

***In short: The SMEs need to become ready for automation, and the automation need to become ready for the SMEs***

PhD defence by David Grube Hansen, 17 January 2020

## Abstract

Small and Medium Sized Enterprises (SMEs) represent a significant proportion of the Danish manufacturing industry. Generally, they produce to order, implying a high mix of products at low volumes. Currently, SMEs have a highly flexible manufacturing setup that can produce HMLV products, usually enabled by the employees in the production, indicating low productivity. In the last decades the competition in the manufacturing industry has become fiercer due to globalization and the direct competition from low wage countries. Therefore, the manufacturing companies strive to become more productive to remain competitive.

Historically there has been different levers for gaining productivity ranging from timed flow production lines to Lean production and automation. Those levers have always been a better fit for the large Low-Mix High-Volume producing companies than for the SMEs.

Recently the notion of the technology driven fourth industrial revolution (Industry 4.0) has gained attention. This has directed ripples of new technologies and automation solutions towards the manufacturing industry. The expectations are that the rapid introduction of new technologies and flexible automation solutions will remedy some of the challenges of automating HMLV manufacturing companies. But up until now the technologies and enablers have remained away from the SMEs.

This thesis is seeking answers to why the automation solutions remain away from the SMEs and proposes solutions to the identified twofold problem. First, the SMEs are facing some distinct automation challenges, such as awareness/competencies, factory layout and production monitoring and control, that hinders the implementation of automation. Second, the automation integrators are developing automation based on previous and traditionally developed solutions for large companies. They need inspiration to use new technologies to successfully develop innovative and tailored solutions in cooperation with HMLV manufacturing SMEs.

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The proposed solutions to the twofold problem are comprised in a Lean automation inspired environment where new technologies and automation solutions are encompassed in an Innovation Lab. In this environment SMEs can experience technologies and automation in a manufacturing setting that resembles their context. In the Innovation Lab, a set of tools and concepts have been developed to lower the perceived level of complexity, for example factory simulations, IoT, Cloud etc. so the SMEs can comprehend and see the use of the technologies. Additionally, the Innovation lab resembles a physical representation of the innovation process where new and innovative solutions can be developed. This enables collaborative development of not over engineered tailored automation solutions that automate the right thing with a low perceived level of complexity enabled by innovative use of new technologies.