

Title:

Industry 4.0 digital twin for mobile robots operating in energy industry facilities

Keywords:

System Interoperability, Digital Twin, Data Exchange, Information Modeling, Operations and Maintenance

Project Responsible:

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Partners:

Equinor (Francesco Scibilia,++)

Objectives:

Give an overview of digital twin technology for mobile robots (e.g. drones, crawlers) operating in industrial plants, including the most relevant use cases. Investigate the use of the Asset Administration Shell as an industry standard approach to digital twin for industrial mobile robots, including an assessment of pros and cons. Demonstrate applicability by developing a use case.

The idea for this MSc project is to investigate the use of the Asset Administration Shell (AAS) for implementing a digital twin of a mobile robot (drone or crawler) that has to perform tasks on a plant. The AAS approach can be used to represent all data, information and functionalities that are needed by the robot to operate. The interoperability capability offered by the AAS could allow more effective and efficient deployments of robots in the plant, especially if the plant equipment and systems use the AAS approach as well: imagine the task of inspecting an offshore compression package, the robot AAS and the equipment AAS could communicate and manage autonomously all data and information needed for the inspection task.

Description:

The term digital twin refers to a digital representation of a physical asset sufficient to meet the requirements of use cases decided by the operator of the physical asset. Digital twins can be used during the conceptualization, design and engineering phases of a new asset; and/or during the operation and maintenance phases of an asset (e.g. for energy production optimization, predictive maintenance, simulation, quality management). Security, system integration, interoperability, and connectivity are fundamental aspects for assets aiming to leverage the concept of digital twin. This presupposes the standardization of interfaces and data formats, information modelling, communication, and established open standardized architectures in the industry. Various associations supported by numerous industrial enterprises are collaborating towards the establishment and maturation of standards for digitalization in the industry. Two associations among the most relevant are:

- Plattform Industrie 4.0
<https://www.plattform-i40.de>
- Industrial Digital Twin Association (IDTA)
<https://idtwins.org/en/>

The Asset Administration Shell (AAS), a key concept of Plattform Industrie 4.0 and adopted in IDTA, is proposed as the standard implementation of the digital twin for Industry 4.0.




<https://www.loop.equinor.com/en/stories/taurob.html>

Our first autonomous robot

Year 2021 – Industry 3.0

- Integrating Taurob with Equinor's own systems is being done by software developers.
- Program which valves Taurob shall inspect.

Year 2031 – Industry 4.0

- Integrating Taurob (and any other robot) with Equinor's own systems is plug & play, as easy as installing a printer.
- The valves are intelligent and know their own health. They will proactively contact Taurob (and any other robot) when there is a need for inspection.

This project will investigate the use of the digital twin for the energy industry (Oil&Gas, wind, solar), focusing on open and common industry approaches as opposed to closed and proprietary solutions. The ambition is to also explore other industries as manufacturing for cross-industry knowledge and technology transfer.

The scope of the work include the following points:

- Literature review of existing digital twin solutions relevant for industrial robots, with focus on mobile robots (e.g. crawlers, drones, etc.), including advantages and disadvantages of each solution.
- Investigate the use of the Asset Administration Shell as standardized digital twin framework for robots in the energy industry. Describe relevant existing uses in the industry, expected benefits and challenges with respect to most relevant use cases considered.
- Map key international information standards relevant for the implementation of the digital twin in an industry value-chain perspective.
- Concepts/demonstrators on use cases

The MSc project work can be extended into a MSc thesis work, where more technical details and concept development will be investigated based on results from the MSc project.

References:

- Rasheed, O. San and T. Kvamsdal, "Digital Twin: Values, Challenges and Enablers From a Modeling Perspective," in *IEEE Access*, vol. 8, pp. 21980-22012, 2020, doi: 10.1109/ACCESS.2020.2970143.
- Digital Twin and Asset Administration Shell Concepts and Application in the Industrial Internet and Industrie 4.0 - An Industrial Internet Consortium and Plattform Industrie 4.0 Joint Whitepaper 09/2020
<https://www.plattform-i40.de/PI40/Redaktion/EN/Downloads/Publikation/Digital-Twin-and-Asset-Administration-Shell-Concepts.html>
- What is the Asset Administration Shell from a technical perspective?
[Plattform Industrie 4.0 WORD Vorlage \(plattform-i40.de\)](https://www.plattform-i40.de/PI40/Redaktion/EN/Downloads/Publikation/Digital-Twin-and-Asset-Administration-Shell-Concepts.html)

- [Specification "Demonstrator I4.0-Language" v3.0 \(researchgate.net\)](#)

SDKs:

- [GitHub - admin-shell-io/aasx-package-explorer: C# based viewer / editor for the Asset Administration Shell](#)
- [Eclipse BaSyx](#)