

# Expose

## Interoperability of Industrie 4.0 Reference Architectures with Human-centered Design

**Project Type:** BA

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### Aim of your research and research questions

How can we implement human data into digital tools? In this research, smart manufacturing reference models (SMRMs) will be investigated, along with comparing them and determine which reference architectures would benefit the process of Human-Machine interaction. The goal is to maintain the completeness and accuracy of the human data. Besides, the proposed framework will be implemented on a factory alike infrastructure. Furthermore, the developed framework will be tested and evaluated with collaborative robots.

### Introduction and problem definition

Automation, robotics and other advanced manufacturing developments are seen as tools for further development and improvement of human physical, sensory and cognitive capabilities. Socio-technical transition into the factory of the future would involve new architectures and engineering concepts for the twofold 'human-centered' and 'cyber-physical' manufacturing processes. Human-centered manufacturing has been the main trend for most previous manufacturing frameworks[1]. However, a range of efforts concentrate on ensuring the consistency and compliance in the data while implementing interfaces. Needless to say, several methods that maintain data completeness using reference architectures are already available; for example, Reference Architectural Model Industrie 4.0 (RAMI4.0) (Fig.1), International Data Spaces (IDS), Industrial Internet Reference Architecture (IIRA), etc. Nevertheless, their integration with human data has not been examined yet[2].

### Methodology and planned procedure

Literature research on reference architectures for integration of human data: A first review of the state of the art will be done by reviewing and summarizing papers that are suggested by my supervisor. In addition, broadening the summary with my research and compare the reference architectures (e.g. RAMI4.0, IDS, IIRA) among each other[2]. The aim of this procedure is to provide an extensive and clear view of all SMRMs.

Proposal of a framework for human data integration considering human centred design: With the guidance of the literature research, a suitable reference architecture to incorporate with human components will be determined. The aim of this procedure is to narrow down all the frameworks and propose a reference architecture to be implemented in the next phase.

Testing and evaluating the developed framework with open source software: With information coming from multiple sources, a platform is essential for managing the exchange of relevant data across multiple applications. FIWARE is an open source platform that establishes a set of standards of context data management, which allows components to enhance the smart industry's development through smart solutions [4]. The purpose of adopting an open source software for testing is that we want the research to be accessible to all. The chosen reference architecture will be tested with FIWARE, and moreover evaluated if an enhancement can be done. With the goal of building

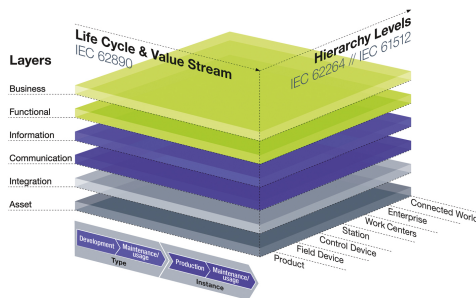


Figure 1: Reference Architecture Model Industrie 4.0 (RAMI 4.0). (Reprint from [2])



on the main focus of the thesis – a smarter human robot collaboration.

### Work plan

The bachelor thesis starts on 03. November 2020 and ends on 23. March 2021 (20 weeks in total). The work plan is listed in Table 1 by week.

Week	Task
1 - 2	Literature Research
3	Write expose, prepare for initial presentation
17. Nov.	Initial presentation
4 - 7	Extending Research on SM-RMs, summarizing the papers
7 -8	Proposal of a framework for human data integration considering human centred design
9	Write intermediate report, prepare for intermediate presentation
start of Jan.	Intermediate presentation
10 - 13	Testing and evaluating the chosen framework
14 - 16	Integration on a factory alike infrastructure
17	Write final report, prepare for final presentation
end of Feb.	Final presentation
18 - 20	Finalizing the final report

Table 1: Work Plan

- [3] Moghaddam, Mohsen, Marissa N. Cadavid, C. Robert Kenley, and Abhijit V. Deshmukh. “Reference Architectures for Smart Manufacturing: A Critical Review.” *Journal of Manufacturing Systems* 49 (2018): 215–25.
- [4] “The Open Source Platform for Our Smart Digital Future.” n.d. FIWARE. Accessed on Nov 15, 2020. <https://www.fiware.org/>.

### References

- [1] Romero, David; Stahre, Johan; Wuest, Thorsten; Noran, Ovidiu; Bernus, Peter; Fasth, Fast-Berglund, Åsa; Gorecky, Dominic. ”Towards an Operator 4.0 Typology: A Human-Centric Perspective on the Fourth Industrial Revolution Technologies. ”(2016)
- [2] Han, Soonhung. “A review of smart manufacturing reference models based on the skeleton meta-model.” *Journal of Computational Design and Engineering* 7 (2020): 323-336.