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Implementing Value Stream Mapping – VSM in a R&D organisation

Johan Tingström
Process support,
Technology Development
Research and Development
Scania AB
15187 Södertälje
SWEDEN
johan.tingstrom@scania.com

Håkan Gustavsson
Predevelopment,
Systems Development
Research and Development
Scania AB
15187 Södertälje
SWEDEN
hakan.gustavsson@scania.com

Peter Palmér
Process support,
Technology Development
Research and Development
Scania AB
15187 Södertälje
SWEDEN
peter.palmer@scania.com

Abstract
The study showed that there are possibilities to improve a process using a VSM approach. In the two cases in this paper, both improved. They improved in different ways. In the first study the aim was to manage more with the same staff and the second was to make same with less staff. As it seems now this was possible to fulfil.

These cases were carried out with help of facilitators and much of the work was done by the groups working in the different processes. This gives strength to the result and that it will be implemented.

The finding is that VSM should not be implemented as a transformation, but as an evolutionary strategy in the organisation. The group acting within the process is the one responsible for improving its processes. The staff needs to know and feel that they have the power to decide how they work in their processes.

Keywords: Lean engineering, Lean Product Development, LPD, Value Stream Mapping, VSM.

1 Introduction

Since a number of years back many companies strive to get more efficient in the way they do things. This could be in many different aspects, e.g. to optimise a physical flow in the production or an information flow in an organisation. For this Value Stream Mapping, henceforth called VSM, can be used.

VSM has a strong base in production, where the flow, increasing value for the customer and tact time are interesting factors. In a production flow, the value of the product is relatively easy to calculate since the customer pay a price. This however is not that easy in product development. In product development monetary units are not that common as time, both for conducting work and waiting in between activities.

The aim for production is to produce the same object exactly the same as the last one. This, in contrast to product development with its uncertainty in the final product. The product development is also more driven by information than the physical material in the production.

Morgan and Liker [1] describes VSM in a product development environment as a tool that helps different functions in the organisation to communicate. As well as understand their different roles.

1.1. Aim and Scope

The aim with this paper is to apply an VSM approach in a R&D organisation. Scania have used the VSM approach in production for a number of years and are now heading in the direction towards product development.

From the start the aim was to try three different kinds of VSM;

- VSM as it is done in a production flow described by Rother and Shook [2]
- VSM following the steps of Womack and Jones [3]
- VSM as it is presented by Locher [4]

But when the work started it became clear that the three approaches are rather similar. Instead a more generic method was used. In the end after using VSM in a R&D organisation the question became.

What happens and which experiences can be made when applying a VSM approach in a R&D organisation?

2 Background

Today both Lean and Value Stream Mapping are expressions that are frequently used in literature and seminars especially for companies. The Lean concept can be seen as an overarching umbrella containing several different methods for evaluating different aspects most often in production or as here product development. Here, VSM is one of many different methods. In recent literature Lean has been expanded to leadership, management, hospitals etc.

2.1. Lean

In a holistic view Lean Engineering has three goals that apply in different areas, according to McManus [5], these are;

- Making the right products – the creation of products that increase the value for all stakeholders in the company.
- Effective integration between product lifecycle and enterprise – applying lean engineering to create value in product lifecycle and in the enterprise.
- Efficient engineering processes – using the lean concept in order to eliminate waste, improve cycle time and quality in engineering.

Among these three goals, VSM apply to the last within product development, with its aim to change to more efficient processes.

When it comes to implementing lean thinking in an organisation, Womack and Jones [3], made a five step plan. All these steps can relate to value stream thinking;

- Define value
- Define value stream within the company
- Create possibility for flow

- Create a pull
- Work towards perfection

To differentiate the five steps between manufacturing and engineering, McManus [5] has made a comparison (See Table 1).

Table 1. A key for comparison between Manufacture vs Engineering [5].

