HYBRID OPTIMISATION OF ADDED VALUE – A METHODICAL COMBINATION OF VALUE STREAM MAPPING AND MTM TO REDUCE LEAD TIME

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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 ADDED VALUE-PRODUCTIVITY-LEAD TIME

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 AT A GLANCE

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. [1]

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

Viewed at a high abstract level the lead time is that period of time (hours, minutes,...) required by any process to transform the inputs (materials, customers, money,

information) into outputs (goods, services). A precondition for determining lead time is the specification of measuring points. 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 [3].

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 [4].

$$LT = \sum_i (OT + PT + ST) + \sum_j IR = \sum_i (OT + PT + ST) + \sum_j (IT + TT)$$

LT	…lead time (of a specific value stream)
OT	…operating (processing) time
PT	…process time
ST	…set-up time
IT	…idle time
TT	…transport time
IR	…inventory range
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. [5]

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 VALUE STREAM MAPPING AND MTM

The design of (work) methods is the most important dimension for influencing productivity [5], [6]. 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.

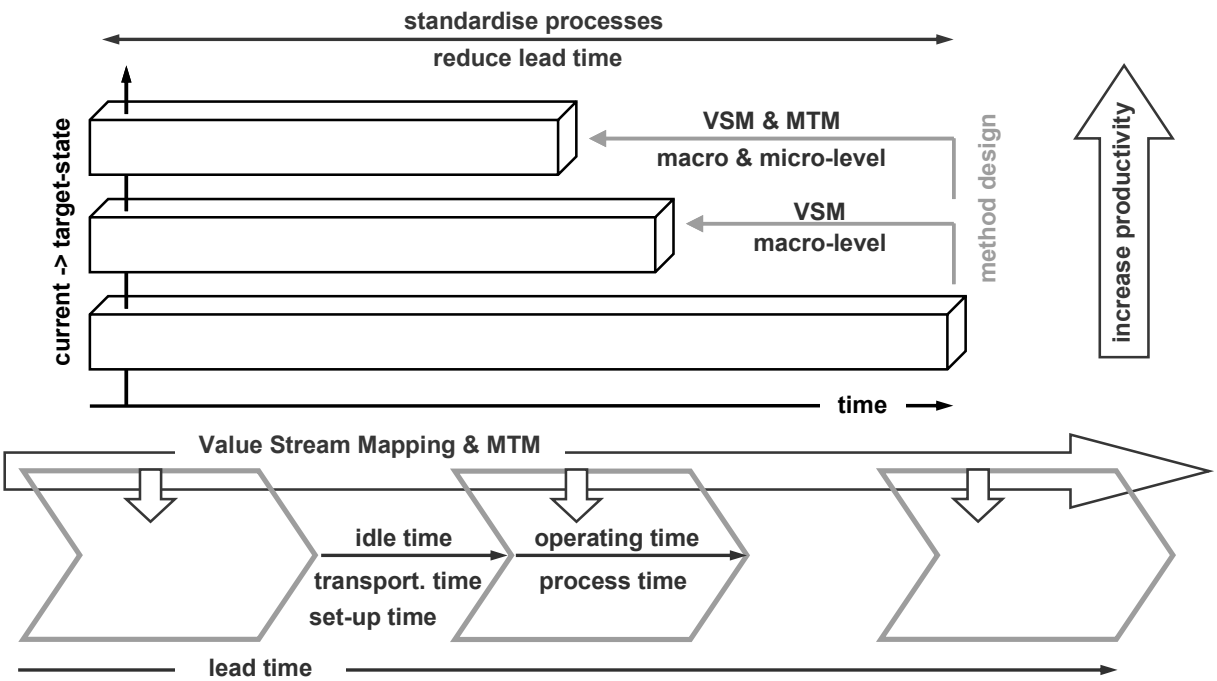

Figure 1: Method design by VSM and MTM. [7]

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.

