



Advancing the Development Process of Digital Twins in Production Systems

Adrian Sanchez de Ocaña

Licentiate Thesis Defence

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Abstract

Manufacturing companies are increasingly making substantial investments towards digital twins to enable the continuous optimization of their production processes. To maximize the value of these investments, a structured development process can facilitate faster development, enhance resource planning, and reduce overall costs while simultaneously increasing the probability of successful digital twin developments for production systems.

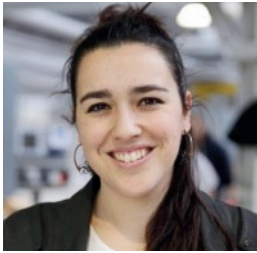
Existing literature principally addresses specific steps and challenges within the development process, leaving a need for deeper holistic exploration into how digital twins can be developed in industrial manufacturing settings. This gap represents a significant challenge for manufacturing companies, as the incorrect execution of this process could result in a considerable loss of valuable time and resources.

The purpose of this thesis is to explore the development process of digital twins for production systems. This thesis studies the development process of digital twins within a global manufacturing by adopting real-time longitudinal case study methodology. By focusing on the development process aspects, this licentiate thesis seeks to generate new insights that will be useful to those responsible for or involved in the digital twin development process.

This thesis provides three main contributions. Firstly, it identifies key requirements when developing digital twins for production systems, highlighting the need to focus on not only technical requirements, but also requirements related to people and processes. Secondly, based on physical, virtual, and process complexity, it identifies the sources of complexity when developing digital twins for production systems. Thirdly, it provides insights into the development activities within digital twin development processes, offering significant guidelines for researchers and practitioners.

This thesis presents a framework that offers a practical contribution to support practitioners in the process of developing digital twins for production systems. It outlines a structured approach to assist practitioners in mitigating the complexities of digital twin development process. The approach outlines key stages and considerations to facilitate the holistic perspective of the process, providing a practical tool for manufacturing companies to enhance their efforts and increase the potential for success in digital twin developments for production systems.

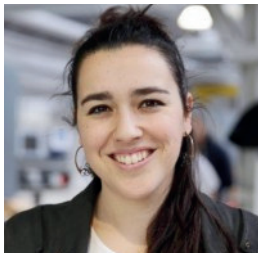
Faculty Examiner



Ainhoa Goienetxea
Senior Lecturer

University of Skövde
Sweden

Committee Members



Ainhoa Goienetxea
Senior Lecturer

University of Skövde
Sweden



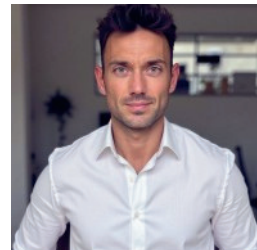
Kristina Eriksson
Associate Professor

University West
Sweden



Walburga Kerschbaumer
Associate Professor

University of Bolzano
Italy



Alessio Bucaion
Associate Professor
(Reserved Committee member)

Mälardalen University
Sweden

Supervisors



Main-Supervisor

Jessica Bruch
Professor

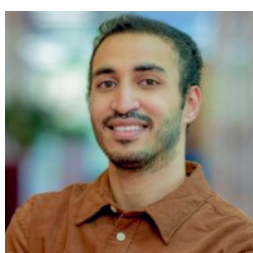
Mälardalen University
Sweden



Co-Supervisor

Ioanna Aslanidou
Docent

Mälardalen University
Sweden



Co-Supervisor

Imad Berrouyne
Postdoctoral Researcher

Mälardalen University
Sweden

List of publications in the thesis

Paper A

Sanchez de Ocaña, A., Bruch, J., & Kober, C. (2024). Exploring the Development Process of Digital Twins for Manufacturing Firms: A Longitudinal Case. Manuscript (preprint)

Paper B

Sanchez de Ocaña, A., Bruch, J., & Aslanidou, I. (2024). Sources of Complexity in the Development of Digital Twins in Manufacturing : Sustainable Production Through Advanced Manufacturing, Intelligent Automation And Work Integrated Learning, Sps 2024, IOS PRESS NIEUWE HEMWEG 6B, 1013 BG AMSTERDAM, NETHERLANDS, 2024, p. 299-310. Conference paper, Published paper (Refereed)

Paper C

Sanchez de Ocaña, A., Bruch, J., & Aslanidou, I. (2023). Model Simplification: Addressing Digital Twin Challenges and Requirements in Manufacturing: Advances in Production Management Systems. Production Management Systems for Responsible Manufacturing, Service, and Logistics Futures / [ed] Alfnes, E., Romsdal, A., Strandhagen, J.O., von Cieminski, G., Romero, D, 2023, p. 287-301 Conference paper, Published paper (Refereed)

Biography

Adrian came to Sweden five years ago with a Spanish scholarship that contributes to developing young talents and acquiring skills in an international setting and started working at the University of Skövde. He researched at the University of Skövde in Virtual Engineering since contributing to both national and international projects with industrial partners such as Volvo Car, Volvo Trucks, ABB, Xylem, and Flexlink. His current position is Industrial Ph.D. within IndTech School in Mälardalen University and employed by the company Alfa Laval to research in Digital Twins for Production Development.

Contact



adrian.sanchez.de.ocana@mdu.se

IndTech graduate school is an industrial Ph.D. school at MDU offering advanced training in the field of industrial digitization, a new and emerging field of technology that revolutionizes all aspects of the manufacturing and process industry. A total of 25 doctoral students will, within the framework of the program, combine employment at companies with pursuing postgraduate studies at MDU from 2021-2027.



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