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# Increasing the traceability through targeted data acquisition for given product process combinations

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**Abstract**

Today's manufacturing companies are faced with the challenge to achieve a high adherence to delivery dates under volatile market demands and to achieve a high efficiency of the order to delivery process. This challenging situation can only be handled with the help of an optimal alignment of the production, the production planning as well as the production controlling processes. Sufficient and high quality information from the production are the major basis for successfully mastering the tasks of production planning and control. With the help of the approach proposed in this paper, companies can start setting up a targeted data acquisition concept for their product process combination. It helps them, amongst other things, preventing production problems and responding rapidly to fluctuating customer needs.



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*Keywords:* data acquisition; production control; traceability

## 1. Introduction

In order to stay competitive, many manufacturing companies, especially small and medium sized enterprises (SME), face the challenge to transform their production and the corresponding production planning and control (PPC) processes for the upcoming Internet of Things (IoT) Era. Often they are missing the necessary competencies or are failing to perform this step from a benefit-oriented resource perspective. Since their time and cost budget is a constraint, SME need to focus particularly on relevant data types, data acquisition points and technologies that will be beneficial for their manufacturing processes. State of the art approaches are lacking in supporting SME sustainably, systematically and company-specific on their way to IoT from a PPC-perspective[1]. With the help of this paper, companies can start setting up targeted data acquisition concept for their product process combination. Through this, they will be able to satisfy fluctuating customer needs and keep a high adherence to delivery dates.

## 2. Data acquisition from production and data Processing

### 2.1. Data analytics as an enabler for improving the Production Planning and Control

The data analytics process is a typical approach in the area of business analytics [2]. In Figure 1 this process is shown adapted to analyzing production data, through stating the objective of each step for using production data.

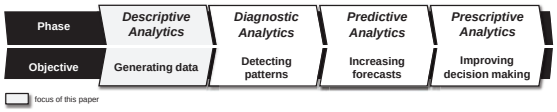


Figure 1: Data analytics process (in dependence on [2])

The steps of the production oriented data analytics process are described in the following. The first step is the phase of the descriptive analytics. Generating data on the shopfloor and in IT-Systems is the major purpose of this phase. The better the data quality is in respect to correctness and


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granularity of the generated data, the better the traceability will be. According to DIN ISO 9000 *traceability* is the ability to identify and trace the history, distribution, location, and application of products, parts, materials, and services. A traceability system records and follows the trail as products, parts, materials, and services come from suppliers and are processed and ultimately distributed as final products and services [3]. In this paper, traceability is considered as the capability to track current and trace the previous status of production, e.g. tracking various orders during their production process or receiving the current capacity status of a working machine. Good traceability is the basic requirement for improving the capability to plan and control a production under volatile production and market conditions such as technical disturbances, rush orders, changes of the customer order, organizational disturbances, incorrect planning times or incorrect transition times. From the technological perspective, there exist many ways for increasing the traceability. Just to name a few: Barcode on orders and materials, data matrix labelling, radio-frequency identification (RFID) of orders or production materials, camera technology, near field communication (NFC) or real-time locating system (RTLS) for tracing materials [4]. The focus of this paper will be on this phase of the data analytics process.

The second step, the diagnostic analytics, is about pattern recognition within the generated data. Typical recurring patterns in data of a production surrounding are e.g. repetitive machine sequences or seasonal variations within a production cycle. Identified repetitive machine sequences could be used for adjusting the machine layout by implementing line segments in order to cut throughput times. By taking into account seasonal variations, material disposition can order early enough so that no shortages in material supply will occur.

In the third step, the predictive analytics, the ability to build forecasts with the help of the previously identified patterns is in the focus. In a production surrounding, forecasts enable e.g. predictions about potential capacity bottlenecks. By intervening as predicted, a bottleneck-reduced production can be achieved.

The fourth and last phase of the data analytics process are the prescriptive analytics. The major goal of this phase is the generation of decision support for managerial problems that occur during production. Instead of having to use gut feeling, prescriptive analytics use the processed data from the steps before and quantifies possible decisions. Last but not least it rates them with the help of a target function.

As described above, the focus of this paper is on the descriptive analytics phase. In order to follow a targeted approach in having all necessary feedback data in the required accuracy and frequency, the data needs of the production planning and control have to be identified. Therefore, in the following subchapter the Aachen production planning and control model will be presented to give a framework for major actions and their data needs for a PPC.

### *2.2. Aachen PPC model as a framework for actions*

The goals of the Aachen Production Planning and Control model are oriented on the typical logistic objectives, that most producing companies are following [5]. The goals are:

- High adherence to delivery dates
- High and smoothed capacity utilization
- Short throughput times
- Low work in progress
- High flexibility [6]

The complete Aachen PPC model is shown in the following Figure 2. Since this paper can only go briefly into the topic of improving the traceability through targeted data acquisition, the focused tasks which have data needs will be the in-plant production planning and control tasks. These core tasks are also the most relevant ones for achieving a high logistic objective fulfillment, because they are linked directly with the production shopfloor.

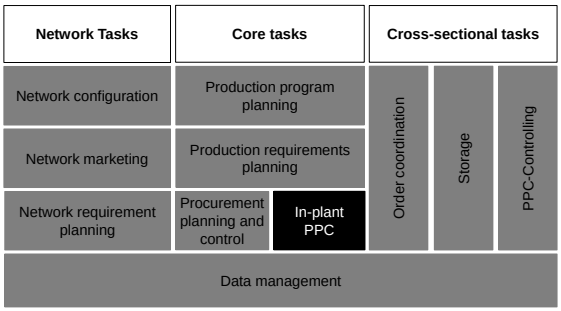


Figure 2: Aachen PPC model [5]

The major tasks of the in-plant production planning and control are described briefly in the following. The four tasks, order generation, order release, sequencing and capacity control will later be used in the proposed approach, to derive their data needs.

Order generation ensures the planned values for the input and output of the production as well as the planned sequence. The order release defines the period of time in which the orders are needed for production and sets the actual input for the production. Capacity control identifies and determines how much time a machine is running and how long each worker is engaged on each machine. Sequencing, however, determines the process order of each machine [7].

In the following section the product process matrix will be introduced. It will be used to categorize product process combinations.

### *2.3. Categories of product process combinations*

Production processes can be distinguished by many characteristics. The automotive mass production of Toyota will differ strongly in terms of characteristics and challenges from the production of a low volume, very specialized machine building company. Hayes and Wheelwright [8] introduced the product process matrix in