



24th DAAAM International Symposium on Intelligent Manufacturing and Automation, 2013

## Support of Effective Planning in the Workshop Laboratory at the Department of Machining Technology in Pilsen

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### Abstract

This article describes an efficiency increasing of the monitoring activities in the manufacturing workshop laboratory at the university, where is required the operational capacity planning of machines management and ensuring necessary number of a human resources according to ISO 9001 requirements. There is analyzed the possibility of software integration for the improvement of the activities of laboratories, production planning and resources. The article documented an application of the selected software as well. In the conclusion is mentioned the evaluation of the planning software benefits.

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Selection and peer-review under responsibility of DAAAM International Vienna

*Keywords:* management; system quality; quality; ISO 9001; improvement; planning; software

### 1. Introduction

Currently can be said the opinion, that for the company is essential to have ISO 9001:2009 certificate. Implementation and the subsequent certification ISO 9001 helps you to set "best practice" in the area of planning, production control and management. ISO 9001 highlights the position of the customer and creates an environment for maximum satisfaction, which has a demonstrable link back to the company's financial results. The implementation of system has many reasons. One of the priorities is to succeed in a competitive environment and give to partner's clear evidence of well-established and well-working organization. But how is it in the education sector?

Quality management system integration in the education sphere has many complications. There are many differences from introduction in the business sphere. In the educational process is necessary to well-know all the

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specific situations and exactly identify all processes, products, customers, and of course their requirements. Therefore was processed and issued an international working contract ISO / IWA 2:2003 Quality management systems - Guidelines for the application of ISO 9001:2000 in education, which is used to facilitate the implementation of effective quality management system just for education sector. [2]

Department of the Machining Technology (KTO) of the Faculty of Mechanical Engineering at the University of West Bohemia in Pilsen has already passed through this entire process and received in the year 2011 the certificate of quality management system. It is permanently effort and also the obligation that this entire system is maintained and improved. The improvement process, which is required by ISO 9001 itself, entails the possibility facilitating and streamlining the defined activities and for this reason it is emphasized. The Department of Machining Technology division workplace managed also the workshop laboratory. Therefore it is obvious that this organizational segment has passed the introduction of audit and now is part of the established quality system in the KTO. For this reason also this section continuous seeks of the improvement in their activities. [1]

One of the major challenges is the decision to undertake a radical change in planning and sourcing for the workshop laboratory of the Department of Machining Technology. The main changes are expected in the area of registration and monitoring of tool consumption, monitoring of machine utilization, planning of orders and of course, make more effective the existing operations.

## 2. The present state – the way of planning customer orders at KTO

Department of Machining Technology is one of the five branch departments of the Faculty of Mechanical Engineering at the University of West Bohemia in Pilsen (UWB) and the only one department of UWB which is a certified by the quality management system according the requirements of ČSN EN ISO 9001:2009.

It is divided into four separate sections:

- Machining and Assembly section
- Quality control section
- Technological preparation section
- Section of Workshop laboratory

Department of Machining Technology is a long time focused in the field of machining, NC programming, automations machining, management quality, metrology, technological preparation of production and assembly. [3]

Department of the workshop Laboratory is composed of two main departments: workshop laboratory which is placed right in the campus, and Science and Technology Park (VTP) which is placed outside of the university campus.

The main utilization of the workshop laboratory is to use for teaching and experimental testing. Another use is for the needs of the projects and custom production for other customers, which are contract partners of the department.

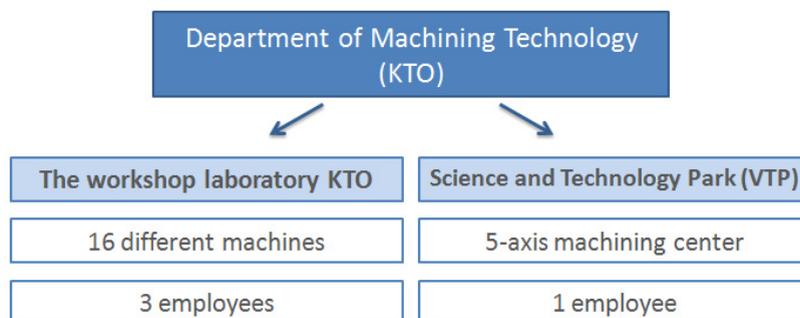


Fig. 1. Organization chart.

