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Digital twin as enabler for an innovative digital shopfloor management system in the ESB Logistics Learning Factory at Reutlingen - University

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Abstract

Technologies for mapping the "digital twin" have been under development for approximately 20 years. Nowadays increasingly intelligent, individualized products encourages companies to respond innovatively to customer requirements and to handle the rising product variations quickly.
An integrated engineering network, spanning across the entire value chain, is operated to intelligently connect various company divisions, and to generate a business ecosystem for products, services and communities. The conditions for the digital twin are thereby determined in which the digital world can be fed into the real, and the real world back into the digital to deal such intelligent products with rising variations.
The term digital twin can be described as a digital copy of a real factory, machine, worker etc., that is created and can be independently expanded, automatically updated as well as being globally available in real time. Every real product and production site is permanently accompanied by a digital twin. First prototypes of such digital twins already exist in the ESB Logistics Learning Factory on a cloud- and app-based software that builds on a dynamic, multidimensional data and information model. A standardized language of the robot control systems via software agents and positioning systems has to be integrated. The aspect of the continuity of the real factory in the digital factory as an economical means of ensuring continuous actuality of digital models looks as the basis of changeability.
For the indoor localization sensor combinations that in addition to the hardware already contain the software required for the sensor data fusion should be used. Processing systems, scenario-live-simulations and digital shop floor management results in a mandatory procedural combination. Essential to the digital twin is the ability to consistently provide all subsystems with the latest state of all required information, methods and algorithms.

Peer review under responsibility of the scientific committee of the 7th Conference on Learning Factories

Keywords: Digital twin, business ecosystem, cloud- and app-based platform, digital factory, software agents, indoor localization, sensor combinations, digital shopfloor management

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1. Introduction

The ESB Logistics Learning Factory, Business School Reutlingen University pursues a holistic approach of the digital and real factory. The digital twin has to be developed. This is a bidirectional term which means that the transformable Learning Factory depicts any change in real time in both the digital and the real factory 1:1 and vice versa. Hybrid automated guided transport systems (robots), an intelligent conveyor system, software for self-control of work orders, a pick by light system, and driverless transport systems for the collaborative tugger train are some of the available real components.
Technologies for mapping the digital twin have been under development for approximately 20 years [1]. In an age of an increasing demand for individualized products, challenges companies to both, innovatively respond to customer demands and to quickly gain control of the increasing product variation [2] as well as a view in the future with less work and on average much older employees [3] requires completely different working models.
So the development of a concept with prototypical realization of a mobile digital shopfloor management system is the consequence with the digital twin as enabler. Machine-learning, stream analytics, cognitive services, as well as interaction and information building blocks based on a changeable production concept in the self-controlled ESB Logistics Learning Factory [Fig 1] are some of the digital modules.

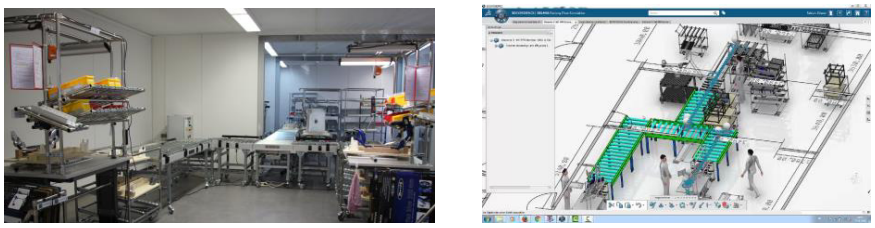

Fig. 1 Real ESB Logistics Learning Factory and cloud based 3D model

2. Combination of several methods for imaging the digital twin

An integrated engineering network, spanning across the entire value chain, is operated to intelligently connect various company divisions, and to generate a business ecosystem for products, services and communities [Fig 2].

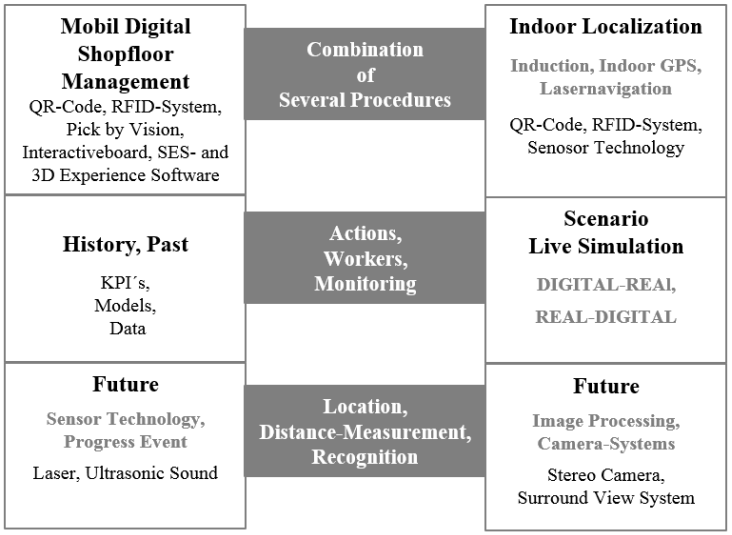

Fig. 2 Combination of several methods for imaging the digital twin**