Digital Twins utilization throughout the Life Cycle of Industrial Processes

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Abstract:

In this presentation, Digital Twins for industrial processes are considered from their historical and future point of view. What is actually a Digital Twin – is their only one or several for different purposes? What enables the development of Digital Twins just now? Which benefits and challenges are there in their development and implementation?

There are many definitions for Digital Twins. Most state that a Digital Twin is a virtual representation of a physical product or process, used to understand and predict the physical counterpart's performance characteristics. Digital Twins are used throughout the product life cycle to simulate, predict, and optimize the product and production system before investing in physical prototypes and assets.

Already 30 years ago, such systems and simulators were developed and utilized which for sure would nowadays be called Digital Twins, concrete examples including Computer Aided Design, Process Modelling and Dynamic Simulators, Advanced Process Control, Condition Monitoring, Expert and Knowledge-Based Systems, and even Remote Expert Services.

Digital Twins are presently at the top in their hype curve, and their enabling technologies develop strongly and rapidly. We are facing partly evolution, partly revolution in their development. For example increased computing power enables real time analytics, cloud-based computing enables flexible calculation capacity, mobile technology enables mobile and remote applications, wireless sensors enable additional measurements, and Artificial Intelligence and Machine Learning tools enable advance analytics. Furthermore important is the connection to Internet of Things and Industrial Internet applications development.

Potential to utilize Digital Twins in industrial processes and equipment is wide, them forming ideally a digital thread throughout the whole life cycle. The goal is efficient information management, its utilization and updating in all phases of the life cycle: product development, production planning, sales, project implementation, operations optimization, personnel training, process operation and maintenance.

Why is the utilization of Digital Twins still so difficult or even impossible? Challenges are created by separate functional processes and IT systems, and especially by organizational silos and suboptimization of goals, in different phases of the life cycle. Open questions exist still related to common data models and standards, and model updates. Own challenges come from the data ownership and principles of sharing data between related actors, equipment manufacturers, end users and service providers, related to design data and operation-time data management.

Looking forward that these challenges and open questions will be solved and the vision of up-to-date Digital Twins, utilized in the whole life-cycle, comes true and enables the performance optimization of processes and equipment in the future autonomous mills and plants.