	Manufacturing	**Engineering**
Value	Visible at each step, defined goal	Harder to see, emergent goals
Value stream	Parts and materiel	Information and knowledge
Flow	Iterations are waste	Planned iterations must be efficient
Pull	Driven by takt time	Driven by need of enterprise
Perfection	Process repeatable without errors	Process enables enterprise improvement

As Womack and Jones stated earlier the flow is important besides the value. Here it is important to study the flow over the entire value stream. If this is not done the work could sub-optimise and the conditions will not improve as wanted. It is important to get the flow continuous and visible in the process [2].

If it is unclear where in the process an activity is placed and how the in- and out-flow is. Then it is difficult to improve the activity since it is not connected to other activities in the value stream [3].

2.2. VSM

VSM is not a single activity tool, it consists of several steps [4]. First it is a preparation phase in order to identify e.g. the mapping team, which process and how to map. Secondly the current state is communicated and understood. Next step is to see the future state which is a shared future vision. The last phase is to develop an implementation plan and execute the implementation.

2.2.1. Value Stream Mapping

There are many different techniques available for process modelling, but Value Stream Mapping (VSM) differentiates in focusing on value creation. VSM was initially a tool for improving the manufacturing process [6] and has shown to be effective within manufacturing [7]. Today the method is also used within many other disciplines. The process includes four steps which are described in the next sections.

2.2.2. Value Stream Scope

The purpose of scoping is to determine what process (value stream) is to be improved and to create a common view of the process to be analyzed. This means understanding which processes are included and where the process starts and ends. It should also be decided upon who will perform the VSM and who will support the event, including management. The output of the scoping is therefore an input-output view (Figure 1) of the process and its control parameters, but also a working plan [8]. Control parameters could be a common strategy or business goals. Enablers are resources consumed by the process such as available people and tools.

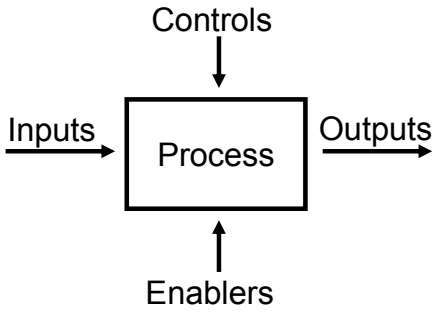

Figure 1. A input-output view of a process

2.2.3. Current State

The aim of this step is to understand how things currently operate. This is done through a walk-through of the entire process from beginning to end, usually in a workshop manner. The demands of the internal and external customers must be identified. The flow of material and information is then mapped, identifying each process time and lead time.

To illustrate how this is done, a fictive example is presented in Figure 2. The sub process of updating a communication interface in a document and a database is mapped with the recommended symbols [9]. Figures of the process are given through a walkthrough of the process. The process time is the required time it takes to complete a specific task when working without interrupts. The task of creating an interface description takes 120 minutes from start to finish. The number of people and resources normally available for a task are given after the symbol in the middle. In this example, we find out that the dedicated employees normally have 30 % time available for creating interface description.

It then normally takes half a day from the handover until the work to update the database is started, which is indicated below in the IN process box. The task to update the interface database is then started, taking an average of 30 minutes to perform with one person available at 50 %.

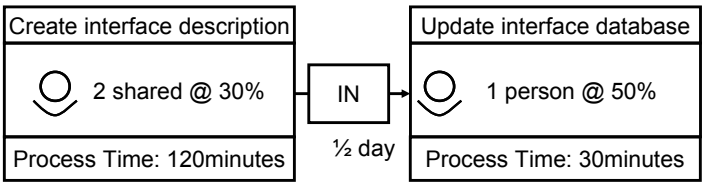

Figure 2. The sub process of updating a communication interface in a document and a database.