There is no central stock with tools. The tools are needed in every workshop or machinery. Control, calibration and sharpening are ensured by external company.

As is apparent from the diagram (Fig. 1), workshop laboratories have four full-time employees. Three of staff are working in the workshop laboratory KTO and one is permanently assigned to workplace VTP, so outside of campus. Everybody work in one shift operation. Machine Park has total 17 different machines, such as band saw, grinders, radial drilling machines, lathe stylus, NC milling machine, NC lathe, 5-axis machining center and etc.

Planning of orders is conditioned by experimental testing for projects, teaching and of course workload of the staff. There are currently scheduling solution only workshop leader who must deal with the possibility operational capacity and compliance with the terms of contracts (Fig. 2).



Fig. 2. Example of current planning.

### 2.1. Specific requirements and difficulties in the planning and resource management of workshop laboratory

This part of the article contains specific requirements which are typical for productive activity of workshop laboratory. The word specific is suggested here, because the differences that are caused by the laboratory and the carried out activities are part of the overall layout and concept of the university, i.e. school environment. And that is different in many ways from the production company.

- Number of machines vs. number of employees

The biggest difference of the workshop laboratory compared to standard production hall is the number of employees. In the common production company every machine or group of similar machines has a staff. Here, in the KTO production hall, is not possible to merge individual different machines into groups and that is why cannot be used multimachine operation. At the moment when all three employees are using any machine, the other 13 machines cannot be used.

If we compare this situation with the business sector, it is possible compare KTO hall to prototype manufacture or repair company. Both of these companies have extensive machine park, but it needs, not always, be used completely during the contract. This leads to the idea that there may be no such number of employees as the number of machines.

- The stock

Compared with manufacturing companies is in our case solution of the stock with tools quite inconvenient. In manufacturing companies usually have a central stock, from which each employee takes what it needs and warehouseman records it. In this case is maintained immediate evidence. The same applies for the return of instruments or tools. There is immediate a control of movement. Another example is when a worker is assigned to any specific accessories and has a responsibility for them. In our case, the tools and instruments are available to each employee of hall and also to academics and students, who are doing practical exercises on them. Then it is up to each of them, wherever the tool will be returned. Of course there are a specified spaces and cabinets, but it is known that a person is in many situations unreliable. And this property is one of the risk factors which is hard to eliminate, particularly when a person is not responsible for the borrowed tool.

- Orders

Another example of differences is the process of orders in the company. In the common companies is order of contracts equal to queue as they come. Then there is not a big problem to determinate a date of delivery. In contrast, the university workshop must calculate with the projects experimental testing and teaching. These activities are usually irregular and can disrupt the entire plan of contracts, or extend the delivery date.

### 3. The proposal solutions - software integration

Integration of the software for the planning should provide to students, academics and partners, as customers of department a clear overview of the using of machinery. Output in the form of a diagram would help their understanding of the possibilities completion or delivery of the order. Another advantage of the software would be faster and thus more efficient all activities. Transparent evidence of tools, materials and their consumption can ensure dexterous reaction to completion or order. The tracking of bottlenecks and timely detection of problems will be ensured, enabling a proper reaction. [8]

Studies show that companies which focus on high adherence to promised delivery dates as their main logistic goal, regularly outperform their competitors. Only with a highly accurate production planning and control companies can accomplish this goal. However, usually there is a gap between the planned forecast of the advanced Planning and Scheduling System and the actual output of the production system. One of the reasons for this discrepancy is inconsistent data which is collected on the shop floor and builds the foundation for the planning process. Ensuring the necessary data with higher integrity could be provided by one of the software module. [10]

At first was itself the workshop laboratory, its structure and all the main and supporting processes analyzed. It was necessary to clarify the objectives and particular outcomes which will be necessary for us. The following were found:

Objectives and outputs:

- recording and monitoring of too consumption
- monitoring of machine utilization
- planning of experimental testing and orders
- summary occupancy of machines for customers
- facilitate and streamline the existing activities

For those difficulties, which were mentioned above, the Department of Machining Technology decided to implement and use software Helios Orange and Microsoft Project 2010.

#### 3.1 Application software Helios Orange by Asseco Solutions a.s.

To streamline the planning and management of contracts, as well as experimental testing in the field of science

and research, the department wanted to use some information software, which would primarily facilitate the work. Because already Faculty of Mechanical Engineering cooperates with Asseco Solutions as, integration of the software Helios Orange was offered as the first. Selected tool should also be used for teaching in one of the subjects. Therefore this option seemed to be acceptable.

