

# Computer Applications in Production Management and Their Impact on Company Performance

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*Abstract:* - Although computer applications for production planning and control are very important for effective production management, little research has been undertaken on their impact on company performance. In our research, the respondents were asked what improvements were observed in their companies after implementing any production planning software. It was found out that the majority of companies have problems with measuring benefits from implemented planning systems. They were able to mention only some positive effects but not their real influence on company performance. Therefore the quantitative research was completed by several interviews with production managers in order to detect the main problems with system implementations and difficulties with measuring the benefits of this investment. As respondents indicated, information systems in production management help them especially to increase sales and decrease costs. However, not always are these effects as significant as the company expected.

*Key-Words:* - Production Planning, Capacity Planning, Performance Indicator, Information System, Planning Software, Enterprise Resource Planning, Advanced Planning and Scheduling

## 1 Introduction

In general, information systems help companies achieve their business goals. However, each company should be able to measure the real effectiveness of the implemented software application. Unfortunately, no standard system of measuring the effectiveness of information systems used in industrial companies or other organizations has been created till now. Many authors, such as P. M. Tuten, S. Nasher, Z. Molnár or P. Učeň, have tried to create their own set of indicators, but neither of these approaches has become widely used in practice [1, 2, 3, 4].

The most complex methodology for IT governance is called COBIT (Control Objectives for Information and Related Technologies). It is an overarching business framework for governance and management of enterprise IT which provides globally accepted principles, analytical tools and models to help increase the value from the implemented information system and bridge the gap between technical issues, control requirements and business risks [5]. This methodology is useful for decision-making and creating any framework for the whole IT management. However, it is not always suitable for the evaluation performance of any software application.

The performance of a business process can be measured in various ways. The most often used variables are net profit and sales growth. Some authors strongly recommend using some multiple performance indicators [6, 7]. The common ones include Return on Investment (ROI), Return on Average Capital Employed (RACE), Payback Period (PP) or Benefit-Cost Ratio (BCR).

Authors deal with performance in many different areas. For example J. Taylor [8] examined performance indicators of Australian higher education whereas Wong et al. [9] tried to develop a performance measurement framework for community health service facilities. Many authors also focus on measuring performance via production management. Chen and Liaw [10] in their study proposed a pattern analysis method that should help companies to rectify weaknesses of production management and promote their business performance. Many authors also deal with effects of Enterprise Resource Planning (ERP) systems to organizational performance. S. Uwizeyemungu and L. Raymond [11] presented very sophisticated evaluation method which includes seven steps. They examined several ERP effects and their impact on selected performance indicators. Described evaluation model was validated in the real company.

To sum up this initial overview, we can say that many authors have investigated business performance from various perspectives as well as many authors have tried to solve problems of evaluating IT investment. However, neither of these studies deals with computer applications in production management and their impact on business performance. In the present paper, we report on a preliminary study of benefits of implemented information system for production planning and control in a sample of 180 Czech manufacturing companies.

## 2 IT Systems for Production Planning

The methods and software applications for production planning and control have been evolving for several decades. The first planning methods supported by information systems were based on push principle. The most famous are [12]:

- Production Control According to a Minimum Inventory
- Material Requirements Planning
- Manufacturing Resource Planning

Some of them are still frequently used in practice, especially Manufacturing Resource Planning.

However, in the 1970s, information systems producers started to integrate pull principles to their applications in order to respect new trends of Lean manufacturing and growing demand for flexible manufacturing systems. The most typical philosophy which respects pull principle is Just-in-Time (JIT). JIT approach is integrated for example in Electronic Kanban, which is included in many ERP systems [10]. Kanban was first introduced as an integral part of the lean manufacturing and JIT paradigm. It can be described as a scheduling system which determines what, when and how much to produce. It can help reduce costs and inventory within the whole supply chain. However, as Hollingsworth says [13], kanban has not to be suitable for each company; it depends on the situation and type of production process.

In today's reality, it is often necessary to combine both (push and pull) approaches. Therefore, information systems producers offer a lot of solutions that support this combination. Many of them are based on Theory of Constraints (TOC) which means that they consider the system bottlenecks. TOC is a management philosophy which can greatly influence optimization of production planning and scheduling if all constraints are considered when production schedule is being made. According to TOC, the planning process

should start on bottlenecks in order to provide its maximum utilization [14]. Software tools that support TOC principles in their planning algorithms are for example Drum-Buffer-Rope (DBR), Optimized Production Technology (OPT) or Advanced Planning and Scheduling (APS). The most complex and the most widely used method is APS. It can be implemented as a special module of the ERP system or as a separate application. APS combines forward and backward planning in order to optimize the production schedule [15].

The less known methods that combine push and pull principle are Concept of Continuous Modeling, Simulation and Optimization (MSO) and Cybernetic Self-Regulatory Mechanisms (SRM) introduced by Steffen Berghof in the late 1990s. MSO is a dynamic system which combines modeling of a virtual production process, its simulation and optimization of targeted behavior and conditions. SRM is also a dynamic method which helps constantly compare set goals with the actual results. Then, SRM can continually update set parameters in order to reach and maintain their required values. [15, 16, 17].

