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# A Process Mining Approach for Production Flow Analysis

**Laura Tomidei**
PhD Candidate
Centre for Advanced Manufacturing
University of Technology Sydney (UTS)
Ultimo, New South Wales, Australia
Laura.Tomidei@uts.edu.au

## Abstract

The complexity of production systems has been growing exponentially over the last decade. Social, economic, and political trends are pushing manufacturing companies to shorten product development periods, while having higher flexibility as well as resource efficiency at the same time. In addition, the adoption of digital technologies has spread to industrial applications, generating new growth opportunities. Industry 4.0 represents the paradigm shift which exploits advanced digitalisation to create smart factories. A common issue faced by manufacturing companies relates to identifying the main value streams in the production. Such issue is particularly relevant for high variety-low volume companies, for which value streams may be composed of hundreds of products and parts. By defining the main value streams, it is possible to gain a better understanding of production processes and highlight the key sources of complexity that limit efficiency. More importantly, the identification of value streams is one of the key Lean Production principles and it represents an enabling step for future improvements. To define value streams, having a clear understanding of production flows is key. The wider availability of data generated from the factory floor unlocks new opportunities for more informed, tailored decision-making in this context. Technologies such as sensors and RFID allow to collect information in real-time and provide an accurate representation of production processes. To analyse the complexity of production flows, Burbidge first introduced the principles for Production Flow Analysis in 1970s. The methodology proposed in this research builds on these fundamental principles and enhances them with Industry 4.0 capabilities, in particular process mining. The use of production data automatically collected from the factory floor allows to analyse part routings, which are the basic data representing interrelations between operations in Production Flow Analysis. The proposed research aims to provide a quantitative approach to automatically structure large amounts of production data based on production data with a specific focus on routings. By defining and analysing product routing homogeneity, it is possible to define clusters of products and hierarchically structure the production into value streams. This can be achieved by combining process mining and machine learning capabilities with the Production Flow Analysis principles. Ultimately, intelligent product routing-based metrics can be translated into automatic features that inform decisions related to the management of production systems.

## Keywords

Production Flow Analysis, Value Stream Analysis, Industry 4.0, Process Mining, Machine Learning

## Biographies

**Laura Tomidei** is a PhD Candidate at the Centre for Advanced Manufacturing in the Faculty of Engineering and IT at the University of Technology, Sydney. Her current research focuses on Industry 4.0 and Industrial Data Science, with her PhD aiming to develop a data science-based method to automatically identify the key value streams based on production data. Laura's research spans on the ability of new technologies to transform processes in various Industries and generate value. Laura has successfully contributed to research projects with industry and Government partners at UTS since 2018. Recent industry projects that she contributed to include the WHS NSW Guidelines for Safe Collaborative Robot Design and Implementation, and a scoping study focused on additive manufacturing opportunities

for Australian agribusiness for Agrifutures. Laura Tomidei holds a B.Sc. and a M.Sc. in Industrial Engineering from the University of Bologna, and a M.Sc. of Commerce with specialisations in Business Analytics and Business Information Systems from the University of Sydney.