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# Potentials of digitalization in tool management

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**Abstract**

It is indisputable that digitalization may tap previously unused potentials in industry. However, the amount of approaches for implementing digitalization in tool management is scarce. To close this gap, this paper proposes a framework for approaching digitalization in tool management. The framework consists of three sequential steps. The first step is about the definition of the company`s individual goals of tool management such as a high tool availability, a low tool inventory and a high product quality. In the second step, the digitalization levers and their influence on these three goals are determined. Three of the most important levers are the development of competencies, the integration of databases and the usage of track and trace technologies. In the third step, measures for the implementation process need to be derived. For assisting companies in determining the gap between the current and the target status, a Readiness-Model is presented. The developed three-step framework increases the transparency of the potentials and provides a guideline for the implementation process.


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*Keywords:* Smart tool management, Industrie 4.0, Framework, Readiness-Model

## 1. Introduction

A potential is defined as "latent qualities or abilities that may be developed and lead to future success or usefulness" [1]. The potentials of digitalization for the manufacturing industry are very strong. In this context, the field of tool management has been neglected and is therefore addressed in this paper.

### *1.1. Digitalization in the manufacturing industry*

Digitalization is “the conversion of text, pictures or sound into a digital form that can be processed by a computer” [1]. Nowadays, the highest level of digitalization in industry is “Industrie 4.0”. According to Bauernhansl [2], it is one of the most important concepts of securing the competitiveness of a company in a sustainable manner. The term Industrie 4.0 is used for various use cases and developments having an alleged relation to the digital transformation leading to a dilution of the original concept. In this paper, the following definition is used:

Industrie 4.0 respectively the fourth industrial revolution describes the connection of physical and virtual processes by cyber-physical systems (CPS), which are horizontally and vertically networked in real time [3].

CPS are a technical evolution of mechatronic systems. In mechatronic systems, elements from mechanics, electronics and informatics are integrated. By the integration of embedded systems and communication technologies, CPS are additionally able to process information and network with other systems. These systems are horizontally networked across several business units within the company boundaries and possibly along the supply chain. Furthermore, through vertical integration with other hierarchy levels they are connected within a company [4]. As can be seen, the revolution is not the digitalization but the possibility of establishing networks of technical systems communicating with each other in real time [4].


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### 1.2. Tool management

Nowadays, companies have to face several challenges. The high product variety and the concurrent reduction in order size increase the complexity of manufacturing processes [3]. At the same time frequent product and process innovations, which are especially due to the globalized market structures, lead to decreasing product lifecycles [3]. Based on these trends, a higher number of tools and more frequent tool changes are necessary. This increases the challenges in tool management which is responsible for managing all activities involved in the handling of tools such as tool storage, tool assembly, tool presetting and measuring, tool provision, tool disassembly, tool reconditioning and tool disposal [5]. Tool management strives for achieving several – partly contradictory – goals like a high tool availability, a high tool usage rate respectively a low tool consumption and a low tool inventory [6].

There are various approaches to optimize the conflicting goals in tool management. However, usually they do not consider the usage of digitalization. Furthermore, there is no framework that assists companies in tapping potential in tool management by integrating digitalization. Therefore, such a framework was developed comprising three steps: the definition of goals, the identification of levers and the gap analysis. In the first step, the company needs to define the goals of their tool management. In the second step, the levers of digitalization having an influence on the goals are determined and the influence is assessed. Finally, by opposing the current and the target status of digitalization in tool management, a gap analysis can be carried out. A Readiness-Model is developed for assisting companies in the last step.

## 2. Step 1: Definition of goals

In the first step, the goals in tool management have to be defined. Even though the weighting depends on the company`s preferences, frequently the most important ones are a high tool availability, a low tool inventory and a high product quality.

### 2.1. Higher tool availability

Usually, tool availability is denoted as the most important goal in tool management [6]. It refers to providing the right tool, at the right time, in the right place, in the right quantity and in the right condition [7]. Therefore, one of the factors influencing tool availability is the search time. Mason [8] states that typically about 20% of an operator's time is needed for searching cutting tools. Reducing the search time increases the tool availability. After the annual inventory, the actual and the documented inventory level match. At all other times, the inventory is not documented appropriately. Thus, the worker does not know with certainty where to find the tool needed. This results in high search times. A study by Jendoubi [9], in which five companies with a multi-variant production were queried, showed that about 30% of the overall tool preparation time, which includes searching, assembling, measuring, presetting, and picking the tool holder and special devices, is needed for finding the tool. In the worst case, this leads to a production downtime.

### 2.2. Lower tool inventory

Frequently, the tool types and the number of tools being stored is unknown or too high [7]. This is due to various reasons. First, high inventories are established to guarantee the tool availability. The inventory level usually exceeds the number of tools actually needed. Among others, this is due to an inaccurate documentation of the inventory level. The tools needed are usually booked out at the storage area and the number of tools in the circulating stock is not documented. However, knowledge about the circulating inventory is necessary to make a reasonable decision about time and quantity of a tool order. Additionally, after finishing an order, the tools are frequently not returned to the designated storage areas but put in storage areas close to the machines to guarantee a maximum level of availability for one machine or worker. It is assumed that the number of tools remaining in these areas accounts for about 15% [10]. However, these tools are not available for others. Workers needing these tools have to order new tools resulting in high inventories. Another factor increasing the inventory level is that usually many tools that have not been used for a long time are still on stock.

### 2.3. Higher product quality

Companies always strive for satisfying the customer needs. Aside from low costs and short delivery times, the customer usually requires a high product quality. Using the right tools and appropriate process parameters is necessary for ensuring a high product quality. Process parameter include rotational speed, feed rate and cutting speed.

## 3. Step 2: Identification of levers

The usage of digitalization is one possible measure to improve the objective values. Even though there is high potential in digitalization, a study by Fraunhofer IPA showed that 45% of the 200 surveyed companies have not done the first steps towards digitalization [11].

Several approaches in industry concerning digitalization focus on optimizing the products (Smart Products) and the logistic processes (Smart Logistics). The usage of identification technologies for tracking and tracing products and transport carts, the visualization of several process steps on mobile devices, and the analysis of process data are some examples.

Tools are usually not considered even though they are responsible for up to one third of the production costs [12] and there is a lot of improvement potential, which can especially be tapped by the usage of digitalization.

In the context of digitalization, data plays an important role. Tool data include process data, administrative data, data about the current tool condition as well as historical data [13]. In the era of digitalization, more data and especially more reliable data than before are available and can be used for optimizing processes. Furthermore, higher computing capacity enables a fast processing of data. This is especially important for dynamic data since it may change in real time.