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Developing a Framework to Evaluate the Applicability and Necessity of Digital Twins for Industrial Assets

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Abstract

Using virtualized assets to improve planning and control is becoming increasingly popular. Digital twins are a way to achieve this idea in various application fields. The concept of digital twins goes beyond asset virtualization and aims to utilize this virtual replica for contextually driven action planning. In addition to the time taken to make decisions, the accuracy of the decision-making process is crucial. Though the idea seems novel and represents the future of asset management, decision-makers should thoroughly evaluate certain aspects before embarking on this transformational journey. The complexity of the decision-making scenario, the capabilities to be built in the twin, the development process, the process of deployment, the required change mindset and readiness level, along with the post-deployment maintenance, and management of the "Asset-Twin" along with the "Asset", are some of the pointers to look up to. The current work aims to develop a framework that accounts for these facets to support decision-makers while choosing the "Digital Twin" way.

Keywords
Complex Adaptive Systems, Decision making, Digital Twin, Prediction and Control, Uncertainty Modeling

Biographies
Dr. Minakshi Kumari is currently an Assistant Professor in the Department of Mechanical Engineering at the Indian Institute of Technology Delhi. Her prior engagement was as an Assistant Professor in the Operations and Supply Chain group at the Indian Institute of Management, Jammu. She earned her doctorate from IIT Delhi, and her professional experience encompasses both academia and industry. She has led the research and business analytics division of a Delhi-based start-up and has collaborated with the Indian Institute of Management Ahmedabad as an academic associate in the production and quantitative methods area. She has worked as both an internal and external consultant for business process reengineering activities for manufacturing and service companies. Her research interests primarily align with the manufacturing sector, focusing on various aspects of digital twins, smart manufacturing, Industry 4.0maintenance planning, reliability engineering, and simulation.

Professor Makarand S. Kulkarni is currently a Professor in the Department of Mechanical Engineering at the Indian Institute of Technology Bombay. He has previously served as an Associate professor at the Indian Institute of Technology Delhi and as an Assistant professor at NITIE Mumbai (now known as IIM Mumbai). He is a M Tech and PhD from the Indian Institute of Technology Bombay. He has also worked in companies like Syntel (I) Ltd., Cap Gemini, Earnst & Young Ltd and Crompton Greaves Ltd. His research interests include reliability engineering, maintenance planning, quality engineering, digital twins for Industry 4.0, and manufacturing analytics.