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Dear MITIP participants,

It is my pleasure to welcome you at the annual 10th conference on The Modern Information Technology in the Innovation Processes of the Industrial Enterprises (MITIP 2008). This conference is located in Prague, in the ancient city in central Europe. During long times Prague has been the city hosting great researchers, scholars and artists. Many great people of the world were born in Prague. It gives me pleasure to see MITIP participants keeping their presentations in this great city. In this annual MITIP edition there are participants from almost 20 countries worldwide registered.

This MITIP edition is organised by the University of West Bohemia. It is symbolic regarding to the fact that the University of West Bohemia is the founder of the conference. The MITIP conference was founded in 1999 in Pilsen.

Organising committee received 75 paper abstracts. After the review process 61 papers have been accepted by the conference scientific committee. These papers have been categorised into 8 sections: Modelling and Simulation of Industrial Processes, Production Planning and Control, Digital Factory, Collaborative Networked Organisations, Systems and Tools of Human Resources Management, Measurement and Evaluation, Technological Innovations, Information Management. Common attribute of all mentioned sections is the effective and innovative application and use of modern information technologies in various industrial processes. This application has a very big potential and it allows further intense qualitative progress of companies and other institutions in the fields of management, products, economy etc. It is possible to realise the progress only by the common high level work of researchers and developers from different countries of the world. They need to share practical experiences and theoretical knowledge. They need to have a common space for cooperation, realising joint projects, intensive communication etc. The MITIP conference is traditionally and successfully supporting these activities.

Let me thank the conference scientific committee for the very careful preparation of the conference especially for the conference promotion and the expert work during the papers review. My special thanks goes to my colleague Pavla Holejšovská for her intense and valuable organisational work during the conference preparation.

Have a great conference!

Jan Hán
Conference chair
MITIP 2008
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STANDARDISATION OF PROCESSES TO REDUCE LEAD TIME AND INCREASE PRODUCTIVITY – A METHODICAL APPROACH BASED ON METHODS- TIME MEASUREMENT AND VALUE STREAM MAPPING

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Abstract:
A hybrid added value optimisation – specifically a combination of Value Stream Mapping (VSM) and Methods Time Measurement (MTM) – uses appropriate methods to raise added value. Both, in the use of MTM and the use of Value Stream Mapping, raising productivity is the center of all thought processes. Other targets are the reduction of lead time in Value Stream Mapping as well as the standardisation of processes and the exact time determination based on the international performance standards in MTM.

Keywords:
Productivity, Added Value, Lead Time Reduction, Value Stream Mapping, MTM

1. INTRODUCTION
Increasing productivity in a defined time frame, among other things, causes the increase in overall added value within this defined time frame. A short lead time through a process chain (a value stream) results in a higher output in higher productivity and thus increases the overall added value within a defined time frame. The lead time reduction in a value chain is caused by reducing lead time (operating time, idle time, transportation time,...) of the single processes in this value chain. The target for the arrangement of processes is therefore to produce added value as fast as possible. Thus, in the given period, “more” time is available to produce “more” output.

2. VALUE STREAM MAPPING AND METHODS-TIME MEASUREMENT
A value stream includes all activities, i.e. value-adding, non-value-adding and supporting activities that are necessary to create a product (or to render a service) and to make this available to the customer. These comprise, not just the operational processes and the flow of materials between processes, but also those activities with which processes and the flow of materials are controlled, including all information flows required for this. Taking a value stream view means considering the general picture of an organisation and not just individual sub-processes thereof. Value Stream Mapping was originally developed as a method of Toyota's production system and is an essential component of lean management. It was first introduced as an independent methodology by Mike Rother and John Shook. Value Stream Mapping is a simple, yet very effective, method allowing one to gain a holistic overview of the status of the value streams in an organisation and, on this basis, to plan and implement a flow-oriented value stream. In order to assess possible improvement potential, Value
Stream Mapping considers, in particular, a product’s entire operating time compared with the overall lead time. The greater the discrepancy between operating and lead times the higher the improvement potential [3].

MTM is the abbreviation for Methods-Time Measurement, meaning that the time required to execute a particular job depends on the method selected for the activity. It is a modern instrument to describe, structure, design, and plan work systems by means of defined process building blocks. MTM exhibits an internationally valid performance standard for manual tasks. Today, MTM is the most popular method of predetermined times in the world, thus establishing a worldwide uniform standard of planning and performance for globally active businesses.