METHOD (WORK METHOD)	**PERFORMANCE**	**UTILISATION**
“process design”	**“performance level”**	**“utilisation degree”**
Macro (flow-orientated view) • process organisation/work organisation • production systems • layout - workplace alignment layout (factory, floor, assembly line, cell…) • material flow **VSM**	• performance standards (performance rate, actual / target-time ratio, standard time, normal performance, …) • personal performance • labor standards • training, routine • motivation/disposition • target orientation / monitoring • competences, skills, education • support / instructions, coaching **MTM**	• net man-hours worked, total amount of hours avaliable • fluctuations in order-frequency and work content • Balancing (static, dynamic) • work in progress / inventory • stock • idle times • scrap (quality of work) • setup times / change over efficiency • maintenance • machine utilisation • material utilisation **VSM+MTM**
Micro (execution-orientated view) • layout - workplace design (tools, fixtures, machines…) • added value, complimentary work, waste • handling expenditures • expenditures for controlling and supervision • ease of assembly/disassembly • ease of grasp/operability • manual material handling **MTM**		
Information flow und control • production planning and control • product design **VSM+MTM**		

Table 1: Design areas of productivity dimensions. [5], [7]

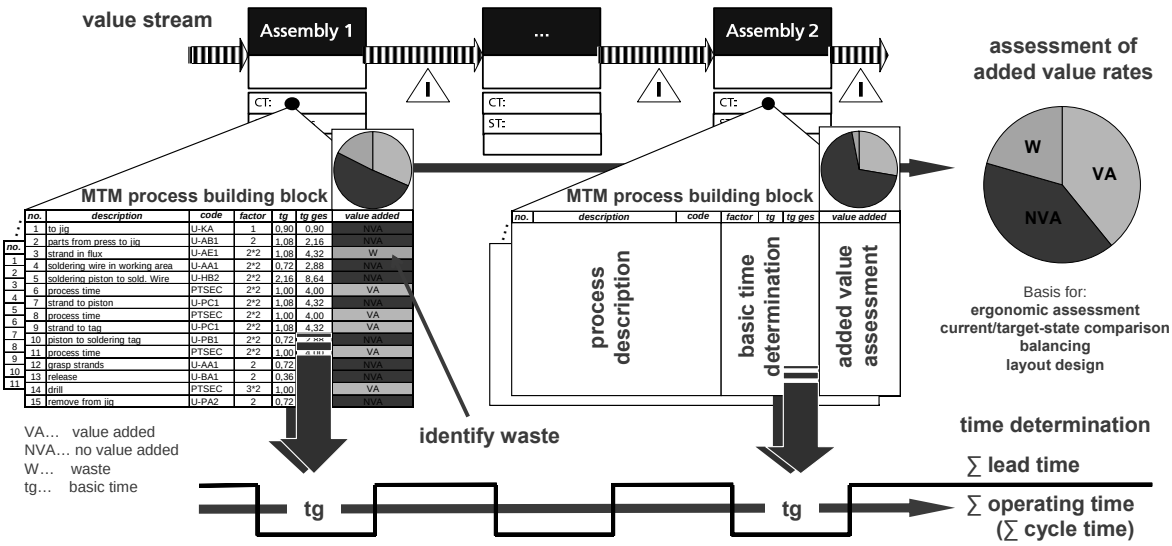

Figure 2: Principle of the application of VSM and MTM. [7]

	VSM	MTM
Exact determination and assessment of		
• operating, transport and set-up times		X
• performance and utilisation		X
Reduction of lead time through		
• minimising and eliminating **idle times**	X	
• improvement and redesign of **methods** and reducting in operating and transport times.	X	X
Increase in productivity through		
• design of **methods** (increased effectiveness)		
o flow-oriented consideration (macro view)	X	
o task-oriented consideration (micro view)		X
• improvement in **performance** and **utilisation** (increased efficiency)		X
• standardising processes		X
Reduction in inventory in the form of	X	
• raw materials, work in progress and finished goods stock		
Improvement in delivery reliability through	X	
• reduction of lead time		
• reduction of batch sizes		
• smoothing out of fluctuations		
Reduction in control overhead through	X	
• simplification of information flow		
• application of the principles of self direction (supermarket,...)		
Reduction in required floor space through		
• material flow optimisation	X	
• improved workplace layout	X	
• improved workplace design		X
• lower stock quantities (inventory)	X	
Comparability and evaluation of current and target states		X
• internationally applied, standard performance benchmarks for human work		
Simulation capability	X	X
• planning, design, assessment and optimisation of "virtual" methods (flow- and task-oriented) in current and target states.		
Simple and comprehensible documentation of methods	X	X
• simple and easily understood documentation of the processes and work procedures		
• transferability of results		

Table 2: Benefits of the combined application of Value Stream Mapping and MTM. [7]

Table 2 provides an overview of the most important benefits from the joint application of Value Stream Mapping and MTM.

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 following practical areas of application and possibilities for use result from the interplay of the combination of Value Stream Mapping and MTM (see Figure 2):

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

7 SUMMARY

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.

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