2.2.4. Future State

The purpose of this step is to improve the process, i.e., to design a lean flow. This is done by analyzing the process with regards to the Lean principles. There are a number of questions that can be asked to find those improvements [9]. What does the customer really want? Which steps create value and which steps are waste? How can we design a flow of work with fewer interruptions? Using this set of question some additional issues will arise in our example: Are the interface description what the customer really wants or are some parts not necessary (e.g. waste)? Does the information need to be added to two different sources or would the database be enough? Can the task be done by the same person and thereby reduce the lead time?

With the guidance of those questions a future state of the example can be drawn. If the document is not needed and the task can be done by the same person the following future

state can be drawn. The lead time is reduced by half a day and the process time with 30 minutes (Figure 3).

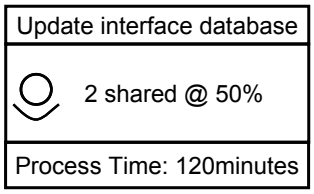

Figure 3. The result of the future state

2.2.5. Work plan and implementation

This last task is the final goal of the VSM, namely to ensure that the improvements are implemented. It is done by describing the specific improvements that are chosen to be implemented from the previous step. A work plan is made showing what will be done by whom at what time. The work plan is used to follow-up that the tasks are being performed. The planned changes must be communicated to everybody involved in the process. To make the necessary changes it is crucial to have management attention. Summarizing what is learned in the VSM event is done in order to ensure that knowledge is carried to the next time (lessons learned).

2.3. Understanding value

There are several different reasons why VSM, is important to pursue. Mascitelli [10], describe VSM as a systematic method to visualise a process, identify waste and set a future improved state. The understanding of value and value flow is important for the Lean philosophy, otherwise it is difficult to get to know the process and then challenge and improve the process [11]. But value is not easy to estimate, there are many different definitions of value over the time and some are presented in Table 2.

Table 2. Value definition for product development [12].

Source	**Value definition**
Miles, 1961	Value is the appropriate performance and cost
Kaufman, 1985	Value is function divided by cost
Shillito and DeMarle, 1992	Value is the potential energy function representing the desire between people and products.
Womak and Jones, 1996	Value is a capability provided to a customer at the right time at an appropriate price, as defined in each case by the costumer.
Slack, 1998	Value is a measurement of the worth of a specific product or service by a customer and is a function of; 1 Product's usefulness in satisfying customer need 2 Relative importance of the need being satisfied 3 Availability of the product relative to when it is needed 4 Cost of ownership to the customer
LAI, 1998	Value is anything that directly contributes to the "form, fit, or function" of the build-to package or the buy-to package Form: Information must be in concrete format, explicit stored Fit: Information must be (seamlessly) useful to downstream processes Function: Information must satisfy end-user and downstream process needs with an acceptable probability of working (risk)

↓

Source	Value definition
Browning, 1998	[Value is] balancing performance, cost, and schedule appropriately through planning and control.
Deyst, 2001	Value is the amount by which risk is reduced per resource expended
Stanke, 2001	[Value is] a system introduced at the right time and right price which delivers best value in mission effectiveness, performance, affordability and sustainability and retains these advantages throughout its life.

3 Industrial case

This paper is made from two different studies in different places on the organisation and in two different countries.

3.1. Method

This study was a case study. A case study is suitable to use when the researcher wishes to study events taking place in the present and aims to answer questions about why and in which way the occur. The authors have also used an exploratory approach to the case study. Exploratory case studies contain descriptions, explanations and investigations, which in this case has been focused on the implementation part.

Data have been collected by studying the different processes as well and making interviews and having workshops with staff working within the processes.

3.2. Case company

Scania is one of the world's leading manufactures of heavy commercial vehicles selling on a global market with a solid reputation of designing and producing vehicles with the core values of Customer first, Respect for the individual and Quality [13]. During 2008 Scania produced 66,516 trucks and 7,277 buses [14]. Scania is a public company with Volkswagen AG as the largest stockholder. The development of all critical parts of the product, such as engine, transmission, cabs and chassis are centralised in Södertälje, Sweden.