A process building block is a process step with defined work content and a distinct purpose for which a standard time applies. A system of process building blocks consists of a defined amount of process building blocks. An MTM system of process building blocks [2] was developed for a specific, clearly defined process typology, a specific complexity of processes and defined process characteristics. MTM process building block systems are assigned to clearly defined fields of application such as, for example, mass production, batch production or job shop production. The most important MTM process building block systems are the basic MTM-1 system and the higher level UAS (universal analysing system) and MTM in job shop production. MTM process building block systems provide a formal descriptive language for processes, are used uniformly throughout the world and train the eye to recognize for relevant influencing factors in a process. The use of MTM process building block systems aids the definition of productivity characteristics and of time based planning and control information and the identification of deficiencies in design and organisation.

A value stream analysis provides a very fast overview of the whole value stream from the supplier to the customer, with the focus on lead time and linking processes. MTM is a simple, yet accurate, tool based on a uniform process language to describe and standardize processes; the (basic) time emerges as a byproduct.

Value Stream Mapping and MTM aim at identifying, evaluating, reducing and eliminating waste within the value stream in terms of lean management.

3. LEAD TIME

In a work system or chain of processes idle time following processing and transport is allocated to the subsequent workplace or subsequent process. The five elements of idle time before processing, transport, idle time after processing, set-up and processing determine the lead time of a process [1]. According to Little’s Law, the extent of inventory reveals a lot about the lead time. This extent of inventory, more or less, corresponds to the idle and/or transport times. In general terms, the idle time thus consists of operating and process times and idle, transport and set-up times.

A value stream’s lead time results from the sum of all operating, process and set-up times of the processes, as well as, the extent of the various inventories [3].

\[
LT = \sum_i (OT + PT + ST) + \sum_j IR = \sum_i (OT + PT + ST) + \sum_j (IT + TT) \tag{1}
\]

In equation (1) the following abbreviations are used:
- LT…lead time (of a specific value stream)
- TT…transport time
- OT…operating (processing) time
- IR…inventory range
- PT…process time
- ST…set-up time
- IT…idle time
- i…no of processes
- j…no. of different “work in progress” / inventories
4. PRODUCTIVITY

Productivity is the expression of the quantitative productiveness of an economic activity (of the product realisation process) and allows conclusions to be drawn as to how well the factors deployed are used. Productivity is defined as output divided by the input factors. Basically, productivity is differentiated according to the individual production factors (work, equipment, machinery).

On the one hand, productivity increase results from increases in effectiveness by eliminating what is wrong and/or from doing what is right and on the other hand from increases in efficiency, through accurate assessment and the achievement of levels of capacity and performance. A consideration of the different aspects of productivity provides a profound understanding of this relationship and a basis for measures to increase productivity [4].

The dimension "method" describes "how" a work assignment or work content in a specified work system is fulfilled and refers to the whole process chain, as well as, to single processes or executions. The dimension of "utilisation" considers aspects of the degree to which resources are utilised. The "performance" dimension considers aspects of performance level.

5. INCREASING PRODUCTIVITY USING VSM AND MTM

The design of (work) methods is the most important dimension for influencing productivity [4], [7]. Planning and implementing "well" designed, i.e., efficient and effective methods are at the very focus of projects to increase productivity (see Figure 1). These projects can lead to investment. The achievement of high employee utilisation, however, does not often require investment. Obstacles, such as fluctuations in customer or order-frequency, without flexible employee assignments lead to utilisation losses. This can frequently be recognised in service and trade sectors such as in administration. The time determination of processes to evaluate the performance level opposes these obstacles in production areas efficiently. Specially, a neutral basis to evaluate performance is required to achieve increases in productivity. Table 1 provides an overview of the different areas of design for the dimension (work) method, performance and capacity utilisation.

Value Stream Mapping does not just contribute to reducing lead times by reducing and avoiding waste, it also contributes to increasing effectiveness and efficiency by improving work methods and the organisation of work, thereby raising productivity. In fact, the focus of optimisation is the alignment and combination of individual processes to form a continuous, efficient value stream throughout the organisation (macro consideration). Through its well-grounded time determination and with its systematic analysis of processes, MTM contributes to evaluation and productivity improvement. In fact, the focuses of optimisation are the individual tasks and working places (micro consideration). MTM serves to correctly determine and assess the performance level. Capacity utilisation is influenced by both MTM and Value Stream Mapping. The two tools complement each other perfectly in contributing to raising productivity as the combined application of Value Stream Mapping and MTM affects the design of all three dimensions of productivity.

