

Industry 4.0-Based Energy-Value Stream Mapping: Connecting the Flow of Value With Energy Consumption in Real Time

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Abstract

The development of a more efficient and effective flow of value in an organization or supply chain has been an extensively researched topic in the literature. Value stream mapping (VSM) has stood out as one of the most applied methods due to its ease of application and practical comprehension. VSM has also been used as a means to enhance the sustainability of value streams. With the emergence of Industry 4.0 (I4.0), disruptive technologies may affect the way value streams are designed, leading to more assertive decision-making processes and contributing to enhancing sustainability of value streams. Nevertheless, few studies have actually combined I4.0 technologies and VSM to concomitantly address the flows of value and energy in an organization. This study aims at proposing a I4.0-based Energy-VSM approach. This approach integrates different I4.0 technologies with complementary roles throughout a value stream, allowing the real-time assessment of the implications of the decisions in both material and information flows over the energy flow. To illustrate our proposition, a case study in a manufacturing company was carried out. This company has a solid continuous improvement management system, and more recently it has developed a program to undergo the digital transformation fostered by I4.0. This case study enabled the verification of the actual benefits and challenges inherent to the proposed approach, raising practical and theoretical contributions to the body of knowledge.

Keywords

Value stream mapping, Industry 4.0, Energy, and Sustainability.

Biographies

Guilherme Luz Tortorella has more than 12 years of experience as a Manufacturing and Continuous Improvement Manager in the automotive industry, having worked in sites from Brazil, Mexico, Uruguay, the UK and USA. Additionally, he has worked as an Industry Consultant for 7 years. With more than 240 journal articles published, 2 books and 15 book chapters, his research is mainly focused on Operations Management, more specifically on Lean Management, Industry 4.0, and Supply Chain Management. He is the Editor-in-Chief of Journal of Lean Systems, and Associate Editor of the International Journal of Quality & Reliability Management, International Journal of Lean Six Sigma, Production Journal, and Operations Management Research Journal.

Daniel Nascimento Lecturer with a tenure track through the Ramon and Cajal contract at the University of Barcelona Business School (Since 2023). Researcher and Professor Doctor at the University of Jaén (2021-2022). Industrial Technology Manager at CERTI Foundation (2019-2021). Recently, he was an Engineering Consultant at PUC-Rio (2015-2019). He is a Professor of Master of Science (MSc) in Management Systems and Industrial Construction at Fluminense Federal University. Associate Editor at Journal of Lean Systems. Ph.D. in Sustainable Management Systems and MSc in Industrial Construction, both at Fluminense Federal University. In Industrial Engineering and Black Belt in Lean Six Sigma, the core areas are BIM, Lean Systems, Circular Economy, Industry 4.0, Lean 4.0, and Construction Life Cycle Project Management.