Scania has a very long tradition of working with a modular product design, starting in the 1940's. The modular system has claimed to be the main reason why the company stayed profitable every year since 1934 [15]. The internal training program teaches the three basic corporate principles of modular thinking [16]:

1. Standardized interfaces between components
2. Well-adjusted interval steps between performance classes
3. Same customer-need pattern = same solution

4 Result

The result is based on two different cases. One is the development of standards, this is in Sweden and the second case is from Argentina where the tooling design was studied.

4.1. Development of standards

The group that develops standards was studied and their process was scrutinised in order to find improvements that could release working time for the employees. The group developing standards is a mature group in a world where changes in organisation and processes often change. During the study all members of the standard group have been interviewed.

The group does not only create standards but also guidelines on a more general level, guidelines that apply on a local level are handled in the line organisation. The group does not

consist of specialists with specific knowledge in all areas where standards are developed. This would be impossible. Instead they are co-ordinators and they have consultative bodies or forums in the organisation.

During the discussion about what kind of value that is generated in the group a number of question marks was raised. For who is value generated, who is the customer? Here the discussion was interesting since all did not have the same customer. This however is based on the fact that the different standards are divided between the different standard co-ordinators. Standards regarding hexagon head screws do not have the same customer as symbols in a CAD environment.

A standard describing screws have two distinct groups of customers, the mechanical designer that will use it in the design and the purchasing department that will procure. In this way the standard can be used as a way to limit the number of details. It is also a way for the designer to know that the screw exist in stock within the company.

As for standards in the CAD environment, all the staff using CAD can be seen as customers. Here it is a value in that all make drawings in the same way in order to reduce the possibility of unclear drawings.

4.1.1. Current state

When the current process was mapped it showed many steps (See Figure 4). The start of preparing a new standard is initiated by a customer before the STD group starts the work. The STD group co-ordinates send out and collect information from consultative bodies.

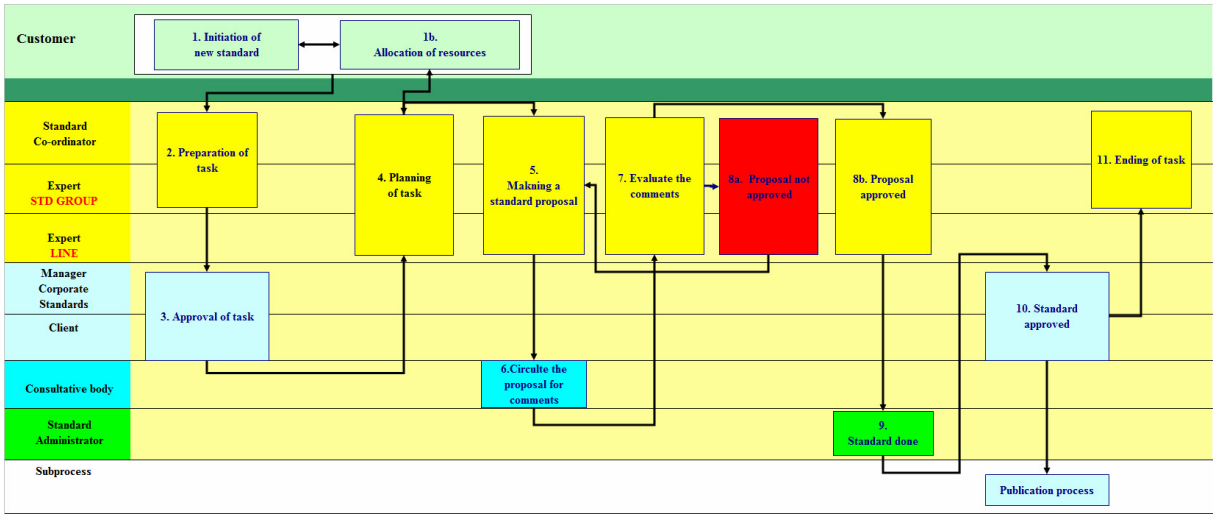

Figure 4. Current process of preparing a new standard.