Economic and Information System HELIOS Orange was designed to meet the needs of small and medium-sized companies. It is conceived as an information system to support economic areas of the company, but also includes modules such as production or circulation of goods. These modules would have been crucial for our needs. Module Production covered technical preparation of production, which includes the area of design and technological preparation of production. It provides tools for quick and convenient capturing raw data, or for their maintenance. Module Technical production - TPV can be operated independently without connection to other modules of the Helios Orange system. Maximum possibilities, however, can be obtained especially in combination with modules of management production and circulation of goods. The main task of technical production is a detailed record and process a data about the construction and production technology in connection with to the supply of production. The part of the module TPV is a tentative schedule. The preliminary plan can perform calculations, capacity, material requirements and the need for tools. Based on the results of these calculations is possible to determine the most optimal variant of the plan to enter into production. The acquired data can be used in the module of Technical production for publishing design and technological documentation, for calculations and related pricing, reports, materials, procedures and etc. At the same time, this data is an essential input into the Production control module. Additionally, the system can directly generate the necessary documentation such as orders, requisitions and invoices. [5, 6]

The software environment is clear and the work is similar to spreadsheets. There are however, sometimes difficult, a connections between modules where the instinctive implementation is not possible at all. Therefore, the training is recommended, or at least a consultation with an expert.

The first and very important step is configuration. Then you need to create the structure of the organization. This means fill all suppliers, customers, human resources and of course store to a stock all necessary tools for individual contracts. Nomenclatures, in which you enter tools and materials may contain large amount of the information about each item. This is a similar for each module.

The next step is a creation of the new order step by step. You can fill in entry and delivery terms and technological progress, assign tools for individual operations and assign specific workplace or organization. It offers many possibilities to connection of resources and information to each order.

The planning system needs extensive entering of all the information about the orders for correct planning. It is not possible to specify only a part or to add all the connections. Everything ties together, so is good to have complete information before entering. Following edits are in fact quite difficult, sometimes even impossible. They would, for example, generate production orders again because they changed the production plan by adjusting the technological progress or the new material reservations, because they are generated based on the production plan.

Despite the relatively tedious process of entering is for the mass or serial production this system certainly relieved. Individual production parts can be copied with all attributes and technological processes. This fact greatly reduces the amount of data. In addition, you can print this information together in documents and have a view of all the resources.

Regarding the piece or prototype production, to which can be compared our case, copying is nearly impossible. The contract must be specified completely. This is one of the reasons why this system does not meet our requirements.

One of the most important tasks for the proper production planning is an overview of machine utilization and capacity planning. When you generate a report utilization of machines, the system unfortunately reflects either individual machines, or the number of employees. Therefore, the resultant diagram shows in fact an unreal situation. You can not specify to operate more machines than workers are available. Or taking into account only three employees, the system chooses any machine of the hall, so lathes on the pile or mills on the drill. It is not possible to find out the utilization of individual machines.

After consultation with others, we concluded that the Helios Orange system is really rather economics. You can create orders for tools, material requisitions, receipts and etc... It is also possible to compute salaries, generate invoices or records of the solution and its circulation. But for capacity planning, it can be used only for common

company or with other extensions or with custom-built modifications. This would be quite expensive. In the extended version is already implemented Capacity planning and production professions such as dial, which should ensure that the planning of production orders may take into account the capacity of human resources required professions that are required to perform the operation. That could perhaps be our problem, but it is not checked. Unfortunately, as already noted above, additional extensions are expensive.

It would plan properly for remote workplace, where a machining centre and one employee. But that would be double the planning and streamlining which would be not effective.

The summary conclusion is that in the basic form this software is not adequate for the purposes of efficient planning of orders and resources in a laboratory workshop KTO.

### 3.2 Application software Microsoft Project 2010 by Microsoft

Another way how to solve the presented task for planning activities in the school workshop is the MS Project software. Already from the title of the program is evident that it is intended for projects. Moreover, there is no need for investment because it is bundled with MS Office, and even user interface and control conceptually fits between these applications.

