The conceptual framework of digital platform to manage and coupled manufacturing data and expert knowledge

Birute Mikulskiene[a,*]

[a] *Mykolas Romeris University, Vilnius, Lithuania*

Abstract

Purpose of the article The manufacturing sector is facing serious challenges: the growing global competition and consumer desire to opt for individual solutions giving priority to product design. Customized production increase production costs, extend manufacturing time and entail frequent errors in the product quality. Industry 4.0 comes with the development trend of machine learning algorithms available to deal with pricing issues, but because of the lack of historical data and uncertainties about future contingencies, machine learning alone may not be sufficient to achieve the required accuracy. In this case, expert knowledge is used. Thus, this challenge could be solved using digital instruments, allowing an immediate reaction to the content of a customized order and proper evaluation of manufacturing procedures, costs and deadline.

Methodology/methods The conceptional model of digital platform was created using triangulation-based methodology, which is built on three empirical studies: (1) qualitative study (18 interviews in two Lithuanian companies with a wide range of specialists, including CEOs, managers, product developers, constructors) regarding price methodology, organizational support, data available for machine learning. The interviewing was conducted in the period from October 2018 to April 2019; (2.) machine learning testing on real production data of one-year 2019; (3.) structural expert judgement experiment conducted with 10 and 32 randomly selected products asking employees to guess the price of those products.

Scientific aim The goal of this research is to create the framework suitable to capture tacit knowledge about product price while coupling machine learning output with expert knowledge. By this research we proposing a management based conceptual model to address the issue of evaluating furniture production orders (the price mainly) using opportunities of digitalization. The proposed solution is based on merging three different approaches, e.g. machine learning, data visualization and employee engagement.

Findings Cost-estimation is still mainly based on data about materials used in production and only operating times are collected and stored in databases excluding other time indexes to be accounted for. So, machine learning exercises has main limitation due to the data incompleteness. While surveyed principles that companies would expect from any digital application for price and order evaluation underlined the importance of material-based pricing systems. Interestingly, that structured expert elicitation experiment revealed that selected experts among company's employees demonstrate better results than other and can meaningfully correct the price estimation. Taken in to account the practices of customise manufacturing, the concept of digital platform is based on paradigm of Knowledge Management, as a key enabler to help capture tacit knowledge when employees can simultaneously share their knowledge and create new knowledge from existing tacit knowledge by codifying it. For this particular function, special approach to visualization of data and machine learning is vital, helping non trained on data visualization experts to capture the main data trends by easiest way and during shortest possible time.

Conclusions The key idea of an instantly functioning system for price estimation of complex manufacturing orders is to engage experts who are managers of customer manufacturing to evaluate output of machine learning by social and market acceptability and price estimates within the shortest possible time, cutting down the process duration from several days to several hours. The accuracy of estimated price firstly is achieved using stochastic methods and the basis of Bayesian methods for neural networks, then with help of structural expert judgement procedure for expert expertise ranking, managers contribute to accordance with their position, knowledge and experience.

* Corresponding author.
E-mail address: birute.mikulskiene@mruni.eu

Keywords: Knowledge management, Digital platform for price estimation, Customized furniture manufacturing, Expert knowledge, Machine learning

JEL Classification: G31, M41

Acknowledgement: This project has received funding from European Regional Development Fund (project No 01.2.2-LMT-K-718-01-0076) under grant agreement with the Research Council of Lithuania (LMTLT).