Today much time is spent on waiting for answers from the consultative bodies. This is not time efficient in the long run. It is a lot of built in waiting in the process. Another thing is that all the standards are manually signed when they are approved and this copy is archived.

In the end when the standard is approved, the next step is to publish. Today the standard can be published in two different locations, both on the intranet and on internet. This creates unnecessary workload in the organisation.

4.1.2. Future state

As for today, the future state has not been fully implemented in the organisation. But the analysis show that there are possibilities to make positive changes in several places in the process. The standard co-ordinator is a central person that collects and distributes documents and information between all the different parties involved in the process. Today the process calls for personal commitment among the consultative bodies. The co-ordinators often have to remind and push to get an answer. This could maybe not be eliminated, but decreased.

There are some potential changes that could be done in for the future;

- To work more near the consultative bodies and that consultative bodies get more committed to this work
- To reduce the work with physical documents
- To not have a publication process with two similar activities

4.2. Designing of tooling equipment

A second case was a study of tooling design, at the plant in Argentina. The group consisted of six designers and one administrator. A value stream approach was applied on the work. The current state (See Figure 5) process was thoroughly mapped and noticeable non-value activities appeared, especially within the administrational part of the process.

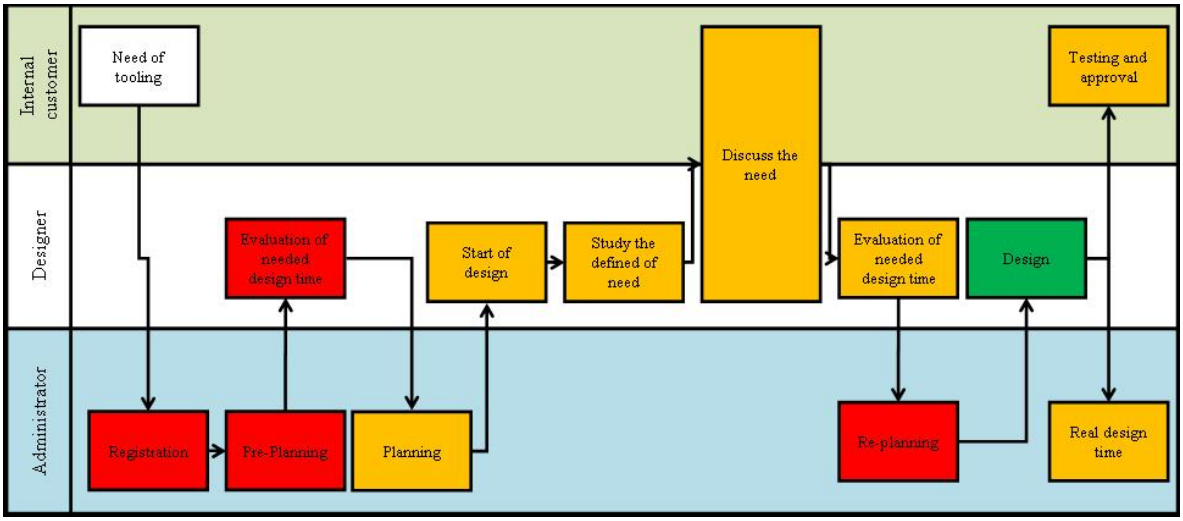

Figure 5. Current state.

The result was discussed and what customer value really meant within this process, driven by creative solution finding, more than a standardised, repetitive, flow. The group defined value added activities (green), non value added activities which were difficult to remove right away (orange) and non value added activities which could be removed right away (red). It was clearly noticeable that the administrator had a great deal of non value added activities.

When a future state map (See Figure 6) was defined, it was clear that the process would work without the administrator and, that even though the designer assumed one activity from the administrator (planning) they actually saved time in their process. The result was that the administrator and one tooling designer could be removed without decreasing the amount of customer value created in the process.