Looking at the dimensions and their design areas (see Table 1) it becomes obvious that the increase of productivity is achieved by designing smarter processes combined with reduced investments and low cost automation. The focus is set on designing methods (processes) and standardising work.
**Figure 18: Method design by VSM and MTM [5]**

<table>
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<tr>
<th>METHOD (WORK METHOD)</th>
<th>PERFORMANCE</th>
<th>UTILISATION</th>
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<tbody>
<tr>
<td>&quot;process design&quot;</td>
<td>&quot;performance level&quot;</td>
<td>&quot;utilisation degree&quot;</td>
</tr>
<tr>
<td><strong>Macro (flow-orientated view)</strong></td>
<td>- performance standards (performance rate, actual / target-time ratio, standard time, normal performance, ...)</td>
<td>- net man-hours worked, total amount of hours available</td>
</tr>
<tr>
<td>- process organisation/work organisation</td>
<td>- personal performance</td>
<td>- fluctuations in order-frequency and work content</td>
</tr>
<tr>
<td>- production systems</td>
<td>- labor standards</td>
<td>- Balancing (static, dynamic)</td>
</tr>
<tr>
<td>- layout - workplace alignment layout (factory, floor, assembly line, cell...)</td>
<td>- training, routine</td>
<td>- work in progress / inventory</td>
</tr>
<tr>
<td>- material flow</td>
<td>- motivation/disposition</td>
<td>- stock</td>
</tr>
<tr>
<td><strong>Micro (execution-orientated view)</strong></td>
<td>- target orientation / monitoring</td>
<td>- idle times</td>
</tr>
<tr>
<td>- layout - workplace design (tools, fixtures, machines...)</td>
<td>- competences, skills, education</td>
<td>- scrap (quality of work)</td>
</tr>
<tr>
<td>- added value, complimentary work, waste</td>
<td>- support / instructions, coaching</td>
<td>- setup times / change over efficiency</td>
</tr>
<tr>
<td>- handling expenditure</td>
<td>- MTM</td>
<td>- maintenance</td>
</tr>
<tr>
<td>- expenditures for controlling and supervision</td>
<td>- VSM+MTM</td>
<td>- machine utilisation</td>
</tr>
<tr>
<td>- ease of assembly/disassembly</td>
<td></td>
<td>- material utilisation</td>
</tr>
<tr>
<td>- ease of grasp/operability</td>
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<tr>
<td>- production planning and control</td>
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<td></td>
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<tr>
<td>- product design</td>
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**Table 7: Design areas of productivity dimensions [6]**
6. AREAS OF APPLICATION

Once MTM has been successfully deployed in an organisation, Value Stream Mapping is a valuable extension in order to examine the whole process chain. Conversely, if an organisation already uses Value Stream Mapping as a tool, the application of MTM is a useful addition. The interplay of the combination of Value Stream Mapping and MTM (see Figure 2) results in practical areas of application [6] and possibilities for use, such as

- time determination,
- assessment of added value rates,
- ergonomic assessment,
- current/target-state comparisons,
- balancing,
- layout design (macro, micro).

Figure 2: Principle of the application of VSM and MTM [6]

6.1. Ergonomic assessment

The design of processes from the point of view of raising productivity must be balanced with designing work with people in mind. Risk analyses are used to ascertain the ergonomic quality of design. These evaluate stresses on the body such as posture, movement, strain as well as influencing forces, senso-motoric functions and psychological pressures. For this purpose the application of the EAWS (European Assembly Worksheet) is suggested. Among other things, process descriptions based on MTM process building block systems are drawn on to form the basis for the risk analysis. Ergonomic design measures are important particularly in early product and process planning stages as they can often be taken into account in this phase without incurring great additional overheads [2].
6.2. Balancing

Design principles such as e.g. adapting to customer work cycles or the design of one-piece flow production present particular challenges for coordinating the cycles of workplaces and workstations. During balancing, the "circle times" of serially connected work stations are coordinated with one another taking account of technical circumstances. Work content must be apportioned and aligned across the individual work stations in such a way that no substantial idle times occur at individual work stations and no staff or equipment is overloaded. Balancing equilibrium and the effectiveness of the line are used as assessment criteria [2]. Using the granularity MTM process building blocks facilitates the even distribution of work content across work stations.

7. CONCLUSION

The interaction, of Value Stream Mapping and MTM (hybrid added value optimisation) at different levels of detail consideration, contributes to the identification, elimination and avoidance of waste and thus leads to the design of efficient and effective processes. The joint mutual benefit of the combined application arises from the increase in productivity, from the standardisation of processes, from the reduction in lead time and from the accurately determined times the increase in productivity, from the reduction in lead time and from accurately determined times.

8. REFERENCES