Businesses. [Online]. Available: <https://www.industrie40-readiness.de/?lang=en>. Accessed: June 05 2021.
- [3] Anderl R, Fleischer J. Leitfaden Industrie 4.0. [Online]. Available: <https://industrie40.vdma.org/viewer/-/v2article/render/15540546>. Accessed: June 05 2021.
- [4] Langer T, Singer A, Wenzel K, Bolev D. Modulbaukasten Digitalisierung – individuelle Lösungen für eine smarte Produktion. In: *Zeitschrift für wirtschaftlichen Fabrikbetrieb (ZWF)* 112. Nr. 12; 2017, p. 902-906.
- [5] Finnerty N, Sterling R, Coakley D, Keane MM. An energy management maturity model for multi-site industrial organisations with a global presence. In: *Journal of Cleaner Production* 167; 2017. p. 1232–1250.
- [6] Pigosso D.C.A., Rozenfeld H. (2012) Ecodesign Maturity Model: the Ecodesign Practices. In: Matsumoto M., Umeda Y., Masui K., Fukushima S. (eds) *Design for Innovative Value Towards a Sustainable Society*. Springer, Dordrecht, pp. 424-429.

The authors gratefully acknowledge the financial support of the Kopernikus-project "SynErgie" by the Federal Ministry of Education and Research (BMBF) and the project supervision by the project management organization Projektträger Jülich (PtJ).

