

## **Ergonomic value stream mapping - can Lean and ergonomics go hand in hand?**

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**Keywords:** Lean manufacturing, value stream mapping, health care, ergonomic tool.

### **1. Introduction**

Lean (Womack et al.1990) has become a dominating approach to rationalization in manufacturing, administration, service and lastly in health care. Lean is being used at most Danish hospitals as a means of process and productivity improvement. The central tool in lean is value stream mapping (Rother and Shook 2003) i.e. mapping all activities of a specific process and measure duration and waiting time for each activity. The value stream map is then analyzed for waste of which lean specifies seven types (REF!!) e.g. waiting, over processing, transport etc. A new process is then designed with less waste which is more efficient.

Rationalization tools such as lean generally have a negative effect on health and risk factors (Vestgaard and Winkel 2012) and result in work intensification. Ergonomists and work environment agents have traditionally sought to improve the workers conditions' *after* the rationalization process has completed. Needless to say, this has not had significant impact and is often a mere band aid. The reason is quite simple: Once the new process has been designed and implemented sometimes requiring substantial investment, ergonomists' can only improve specific activities and not redesign the process. Work environment should be included in the discourse of the company strategy (Edwards and Jensen 2013) and overall rationalization effort.

Ergonomic Value Stream Mapping (ErgoVSM) is a methodology (Jarabrandt et al. 2010) that adds an ergonomic analysis to the regular value stream mapping (VSM) methodology (Rother and Shook 2003). ErgoVSM piggybacks on the VSM process and analyses each activity in the process from an ergonomic perspective. Where VSM is concerned with time between activities and time for each activity, ErgoVSM includes analysis of both physical and psychosocial dimensions.

ErgoVSM scores each individual activity e.g. mobilizing patient for the following physical dimensions: 1) work posture, 2) weight/force, 3) Physical ergonomic potential, 4) physical porosity, 5) physical variation. ErgoVSM also scores the following psychosocial dimensions: 1) Control, 2) Communication, 3) Potential in work content, 4) Mental porosity and 5) Variation in work content. Each dimension has a scale which the group uses to evaluate each activity. An example of a scale for demands: 1 point = "There is always enough time for talking with colleagues, patients, relatives" *to* 10 point = "It is always difficult to have enough time for the work task".

This paper reports findings from an orthopedic bed ward where ErgoVSM has been used as part of a lean project.

## 2. Methods

This is an intervention study where the researcher has used the ErgoVSM methodology as part of a lean project taking place in an orthopedic bed ward. The researcher was not responsible for the lean project in the ward and only intervened when the specific ErgoVSM methodology was used. The lean project was managed and facilitated by a lean consultant from the hospital efficiency department charged with facilitating lean at the hospital.

The lean project at the orthopedic ward followed the standard project plan used at the hospital. Lean projects are initiated when a ward contacts the lean department for assistance. First meeting is held between the lean consultant and the ward manager where purpose of the project is defined. Next meeting is with the project group, which is the ward manager and selected employees from the wards and the lean consultant. Here the project group is introduced to lean, the project model and the managers' initial purpose, which may be adjusted. Next the actual workshops begin and the number of workshops depends on the need and progress. In this case three full day workshops and a 2 hour follow-up workshop were held with about one month in-between each workshop.

The ErgoVSM methodology was used in the first workshop for analyzing the current situation and in the evaluation workshop to analyze the new situation. The ErgoVSM intervention took 1.5 hours in the first workshop and 50 minutes in the evaluation.

All workshops were recorded on video and notes were taken after the workshop.

The question of whether lean and ErgoVSM can go hand in hand was answered by assessing if the ErgoVSM had negative impact on group dynamics in the workshop. Lean is a participatory approach that requires a collaboration and work from the group. The workshop facilitator is responsible for designing a process that will keep the group engaged, interested and creative. This is done by letting the group use a variety of participatory tools to improve their own work situation. It's important for the facilitator to improvise and adapt to the situation and change methodology accordingly. This is done to keep the group engaged and "not to lose the group". If the group is lost its very difficult to re-energize the group.

For this reason group engagement at the workshop become a proxy of whether ErgoVSM can be integrated into leans VSM. If group engagement falls when using ErgoVSM is not usable and may jeopardize the lean workshop entirely.