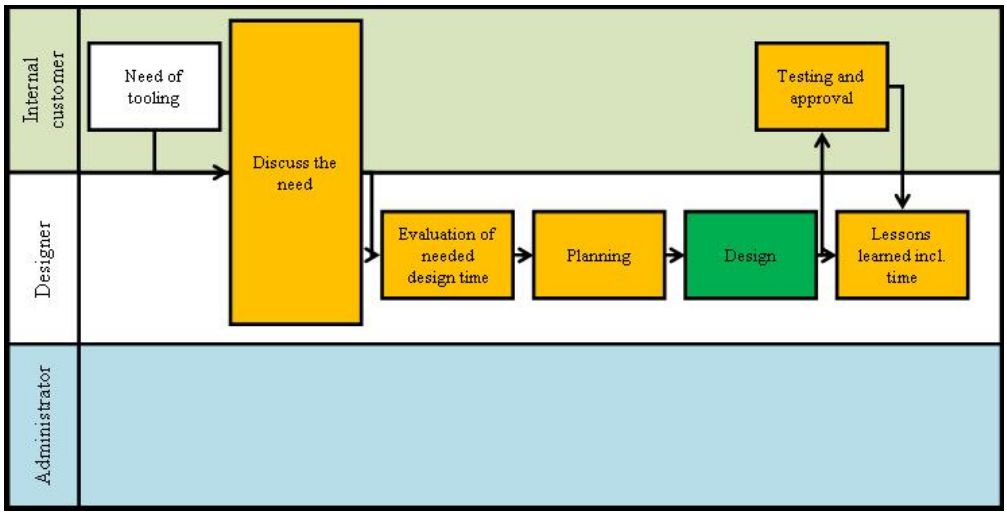

Figure 6. Future state with fewer activities.

In the end both employees were re-localised to more needed parts of the organisation. This change could not have been done if the administrator would not have decided to change to another place where his knowledge came in better use. Here was the strength in letting the group work with their own process. They themselves realised that it was over capacity in the group.

5 Discussion

It is our belief that it is often possible to find some improvements in all processes that are scrutinised. In our case is it not possible to estimate in time or monetary units how much that can be saved. More important is that a change can be made in the direction of working better.

The result from applying VSM shows that there were improvement possibilities in both processes. In the first process staff could find more time to do more, the efficiency increased in the group. For the second the same workload could be carried out with less staff, since activities could be removed or re-allocated.

The result from the study shows that it is difficult to determine the value in a process within R&D. In manufacturing it is simple to see if an activity contributes to form, fit or function of the material flow. McManus (2005) have two reasons why it is difficult to map this form-fit-function metaphor into product development:

- The flow in product development is difficult to see, as it consists of information
- An aspect of the information is the uncertainty; there is always a risk that the product will not meet customer needs.

The power of using the staff working within a process was noted in a way that they were interested in creating and taking control over their own situation. According to Scania principles the people can influence their working situation. Scania have a way of working there improvement groups are created organisational- or process-wise. These groups develop and improve their own situation. Scania have a mentality of supporting and coaching changes in order to involve the staff and get a sustainable change.

Letting the people within the process evaluating and improving the same might create a potential problem since nobody wishes to make themselves redundant. This might lead to that the organisation is not willing to take quantum jumps in changing processes, but small

evolutionary steps. This principle with small steps is however a way to constantly keep the risk at a low level.

Within much literature defining lean product development (LPD), VSM is omitted, or even mentioned as a tool which should not be used as it is supposed to be in conflict with creativity and learning. Actually the above mentioned finding is a good way of avoiding those risks.

Finally, perfection is even harder to reach, as simply doing the process very fast and perfectly with minimal resource used is not the final goal; efficient product development process is simply an enabler of better enterprise performance and better products [5].

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