

Applying lean principles during ramp-up of high technology goods

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This article is based on a study conducted at Axis Communications AB's Configuration and Logistics Centre (CLC1) in Lund, Sweden. The purpose of the study was to propose ways to reduce lead-time and variation while improving flow efficiency and work processes in order for Axis' CLC1 to become more lean. To fulfil the purpose a case study at CLC1 was conducted in order to identify inefficiencies and non-lean processes, which were then analysed further with the goal of finding ways to mitigate them by applying lean tools. The identified problems and the recommended solutions are presented in the article.

Keywords: Lean production, Efficiency, Production ramp-up

INTRODUCTION

Since inventing the world's first network camera back in 1996 Axis Communications has been leading the way in developing digital surveillance camera systems and is considered the industry leader. As a result of the technology shift towards digital platforms Axis has experienced remarkable growth during the last decade in terms of revenue, employees and product portfolio. Operating at the high-end of the market quality and service is key to satisfy customers and motivate a high price. But maintaining the core value of high quality is challenging with ever-increasing volumes and a high rate of new product introductions. To find and resolve issues with new products, and ensure a smooth transition to high volume manufacturing all products are ramped-up at an industrialisation site called CLC1. When a new product is mature enough, usually after 3-6 months, it is transferred to one of the mass-producing CLCs not operated by Axis themselves. To gain market shares Axis has had the aim to

always deliver, but with increasing competition the business must be efficient in order to preserve margins.

PURPOSE AND RESEARCH QUESTIONS

The thesis project had the purpose to propose ways to reduce lead-time and variation while improving flow efficiency and work processes in order to become more lean. The overall purpose was broken down into three research questions designed to give a picture of the current and possible future state of CLC1 as well as discuss the suitability of implementing lean at an industrialisation site.

- (1) To what extent is the current setup at CLC1 efficient in terms of flow efficiency, lead-time and flexibility?*
- (2) How can CLC1 become more efficient using lean principles?*
- (3) To what extent is a lean setup strategically aligned with the scope and purpose of CLC1?*

METHODOLOGY

This thesis uses a systems approach to capture the holistic picture of the flows and processes at CLC1 and to understand the relation between people and processes. Further, an abductive research method was applied, combining semi-structured interviews with quantitative data gathering and a two-week practice period to get a deep insight into the processes using triangulation.

In practice this meant that the theoretical framework was developed in tandem with the current state analysis building one on the other during the initial weeks of the project. As a part of the current state analysis a set of value stream maps were created for each of the six identified product families to get an understanding of the material flows within the site. To clarify and to deepen the understanding of the processes at the site several interviews with key persons at Axis were held. These included team-leaders as well as production managers and operations executives. To receive feedback on ideas along the course of the project a set of meetings and workshops were conducted with managers related to CLC1 in some way.

THEORETICAL FRAMEWORK

The literature review for the thesis included theory searches on the relevant concept for this study; *lean production*, *Toyota production system*, *lean production* and *value stream mapping*. The theory search was augmented by relevant books on the subjects.

The concept of lean was first invented by Toyota as a necessary mean to cope with the shortage of resources during the years following the Second World War. The scarce resources didn't permit Toyota to simply copy the American

manufacturers production philosophy and forced the company to rethink how to conduct mass production (Womack et al., 2008). Lean is all about achieving an efficient flow in production by reducing or eliminating every activity that is not adding value to the customer, known as "waste". Examples of waste is waiting, unnecessary motion, inventory and over processing. One of the masterminds behind the Toyota Production system and lean production Taiichi Ohno sums the thinking behind lean quite neatly:

"All we do is looking at the time-line from the moment the customer gives us an order to the point when we collect the cash. And we are reducing the time-line by reducing the non-value adding wastes." (Ohno, 1988)

Much of what is perceived as waste stems from variation of processes, quality and demand. To enable the reduction of waste many of the tools and techniques used within lean are aimed at reducing variation. If variation is reduced, processes can be more tailored to a specific, and stable, environment allowing operation with less slack and slimmer margins. Standardised work processes and just-in-time, or JIT, deliveries between workstations are classic examples of such tools, as is value stream mapping, VSM. A VSM is a schematic picture of the production site or supply chain and depicts the flows, processes and bottlenecks in the system.

One of the most important parts of lean is called *kaizen* or continuous improvement. The idea is to make daily incremental steps towards perfection and that this mentality should permeate the entire business (Modig and Åhlström, 2013). However there is no consensus among authors on how to apply lean as a concept on an enterprise. Some think of lean as a philosophy and

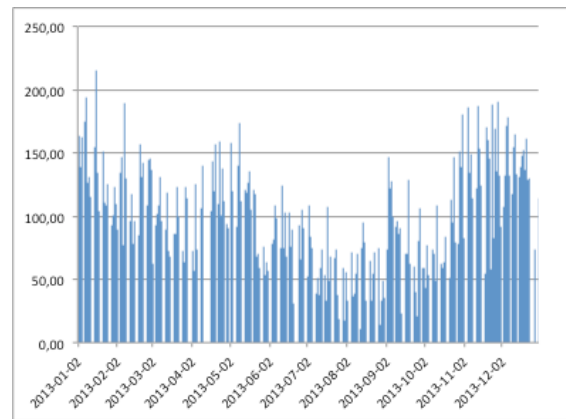
apply the thinking on a very abstract level whereas others apply lean in a very hands on way, cherry-picking suitable tools instead of changing the culture (Modig and Åhlström, 2013).

