Interdependencies of Industrie 4.0 & Lean Production Systems
- a use cases analysis -

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Abstract

Lean has become a widely spread approach to gain high efficient processes in enterprises. Nowadays, Industrie 4.0 is one of the most promising approach to cope future challenges in the production environment. It is shown, that a process orientated organization and thus, Lean Production Systems might be an enabler towards a successful and sustainable implementation of Industrie 4.0 in the production environment. To enable a detailed analysis of interdependencies between Lean Production Systems (LPS) and Industrie 4.0, several Industrie 4.0 elements have been structured into technologies, systems and process related characteristics, based on 260 use cases of applied Industrie 4.0 technologies in the German industry. Afterwards, the use cases have been analyzed regarding interdependencies between Industrie 4.0 and principles of Lean Production Systems.

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1. Introduction

Due to the volatile and globalizing market as well as the accompanying intensified competition, German manufacturing companies face new challenges in terms of cost, quality and time. The increasing number of competitors and the change from the seller's to the buyer's market, enables customers to choose a variety of different products with a high degree of freedom. This increases the need of individual products, whereby a constant cost and quality level is demanded. Thus, the importance of an economic production in lot size 1 for manufacturing companies will increase in future. This trend can be summarized under the term 'mass customization'. In order to remain competitive as a manufacturing company in high-wage countries like Germany, processes and methods along the entire value chain have to be designed in a productive, efficient and flexible manner.

2. Lean Production Systems and Industrie 4.0

2.1. Lean Production Systems

In the past, companies have introduced Lean Production Systems (LPS) to create efficient and target-oriented processes and thus, to cope the above mentioned challenges. Thus, processes and procedures of manufacturing companies are currently designed according to the Lean principles. Lean Production Systems can be described as “an enterprise-specific methodical system of rules for the continues orientation of all enterprise processes to the customer in order to achieve the largest by the enterprise management” [1] and pursues the goal of a systematic and continuous reduction of non-value-adding activities and the alignment of all processes to the customer’s perspective. [2] LPS are targeting to achieve a continuous improvement process (CIP) within the entire enterprise. [1]

In the meantime, LPS have been established in almost all industries and has become an industry standard with the publication of the VDI 2870 in 2013. Nowadays, 90% of manufacturing companies have already implemented the principles and methods of a LPS in the production environment. [3, 4] The processes and procedures of these companies are often structured and organized according to the LPS principles, using different company-specific individual configured methods and tools of the LPS. The continuous improvement activities are carried out by workers on the shopfloor under consideration of the overall enterprise targets. An important aspect for the sustainable success of LPS is the consistency of goals, processes, design principles, methods and tools applied within the entire enterprise.

2.2. Industrie 4.0

To cope the above mentioned continuous increasing challenges, the approach of Industrie 4.0 has been presented at the Hannover Messe in 2011. Industry 4.0 can be defined as “real time, intelligent and digital networking of people, equipment and objects for the management of business processes and value-creating networks” [5]. The Industry 4.0 can be realized due to the, according to Moore’s Law, decreasing price and the increasing performance of modern information and communication technologies (ICT). These ICT will be applied to products, machines, workers in production and logistics processes. [6] This enables all participants of the product development process and other stakeholders to communicate with each other, to analyze data according to defined algorithms and to control production flows and initiate potential continuous improvement activities [7], which enables customers to launch a production order independently. This order is controlled autonomously by modern ICT in real time and negotiates with other objects about available resources. In addition, processes can be analyzed, improvement potentials can be derived independently of humans and suggested to employees respectively the process owner, always considering the overall optimum for the company. Thus, industrial manufacturing, logistics, business and process management, intelligent transportation of people and goods can be optimized by modern ICT. [8] However, many terms like sensors/actuators, RFID, horizontal- and vertical integration etc. are used to describe Industrie 4.0. [9]
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