

## **MAPPING THE PAST, PRESENT AND FUTURE OF DIGITAL TRANSFORMATION RESEARCH IN MANUFACTURING**

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### **ABSTRACT**

#### **Introduction**

Digital transformation (DT) has become a driving force in the current rapidly changing business environment, compelling institutions to undergo a metamorphosis. The manufacturing sector is especially more often prone to such innovations (Tao et al., 2018; Liere-Netheler et al., 2018). As processes are standardized, changes in these promise huge, effectivity outcomes. From this perspective, the manufacturing sector is often a good starting point to observe changes and how business research evolves. Thus, our study aims to explore the current state and emerging trends in DT within the manufacturing sector. Our research question is: Which areas of research in DT within manufacturing are of current and future importance?

We contribute to the further development of the field of DT in general. By showing the field's current state and future avenues, we can detect missing aspects. Specifically, we contribute to adjacent areas such as construction as well as non-adjacent sectors such as service, as insights from research on the manufacturing industry would be of relevance in these areas, too.

#### **Methodology**

To answer the first part of our research question, we collected 462 research articles obtained from Scopus by using the following search string "Digital Transformation AND Manufacturing" found in titles, abstracts, or keywords. In our study, we performed a co-occurrence analysis using VOSviewer software, developed by (van Eck & Waltman, 2010). For the second part, we collected calls for papers from the ten best conferences on Business & Management listed in the database research.com. For the call for papers, we aggregated the content using an open coding approach using Nvivo.

#### **Preliminary results**

Focusing on the evolution, current trends, and future research agenda of DT within manufacturing, we began our analysis by mapping the evolution of DT within manufacturing, tracking the development and diffusion of key concepts and technologies over time. Our analysis of current trends (figure 1) revealed a growing emphasis on several key areas of research.

## *Mapping the past, present and future of digital transformation research in manufacturing*

An increasing focus lies on advanced manufacturing technologies such as the Industrial Internet of Things (IIoT), artificial intelligence (AI), robotics, and additive manufacturing under the umbrella of Industry 4.0. Advanced manufacturing technologies offer significant opportunities to improve resource efficiency, reduce waste, and minimize the environmental impact of manufacturing processes. For example, additive manufacturing enables more precise material usage, reducing waste and energy consumption, while AI-driven predictive maintenance can optimize equipment performance and extend its lifespan, contributing to more sustainable operations.

Our analysis reveals a strong connection between research on the adoption of digital transformation strategies and its effects on manufacturing performance. Studies reported improved production efficiency, reduced lead times, and enhanced product quality for companies following a digital transformation (Liere-Netheler et al., 2018). Our analysis further shows that the adoption of smart manufacturing practices is positively associated with increased levels of innovation, according to research. Moreover, there is also growing interest in exploring the role of digital platforms and ecosystems in enabling value co-creation and collaboration among stakeholders.

Research on the intersection of digital transformation, smart manufacturing, and sustainability has begun to explore innovative approaches to sustainable value creation, such as the integration of renewable energy sources, the development of energy-efficient production processes, and the implementation of circular economy principles in manufacturing operations. By leveraging digital technologies to enhance sustainability performance, manufacturing firms can not only minimize their environmental footprint but also gain a competitive advantage in an increasingly resource-constrained world.

The literature also highlighted the importance of adopting a holistic approach to technology integration, considering not only the technical aspects but also the organizational and human factors influencing the adoption and implementation of digital technologies (Vial, 2018).

Our analysis of the call-for-papers revealed that industrial automation, IoT in manufacturing, Digital Twin, Data Analytics, ML for process optimization, and Robotics were the most significant keywords found. In addition, we found that agile manufacturing and lean manufacturing were also important themes.

### **Discussion and Conclusion**

The findings indicate a strong focus on technical aspects in both the published works and the call for papers. Of course, enhancements are important for the further development of connectivity and communication technologies. At the same time, the focus of adoption through enterprises and their employees needs to be a broader strand of research. Thus, we see keywords such as agile and lean as a representation of a more adoption-oriented way, as these are management concepts. Overall, we see the need for a stronger balance of research between technology push and market pull.

Our study provides valuable insights into the research priorities in the field of manufacturing. Our study also reveals a need for evolution with a socio-technical lens, such as agility, human centrality, and effectiveness.

**Keywords:** Digital Transformation, Manufacturing, Review

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