## 2 Methodology

In order to investigate the impact of computer applications for production planning and control on company performance, we examined their positive effects on several business areas, such as sales, customer service, production costs, inventory, controlling etc.

Our research was based on combination of quantitative and qualitative methods. We used both primary as well as secondary data which were collected from several data sources, namely from already published case studies, our questionnaires and interviews. The sample included 180 respondents in total. The exploration proceeded in two phases:

- Firstly, questionnaires and case studies were used to determine the status quo, the existence of information systems in production management and their benefits for a manufacturing company. The sample included especially small and medium sized Czech companies. Afterwards, the mentioned benefits were classified into several groups according to their impact on different tactical objectives.
- After that, interviews with production managers of 5 selected companies were conducted in order to discover major problems with measurement of the

effectiveness of their information system for production planning and control. The respondents were also asked to identify several factors that positively or negatively influenced the implementation of their planning system.

As Cox and Schleier [14] say, the main goal in most for-profit companies takes some form of ROI or RACE. This goal is almost always influenced by the following tactical objectives (Fig. 1):

- Decrease inventory (materials, works-in-progress, final products etc.)
- Improve quality
- Increase sales
- Decrease cost
- Improve services

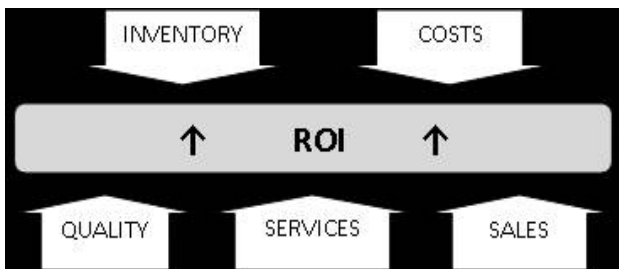


Fig. 1. Increasing ROI through the five tactical objectives [14]

ROI is a very popular metric for measuring performance because of its versatility and simplicity. Therefore, we used this approach in our research and we divided benefits from implemented planning system indicated by our respondents into two main groups:

- benefits that directly influence ROI or RACE and
- benefits that help to monitor and improve production process and traceability but do not directly influence ROI in the short time period.

### 3 Results

In the first phase of our investigation we collected the case studies from several resources and sent questionnaires to several Czech manufacturing companies. We had together approximately 180 samples to be evaluated. The results of this first part are described in the next section called “Results of the quantitative study”.

After that we started the second phase of our research which was focused on gaining the more detailed information about problems with measuring the effectiveness of computer applications used in

the production area. In order to get this information, five interviews with production managers were conducted. The most important findings from these interviews are presented in the section “Results of consequent qualitative study”.

#### 3.1 Results of the quantitative study

Respondents indicated many different positive effects that had been noticed in their companies after implementing any type of information system for production planning and control. We divided all these mentioned effects into two groups (described above) and dealt with each separately. Before we start describing our results, it is important to note that the total amount of benefits does not correspond with the total number of respondents since each of them mentioned more than one benefit in the questionnaire or case study.

Figure 2 includes effects that have positive impact on company performance. All mentioned benefits were classified into five groups according to the specific tactical objective that is influenced by them. As can be seen, in the majority of cases, indicated benefits positively influence sales. The most commonly mentioned effects in this category (Increase sales) were:

- more effective capacity planning,
- keeping delivery dates,
- more flexible production process,
- better utilization of production resources and
- greater productivity.

However, it is important to mention that we consider the hypothetical situation that each company really has customers for the increased production. Some of the effects mentioned above also relate to production costs, but these costs are really reduced only in case that the number of products grows and all products are subsequently sold to customers. That is why we decided to include these arguable effects into “Increase sales” category.

Software applications for production planning and control appear to have major influence on company performance through the decreasing production and other costs and increasing sales. All respondents indicated at least one benefit from one of these two categories.

On the other hand, it is surprising to note that even 25% of them mentioned decreasing inventory as one of the positive effects after implementing their planning system.

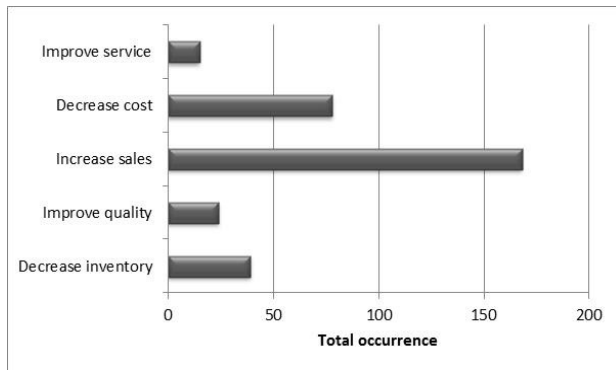


Fig. 2. Five groups of effects that positively influence company performance [source: author's own]

The respondents also mentioned some benefits which do not directly influence the company performance. These effects were divided into the following categories (Fig. 3):

- effects that help to improve production traceability through the whole production process (this group includes more transparent in-process orders control, actual information about material or resource availability, actual information about critical points etc.) and
- effects that help to monitor production process indicators and predict future requirements (this group includes better and more transparent controlling, actual information about the future demand and production requirements etc.).

