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Business-Driven Digital Transformation in Industry 4.0

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Abstract

Industry 4.0 integrates physical and data technologies such as Internet of Things, Artificial Intelligence, and big data analytics, transforming both manufacturing and service industries. Central to Industry 4.0 is digital transformation, which infuses data technologies throughout businesses, enabling insights into manufacturing processes, identifying areas for improvement, and optimizing operations and services. A key challenge of digital transformation lies in determining who will lead the transformation and maintain digital assets. Organizations may opt to purchase SaaS (Service as a Service) digital products or develop their own. However, maintaining control over digital assets during transformation proves daunting. Digital products, akin to black boxes, are user-friendly yet challenging to control and comprehend. The opacity of production development and unfamiliarity with data technologies often cause organizations to hesitate in their digital transformation decisions. In this paper, we propose a solution that divides digital product development into pure engineering and business configuration components. Each aspect can be concurrently developed by engineers and business owners. This approach allows business owners possessing domain knowledge and requirements to actively engage in digital product development alongside development engineers, comprehensively understanding and controlling their digital assets. With this solution, business owners assume full control of business logic and requirements, while engineers focus solely on engineering products that can be easily extended, upgraded, or replaced. This framework reduces dependencies on data technology and engineering efforts, empowering business owners to drive and lead digital transformation. A data engineering project is presented to illustrate the design of a scalable, plug-and-play framework.

Keywords

Industry 4.0, Digital Transformation, Data Infrastructure, Big Data

Biographies

Zhongyuan Li is a PhD student in the Department of Multidisciplinary Engineering at Texas A&M university, College Station, Texas, USA. His research interests mainly concern Industry 4.0, with a focus on the digital transformation in the service sector, data-driven applications and big data analytics. Zhongyuan has been recognized as a professional data engineer with over 12 years of experience in working with data analytics businesses across different industries. He is also the author of more than 20 scientific conference/journal papers and book chapters.

Hamid R. Parsaei is a professor in the Department of Industrial and Systems Engineering at Texas A&M university, College Station, Texas, USA. Dr. Parsaei is awarded as a fellow IISE, ASEE, SME and IEOM. His leadership experience and accomplishments include serving as Professor and Associate Dean for Academic Affairs at Texas A&M University at Qatar (TAMUQ.) He also served as the Director of Outreach and Accreditation and the Interim Chair of the Mechanical Engineering at TAMUQ while holding the rank of Professor in the Department of Industrial and Systems Engineering at Texas A&M University in College Station, Texas. Prior to joining Texas A&M University, Dr. Parsaei served as Professor and Chair of the Department of Industrial Engineering at University of Houston for 10 years and Director of Graduate Studies and Graduate Advisor for five years. He also served as Director of the Texas Manufacturing Assistance Center's Gulf Coast Region from March 2001 to September 2005.