A questionnaire N=31, response rate= 58% was emailed to the staff approximately one month after the project was finished. The questionnaire asked the respondents to rate changes in work environment on a 5-point Likert scale.

Products such as value streams, to do lists' and results from analysis were photographed.

## 3. ErgoVSM in the orthopedic bed ward

The orthopedic bed ward experienced a problem where patients with hip fractures were not mobilized enough. Therefore the lean project focused on the first 24 hours post-surgery for hip fracture patients. The purpose of the project as decided with the ward manager was to optimize the 24 hours post-surgery for the benefit of patients. From a treatment perspective, the key issue is to make sure that patients are mobilized as soon as possible following surgery, as often and as much as possible. Doing so will improve the patients prognosis.

The lean coach facilitated the project group to map the process i.e. the first 24 hrs.

from the patient left surgery. Following the VSM the facilitator asked the project group to note improvement ideas on post-its.

The ErgoVSM scoring was done as a group effort where the project group discussed the score for each item. One dimension was scored at a time for all activities because it becomes faster to score each activity when the group gets used the scales so the group began by scoring work posture for each activity. The scores were noted on each of the activity cards. At the end of the workshop the lean consultant asked the project group to evaluate their experience of the day. The project group was surprised by the high ratings of their work and the following was noted in the minutes: “Is it really so hard (the work) => have to do something”. The ErgoVSM scoring was perceived as slightly tedious.



Figure 1: The complete value stream for the first 24 hour post-surgery for hip fracture patients.

#### 4. Results

The ErgoVSM methodology was used as part of the lean process to score all activities the first 24 hours post-surgery for hip fracture patients. The group developed 25 suggestions for improvement. Some big e.g. change in meeting times and structure, some small e.g. improve the paper summary on patients.

The ward managed to improve the time from surgery to first mobilization and also to increase number of mobilizations with the same staff. The ward further managed to reduce the average time of stay for patients from 5 to 4.5 days.

From an ergonomic perspective this constitutes a classic case of work intensification. Processes were improved and waste was removed leading to more time for work and also less time for restitution.

Table 1: Changes in work environment. N=31, response rate=58%

General changes: Have there been any changes in the ward since the project optimizing the first 24 hrs. post-surgery for hip-fractures?	Improved %	Unchanged %	Worse %
5.1 Psychosocial work environment (e.g. demands, control, stress) have become:	35,29	17,65	47,06
5.2 Physical work load (e.g. posture, heavy lifting, work variation) have become:	40,00	40,00	20,00
5.3 Efficiency have become:	60,00	33,33	6,67
5.4 Treatment quality have become:	66,67	33,33	0,00

Table 1 shows that in spite of increased work load from more mobilizations, the employees respond that physical work load has improved. This is attributed to increasing use of equipment but more so to changes in coordination during the morning meeting as suggested at the lean workshop. The nurses used to meet in the morning and read up on each individual patient. This was changed to a short morning meeting where patients were

distributed between teams. More importantly the morning meeting was also used to coordinate which patients required two nurses or assistants to mobilize. Using two staff members to mobilize one patient initially appear to be wasteful from a lean perspective. However, two staff members are much faster and less stressful for the patient who feels safe and secure, which also ease the situation.

During the first workshop ErgoVSM was tested on the VSM mapped process. The ErgoVSM scoring was done as a group process that the researcher asked about all ErgoVSM dimensions for each activity (light blue cards in figure 1). With 23 activities this became quite a long process that lasted about 1.5 hours. Three different professional groups were present at the workshop and they were not all involved in all activities. This meant that some began to get bored with the process and the group was losing energy. It required effort from the facilitator to maintain the groups focus.

In the evaluation workshop the scoring process was adjusted and each professional group worked together to score the activities they are part of. This had the advantage of speeding up the overall scoring process and reducing to almost half the time. It also has the benefit of engaging the professional groups in discussing their work. At no time in the evaluation workshop did the group show signs of being bored with the process indication that this was a positive change.

The lean project has increased efficiency in the ward. While ErgoVSM has forced the employees to evaluate their physical and psychosocial work environment it is not possible to conclude that those improvements are due to ErgoVSM. Still the ward managed to improve efficiency and reduce self-reported physical strain. Psychosocial strain, however, has increased.

This case-study shows that it is possible to augment VSM with an ergonomic complement.

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