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Implementation of a Software Prototype with ConWIP Characteristics for Production Planning and Stock Management

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Abstract

Production planning is an elementary aspect of supply chain management and requires appropriate and effective tools. The purpose of this paper is to present the concept, design, and implementation of a software prototype for production planning that incorporates aspects of the Constant Work-In-Process (ConWIP) manufacturing system. In introductory sections, essential knowledge about fundamental strategies of production planning and the concept of ConWIP are subsumed. After a brief illustration of the manufacturing process in the company for which this work has been conducted, various aspects of the actual software implementation are presented. The paper concludes with a discussion about potentials and limitations of the solution.

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1. Introduction

In order to master an increasingly competitive business environment, the optimization of intra-company logistics and the application of efficient systems for production planning and control (PPC) are nowadays essential for manufacturing enterprises. These enterprises have to analyze the current state of production, examine the prerequisites for improvement, and create resulting concepts to optimize the intra-company logistics and production planning especially in regard to aspects that increase efficiency. Even though many concepts for logistics and

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production planning already exist, the main challenge lies in choosing appropriate processes and procedures, as well as in developing, implementing and optimizing an ideal combination for the respective production environment.

Benefits for business clients are rooted in high quality products combined with competitive prices. But globalization has led to a dramatic intensification of competitiveness in manufacturing industries and only those who react accordingly will be able to retain this combination of quality and price to succeed in the future. The need for adequate concepts for agile and lean logistics and production processes becomes apparent. Thereby, the focus lies on the increase of efficiency, flexibility, quality, and cost effectiveness so that the company remains on par with the global competition and may eventually adapt faster to changing customer demands. Besides, customers have an advantage when their partners are reliable and flexible. A customer-oriented approach of a company is often tantamount to its profitability, so the challenge is to optimize current resource capacities in terms of cost, time, and quality. The ability of companies to remain successful and competitive under current conditions, which are also influenced by the economic crisis, consequently requires simultaneous improvement of three basic factors: increase of flexibility, improvement of quality, and reduction of costs. Optimization of manufacturing processes is currently one of the most common and extensive tasks. Complexity and challenges of the market environment forces companies to pay particular attention to the improvement of operating conditions that also support its competitiveness, implementation of economic objectives, and increase of efficiency.

In this context, the following paper is going to present the concept and implementation of a software application prototype used for production planning and stock management. Development and evaluation of the prototype are done as part of a case-study that aims to modernize and optimize production processes of a medium-sized manufacturing company operating in the sanitary branch of plastics industry. The work of this paper builds upon the scientific findings presented in previous publications, such as Gastermann et al. [2], and Stopper et al. [8].

2. Review of production planning and control systems

In order to discuss production planning software, a basic knowledge of the theoretical background of PPC systems is required. Therefore, this paper will at first provide a short introduction to the most relevant topics required for the understanding of the later sections, though it is not the scope of this paper to discuss them in detail. Various other publications like Gastermann et al. [2], or Stopper et al. [8] already covered these topics to a greater extent, so please refer to one of these papers for a more in-depth view on that matter.

This introductory section will first take a short look at the fundamental strategies of push- and pull-based manufacturing, and describes an enhanced concept that combines both approaches into a single but hybrid system. Additionally, a brief review of the Constant Work-In-Process (ConWIP) production system is provided.

2.1. Basic strategies of production planning and control systems

In respect of their basic modes of operation, two general types of production strategies exist in supply chain management: The first being a push-based approach, and the second being a pull-based approach. Both of these strategies constitute the basis for most of the manufacturing systems like Material Requirements Planning (MRP), Drum-Buffer-Rope (DBR), Kanban, or ConWIP.

Push-based systems are built upon a master production schedule that determines the release of work packages into production. Such schedules are mostly based upon either calculated forecast or empiric historic demand, but are unable to incorporate actual demand. They cause new work packages to be released at a certain rate and pushed through production until work on a package is finished and resulting end products are put on stock. This workflow occurs regardless of actual customer demand of these products, thus its name of a push-based approach.

On the contrary, pull-based manufacturing systems depend on real demand in order to release work packages to production. In this case, the source of demand is irrelevant, so it could either be an actual customer order or internal demand generated by subsequent manufacturing steps. In other words, as soon as any kind of demand is present and the current system state allows it, the release of new work packages to the previous stage of the production chain is authorized or triggered in order to satisfy these requirements. When looking at the whole production chain, this process appears as if demand were pulling new work packages along the production line from start to finish up to the point where the demand is met by the work packages' output.