Microsoft Project is a project management tool that is included with Microsoft Office by Microsoft. It can be used to support project management, task management, resource discovery and current status of the project. It provides various outputs - Gantt charts, calendars, Cash Flow, EVA and PERT analysis, etc. [7]

Before starting a new project the setting is necessary. After the foundation, the existing project complements the new contract. Individual tasks are entered under it and then the group marked as a summary task, i.e. the contract. Between the tasks shall be added dependencies, the order in which tasks will follow. Can be assigned dates and of course resources. This list of actions is indeed the technological process.

The application contains a collection of resources that are divided into the working one, i.e. the human and material. You can view diagram utilization of resources and assign the costs.

Compared Helios is here with items smaller number of attributes and information about items you can write to a note. Another advantage is the ease of transportation such as to / from MS Excel.

Planning can be manual or automatic. The advantage is that if a resource exceeds its capacity, the application displays on the start line of the operation exclamation point. This indicates that the resource is overloaded and automatically suggests a re-planning. Similarly it is also with deadlines. If the date is exceeded it is indicated (Fig. 3). The term is still possible choice of restrictions such as soon as possible, As Late As Possible, Finish before the date, Start the day and etc.

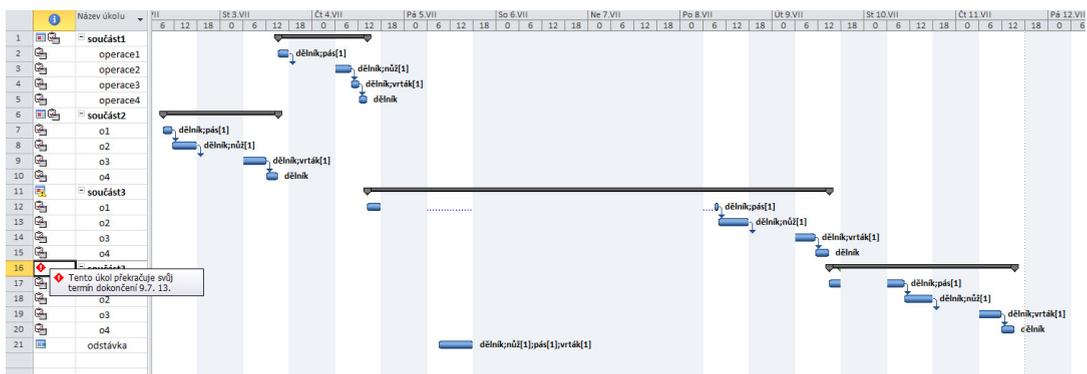


Fig. 3. Overview of the utilization of the hall with a demonstration of warnings exceeding the deadline.

For preliminary planning at this point MS Project is preferable, yet still being tested. The output would be for customers the Gantt chart, which is sufficiently clear. Fund resources would be used for recording tools and the plan is on the draw attention capacity is exceeded. Not yet determined how it would be with an overview of the

utilization of individual workplaces. [9]

#### 4. Conclusion

Integration of the planning and resources management software in the indoor laboratory is in our case in the beginning. The MS Project looks as the best for now. It shows the Gantt diagram, where the customer can see occupation of production, which is one of the main goals. The advantage is also the consideration of capacity and resources with the warning when they overrun. After all, the shown plan in any software is only tentative. There are countless influencing factors that can disrupt the plan and must be reckoned with them. About these factors have already been described in the introductory part of the article as different specificities from manufacturing practice. Then it is again only on the workshop leader, as at present, how to deal with it and how to resolve this situation.

As for the evidence and monitoring of consumption tools and follow-up to completion or order, remains as the best variant MS Excel with filters for better orientation and search. The question is whether the creation of any macros can solve consumption of tools more effectively.

Every software and work with it requires the human consistency. It is not possible insert to any software and work with the characteristics of employees and other potential variable parameters, which for the most part affect 100% planning.

As for the solution of the current situation in the workplace, each employee will receive their own tools, which they will be responsible for. Other tools and equipment will be inspected regularly, and will be monitored their consumption. Another plan is to focus mainly on complete audit of contracts, including all documentation relating to for example: choice of technology and the way of clamping. All those things will help to faster orientation during backward control, ensure the monitoring machine utilization or push forward order repeated fulfilment (for example, it will not be needed to consult the way of technology or clamping method again and again). Scheduling with the help of MS Project software will be solved only for the external laboratory (VTP), which is more used by partners and there is not so difficult to schedule the contracts for a certain period.

#### Acknowledgements

This paper is based upon work sponsored by the student project grant competition no.SGS/2012/023.

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