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Abstract:

Digital Twin as a Tool for Project Development

Today, the "digital twin" is an important tool in industry for controlling and optimizing processes, production facilities and entire factories. Automation and digitalization form the basis of this digital transformation. With the digital twin, it is also possible to estimate future scenarios. The digital twin can already be used for small projects or for assembly production. These individual solutions can be combined so that the simulation of complex systems is also possible. The first prerequisite is that the relevant data that significantly influence the process are recorded and displayed. However, too much detailing of the systems and the input variables would unnecessarily increase the workload.

Since the visualization of processes creates a good understanding for the user, a variety of software solutions are used today. For example, offline programming is used to plan and control the production steps. A digital image of the hardware of the production equipment is created and the product is manufactured virtually. For example, when welding an assembly, all process steps within a production cell with a robot in a 2D or 3D application are traversed step by step and relevant process parameters are defined. Robot movements, the closing and opening of clamping devices, the control of the welding units are generated independently by the software and the complete production sequence can be simulated. This then results in the required process times and the user can make optimizations in order to manufacture a technically perfect product under economic aspects. Required semi-finished products and auxiliary materials can be extracted and the technical connected loads can be estimated. This data is then fed into the higher-level process planning and control system. The production unit under consideration can then be transferred to the factory layout, so that in the end a digital twin is created, with which connected processes can be represented. Real processes are simulated and further optimized. If changes become necessary, e.g. due to external disturbances or optimisation requirements, these can then first be processed virtually without having to intervene in ongoing real production processes.

The findings from production can also be adopted for transport systems. In transport logistics, the automation of handling processes and picking for deliveries (JIT and JIS) will play an even greater role in the future. New logistics concepts such as CargoTube are being developed with the help of the digital twin, among others, to determine the potentials of climate-neutral transport of goods in low-pressure tubes. The supply security of a production location through an externally positioned logistics hub as well as the performance of CargoTube applications within logistics networks are being addressed in initial studies. The essential success factor from today's point of view is the automated loading and unloading of vehicles in the logistics hubs as well as the required switch technology for the pods between tube and hub to achieve high cycle times.

In CargoTube a Robotic Smart Packing/Loading Simulator will be used to develop and understanding of how these technologies support the end-to-end cargo flow in fast moving logistics operations. A digital twin enables to test algorithms, design robots, perform regression testing, and train AI system

using realistic scenarios. Populations of robots can be simulated in complex indoor and outdoor environments, using a robust physics engine and powerful high-quality graphics.

New and innovative technologies in particular require visualization and need a large number of variations of the technologies used in order to be able to offer a marketable product at the end of the development process. Here, the digital twin can provide significant amounts of knowledge and is more than just a simulation software of process steps to determine individual KPIs.