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Lean information and communication tool to connect shop and top floor in small and medium-sized enterprises

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Abstract

In small and medium-sized enterprises (SME), information acquisition and transmission between business departments is carried out mainly in a paper-based way. For instance, in manufacturing and assembly, the modifications of technical drawings are documented manually on technical drawings. At the end of the production process, all technical drawings have to be forwarded to the design/development department. Nowadays, all these drawings are passed over, in order to create an overall machine documentation. The technical drawing and machine modifications have to be reviewed successively which increases both the completion time and project term. Furthermore, it increases the risk of consequential errors. Moreover, it is personal intensive, which results in a delayed engineering documentation for the customer. To overcome this ineffective process, a computerized production application in combination with smart devices was developed. This shop floor information application supports employees with recording and communication of modifications of components and technical drawings. The tool for Industry 4.0 focuses on different business departments and business processes to digitalize the previously described analog processes and avoid media gap in the company.

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1. Introduction

Small and medium-sized enterprises (SME) face challenges such as personalized products in small quantities, an increasing price pressure and shorter delivery times. In response to these challenges, lean and reconfigurable processes are applied in production as a solution. The required responsiveness can be achieved on the basis of information usage [1]. In order to support business processes, a multiple of task-specific IT-systems and cyber-physical-systems (CPS) are used nowadays [2]. Cyber-Physical Systems as well as production-oriented IT-systems, such as Enterprise Resource Planning (ERP) and Manufacturing Executive Systems (MES), are a standard to enable horizontal and vertical networking. With ERP and MES, a good starting point for the implementation of I 4.0 technologies has already been created. However, the adjustments to the existing IT-system landscape require a high commitment of resources such as time, capital and labor. These resources can rarely be provided by SME. CPS and lean production apps offer an adequate solution in order to achieve a complete networking on both the horizontal and vertical level, to control the scope of investment as well as to maintain existing and proven IT systems [3].

Hence, this paper deals with the development and implementation of a production app. With the help of this procedure, a solution for the use case called “shop floor-information-application” (SIA) is developed. It consists of a production-app and smart devices such as tablet and smart pen. After a short overview of the state of art, the motivation and the use case are highlighted in more detail. The developed procedure for SIA is described as well as its technical functionality. Finally, a summary and outlook are given.

2. State of the Art / Related Work

In industrial production, data and information are decisive competitive advantages for international corporations and SMEs [4]. Individualized, high-quality products with low batch sizes, increased price awareness and the demand for increasingly shorter delivery times were the challenges of the past few years. The decisive goals for manufacturing companies are quality, price and delivery time [5]. CPS and production apps are designed to achieve these goals. Over the past few years, an ambitious effort has been made by science and industry to optimize production-related information systems and IT-systems. For this reason, this area is a permanent research subject of some scientific work. A concept or a technological development, which supports the employee in SMEs in the reception and provision of context-related information on the shop floor and which distributes this information to organizational departments, according to needs and requirements, does not currently exist.

2.1. Production factor: Information

In order to be able to react adequately to time-intensive factors such as production changes and disturbances, it is necessary to develop solutions and find ways to optimize production which requires lean and responsive processes. The required responsiveness can be achieved on the basis of information and transparency [6]. During industrial production, a variety of information e.g. product-, process-, and project-related information occurs. For these types of information, there are several methods and systems of information gathering. At the shop floor area, information is transferred via verbal, written or computer-related communication. Production Data Acquisition (PDA), Machine Data Acquisition (MDA), Shop Floor Programming (SFP), NC programming systems and tool management systems are the most frequently used applications in the shop floor area. Some systems have grown historically as isolated applications, without suitable interfaces that enable the integration of further systems. In addition, these systems are stationary and often not very intuitive. Declared goal of research and industry is a consistent shared use of data and a complete integration of all systems, as well as a uniform structure of information to ensure data exchange among each other [7].

Even today, verbal and paper-based information exchange is the most widely accepted form of communication. To support computer-related information transfer, information carrier technologies such as auto-ID systems are indispensable tools. An increasing amount of devices is able to receive, use and send data, by using sensors, storage media and computing power. These functionalities are only possible to a very limited extent of components and documents. By linking barcode, quick response code or RFID, the media gap between the object and information level can mostly be reduced [8].

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