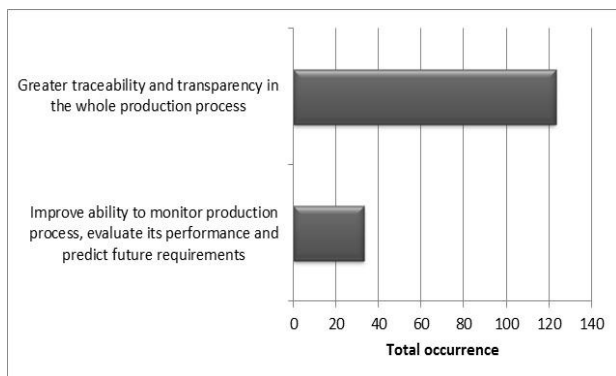


Fig. 3. Effects that help improve production traceability, monitor production process and predict future requirements [source: author's own]

Since our research and this paper are focused on computer applications in production management and their impact on company performance, we deal especially with effects that can directly influence ROI as one of the most often used indicators for measuring business performance. We asked our respondents to introduce all reached improvements

in percentages. Unfortunately, only four companies were able to provide us any measured values. Therefore, we continued our research with a qualitative study, which is described in the next section.

### 3.2 Results of consequent qualitative study

Interviews with production managers of five selected companies were conducted in order to discover major problems with measuring the effectiveness of implemented software for production planning and control in their companies. All respondents mentioned one major problem with measuring IT performance: difficult separation of benefits connected with system implementation from benefits connected with other managerial decisions and improvements. They are able to measure only some partial indicators, but not the total impact on business performance. The monitored indicators are very similar as we used in the first phase of our research. The companies really measure the tactical objectives such as inventory, production costs, increased sales or production quality and services. However, they are able to monitor them only in general, not in relation with the particular software application.

Each of the interviewed companies confirmed that the main goals of system implementation were set at the very beginning. However, unfortunately, four of five respondents admitted that these goals have not been fulfilled till now. There are several reasons for explaining this problem:

- wrong choice of a suitable information system for production planning and scheduling,
- poor support of the implementing partner during the whole implementation process,
- unrealistic goals or
- insufficiently trained users.

We would like to add one other reason which was not directly mentioned by our respondents, but we consider it as the most important issue. We observed this problem in many manufacturing companies that had implemented any information system for production planning and scheduling. The mentioned problem consists of poor adaption of internal processes to the new controlling system. Software applications can create an optimal production plan and schedule, but people must be able to realize this proposed plan in the real production process. On the other hand, the production plan is realistic only if data received from all internal and external processes are realistic as well.

## 4 Discussion and conclusion

The main goal of our study was to demonstrate the impact of computer applications used in the production process on the company performance. We investigated this problem through the five tactical objectives influencing ROI (see results section). Our respondents mentioned several benefits of implemented software solutions, which were divided into several groups just according to these tactical objectives. The majority of mentioned effects fell into the group including effects that help increase sales or decrease costs. The respondents most often indicated the positive effects like increasing the flexibility of production process and production planning, better utilization of production resources or increasing the effectiveness of the capacity planning. From these results we could conclude that computer applications used in production management help improve especially the capacity planning, which is one of the major problems of production planning and scheduling in many manufacturing companies. Unfortunately, almost none of our respondents were able to quantify the reached improvements. Therefore, we are unable to determine from this data how seriously information systems for production planning and scheduling can influence company performance.

We said that ROI is the most often used method for measuring business performance and it is influenced by five tactical objectives. However, it is important to note that improving these five tactical objectives does not always drive ROI in the right direction because they often come into conflict with each other. Cox and Schleier explained that each local manager often drives the organization into conflict with itself by improving his/her functional responsibility and this limits the company from improving its performance [14]. Therefore, companies need to be careful about the reached improvements because they cannot definitely state that improving for example due date performance or decreasing inventory must always have only a positive impact on the company performance. They must consider all other relevant factors, for example decreasing inventory against material availability when required.

From interviews, conducted in five Czech manufacturing companies, we found out that organizations are used to set measurable goals before the system implementation and they try to monitor these goals as well. However, it is usually difficult for them to distinguish benefits that result from the new information system from those due to other activities.

Therefore, our further research in this area should produce materials of greater help to manufacturing companies with measuring the effectiveness of computer applications used in production management. We will try to choose the most suitable indicators for this purpose and create a methodology for the effective choice of the information system for production planning and scheduling.

## Acknowledgement

This paper is one of the research outputs of the project IGA/FaME/2012024 registered at Tomas Bata University in Zlín.

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