Systematic Mapping Study of Digitization and Analysis of Manufacturing Data

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Abstract : The manufacturing industry is currently undergoing a digital transformation as part of the mega-trend Industry 4.0. As part of this phase of the industrial revolution, traditional manufacturing processes are being combined with digital technologies to achieve smarter and more efficient production. To successfully digitally transform a manufacturing facility, the processes must first be digitized. This is the conversion of information from an analogue format to a digital format. The objective of this study was to explore the research area of digitizing manufacturing data as part of the worldwide paradigm, Industry 4.0. The formal methodology of a systematic mapping study was utilized to capture a representative sample of the research area and assess its current state. Specific research questions were defined to assess the key benefits and limitations associated with the digitization of manufacturing data. Research papers were classified according to the type of research and type of contribution to the research area. Upon analyzing 54 papers identified in this area, it was noted that 23 of the papers originated in Germany. This is an unsurprising finding as Industry 4.0 is originally a German strategy with supporting strong policy instruments being utilized in Germany to support its implementation. It was also found that the Fraunhofer Institute for Mechatronic Systems Design, in collaboration with the University of Paderborn in Germany, was the most frequent contributing Institution of the research papers with three papers published. The literature suggested future research directions and highlighted one specific gap in the area. There exists an unresolved gap between the data science experts and the manufacturing process experts in the industry. The data analytics expertise is not useful unless the manufacturing process information is utilized. A legitimate understanding of the data is crucial to perform accurate analytics and gain true, valuable insights into the manufacturing process. There lies a gap between the manufacturing operations and the information technology/data analytics departments within enterprises, which was borne out by the results of many of the case studies reviewed as part of this work. To test the concept of this gap existing, the researcher initiated an industrial case study in which they embedded themselves between the subject matter expert of the manufacturing process and the data scientist. Of the papers resulting from the systematic mapping study, 12 of the papers contributed a framework, another 12 of the papers were based on a case study, and 11 of the papers focused on theory. However, there were only three papers that contributed a methodology. This provides further evidence for the need for an industry-focused methodology for digitizing and analyzing manufacturing data, which will be developed in future research.

Keywords : analytics, digitization, industry 4.0, manufacturing