FINDINGS

The activities performed at CLC1 are by definition not adding value to the customer for the most parts. Warehousing, testing and transport packaging are not activities that a customer is willing to pay for. The value added differs between product families as some products require more assembly than others. A value adding activity common for all cameras is the upload of software. The VSM showed that total value adding time is usually single-digit minutes for a given product family.

The current way of working at CLC1 is set up to be simple and rugged rather than efficient and lean. The setup is effective, returning high scores in quality and delivery accuracy KPIs. As CLC1 is an industrialisation site it is not primarily designed for mass production but for troubleshooting newly introduced products. To do this flexibility is key and a priority for Axis. New products inherently brings with them variation in quality and demand that is difficult to predict in advance. To cope with this variation CLC1 has elected to work with big margins and uniform flows.

The throughput time is set to four days regardless of product. This means that the product spends one full day for each activity (picked from warehouse, assembled and tested, packed for transportation, shipped off) building a lot of work-in-progress and issues with violent fluctuations in day-to-day workload for the workers, illustrated by the graph below.



Workload in production during 2013

The value stream map revealed that a product spends on average about one full working day both before and after production in wait for the next process step. In a lean facility the products would be delivered to the next step a very short time before they are needed, "JIT". These big buffers are necessitated by the fact that Axis lacks the ability to accurately track the progress of an order during the actual production process.

As the finishing time of a product is unknown to the next downstream department the system is set up so that each days work is already ready for the next step at the start of the day. Hence each department has a full day to do the scheduled work and already at the start of the day know that everything is ready and waiting to be processed. This setup is very flexible since it allows any combination of products to be processed without regards to departments up- or downstream, and also gives operators room to deal with cameras with an unexpectedly large share of defects.

The lack of tracking ability is due to the fact that actual production times are not measured throughout the products lifecycle at CLC1. A test run is done before production commences, but is not followed up later to make sure the test run reflects actual production time. The test times serves as a production

time estimate for later production planning. But as there is no follow-up there is no way of telling if the workforce is harmonised for speed or way of working, which is not very lean. Any issues here are most likely hidden by the big buffers and the uniform flows.

What is also an issue is that slack and changeover time is added routinely to each order instead of on a need-basis. Currently 30 min of changeover time is added to each order as well as 30% slack on top of the estimated production time. The relevance of these add-ons could be questioned, as it would in theory reduce the effective production time to 50% during an average day.

To sum up our findings one can say that CLC1 doesn't excel in areas such as flow efficiency, lead time and value adding time but is on the other hand very capable in handling variation and resilient to internal quality issues.

RECOMMENDATIONS

What could CLC1 do to become more lean, and is lean really the way forward for the site? In its role as an industrialisation site variation is very unlikely to go away. Teething problems and difficulties in estimating demand are part of new product introductions and will likely remain so for a foreseeable future. In such an environment it would be foolish to try to reform CLC1 into a truly lean production facility. Nor is Axis as a company aimed at efficiency but rather agility and high service levels. With this as a basis we decided to apply lean as a set of tools rather than a philosophy. We also took the conscious decision to not over-do lean as flexibility and ruggedness are such vital aspects for CLC1. Our suggestions can be summarised in three areas:

1. Implement production performance follow-up

By introducing a set of measuring points just as production starts and stops production managers will get an accurate and updated picture of how long the production of each product takes and can act accordingly. The logging can be done via a set of scanners and barcodes eliminating the need for operators to navigate an ERP or production system. The statistics will help production staff monitor how efficiently they are operating and add slack and changeover time as needed instead of by default. Having accurate production times instead of estimates is an enabler for the points below.

2. Introduce a production planning tool that allows lead time flexibility

To reduce the variation in workload a tool that helps the planner optimise the production schedule can be implemented. By allowing orders to take longer and shorter than the current four days, it would be possible to move production start and thus smooth out spikes and dips in workload. This requires knowledge of actual production times to better plan to the available capacity and make sure the planned schedule is viable.

Abandoning the full day timeframe for each department would require a common priority of orders and working with "ready times", a latest time for when the next department must have the product to avoid time constraints. It would also require a "firm order period" to allow the planner and tool some leeway to optimize the production schedule.

3. Initiate a continuous improvement effort and standardise processes

To harmonise the workforce certain critical work processes can be documented and standardised as a “best practice”. This will make production planning easier as each operator will work at roughly the same pace but also aid efficiency, as all operators will be doing the right things.

A standardised way of performing tasks will also serve as the starting point for the continuous evolution of these processes, making them better over time. But continuous improvement could, and should, be applied to all aspects of the production facility, from safety issues to ergonomics to saving time. By allocating time and resources to the suggestions put forward by operators and other staff the company will likely see both direct and indirect returns in the form of time cuts in production as well as more enthusiastic staff and lower sick-leave rates as a result of improvements in the work environment.

Improving production times for products at CLC1 might not be a priority for the site itself but will pay off as a product is transferred to another, mass-producing, CLC as Axis then will purchase fewer production hours from the service provider.

It is important to make continuous improvement a natural part of the daily routine both for managers and operators. Management must show support and dedication to the cause to build trust and empower the staff to take their own decisions and solve problems themselves.

CONCLUSIONS

The site is not particularly efficient today but it is not its purpose to be lean. By acquiring better knowledge on production performance and a more advanced planning heuristic CLC1 can become more efficient and flexible at the same time. Setting a continuous improvement cycle in motion will over time improve the site in these aspects as well as other, softer, areas. Overall, our suggested actions are not meant to transform CLC1 into a high-efficiency, super lean facility but rather to overcome the worst inefficiencies and to further improve what is already very good.

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