DEVELOPMENT OF DIGITAL TWINS AS A PROMISING DIRECTION IN THE DIGITALIZATION OF PRODUCTION PROCESSES

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In today's competitive environment, industrial organizations require advanced analytics that enable near-real-time decision-making for more efficient production process management. By leveraging cutting-edge digital twin technology, which offers the most advanced monitoring, analysis, and predictive capabilities, process engineers can conduct 24/7 monitoring of plant data, as well as ongoing health checks and recommendations for resolving performance deficiencies [1, 2].

One trend in digitalizing a production facility with the goal of creating its digital twin for industrial plant optimization and increased production efficiency is a dedicated cloud and software infrastructure called asset performance management (APM). Asset performance management technology unifies asset and process data by integrating all sensor sources, control systems, process histories, and machine condition monitoring systems. The ability to uncover new levels of untapped plant productivity begins with the creation of this unified set of process and asset data. The innovative idea of optimizing an industrial facility using an APM system involves incorporating a library of a wide range of asset models into the APM IT infrastructure (Fig. 1). The library combines three key asset modeling methods into templates for specific assets: performance modeling, analytics modeling, and operational modeling [3, 4].

Another established trend is the implementation of digital twins supporting advanced process control (APC). Industrial APC applications require the created process model to accurately represent the process dynamics. Typical strategic goals for these applications include improving production economics or increasing the quality and quantity of target products. The online optimization function is designed for continuous process monitoring and for predicting the optimal production control mode through continuous reconciliation with a reference process model.

Online optimization software typically uses simultaneous equation solving technology. The model is part of a suite of applications that represents the best course of action for the process to achieve objectives.

A third important trend is the development of process simulators, or so-called computer-based training systems (CTS), to improve the competence and qualifications of personnel servicing production facilities. A computer-based training systems is a set of software modules integrated into a simulation model of process equipment and control systems. A CTS is designed to allow trainees to practice various operating modes and situations, including startup and shutdown modes, and the ability for the instructor to simulate deviations from the mode. This allows for the creation of a wide range of scenarios for trained operators and the observation of their actions.

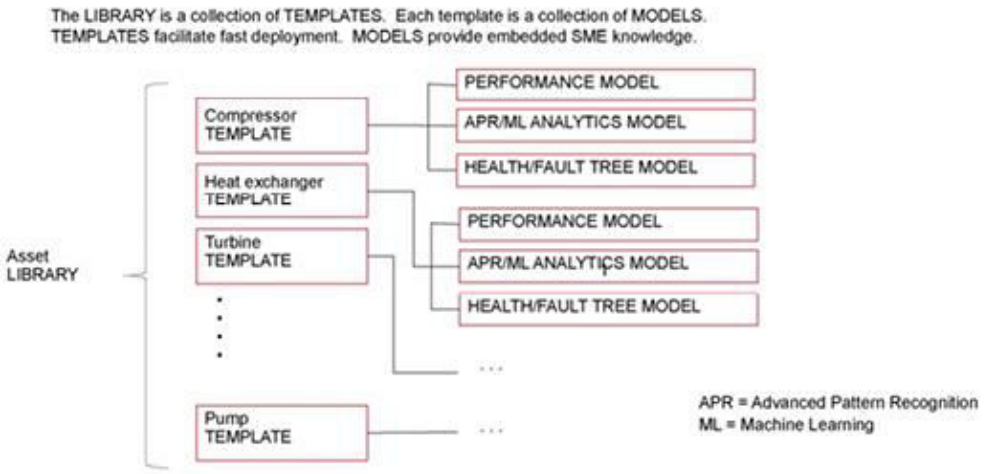


Figure 1. APM Asset Library.

The trend of creating projections of technological process simulators is probably the most developed in connection with the urgent need for simulators over several decades, but at the same time one of the most profoundly developing as the technological processes themselves become more complex and, at the same time, the accelerated development of training systems and tools, including modern technologies of virtualization, augmented and virtual reality.

Thus, digital twin development trends will inevitably expand and deepen as human activity becomes more digital. A key aspect of the high-quality and efficient operation of any digital twin is the maximum available volume of collected data and the analytical tools for processing it. Therefore, any step toward digitalization of elements or objects associated with the primary prototype of a digital twin is essentially a step toward improving the digital twin.

References.

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