Development of the concept ”Swedish Production System” (SwePS)

Swedish Production System (SwePS) is an effort to raise the awareness of Lean Production within the Swedish industry. The SwePS project is contributing to the development of sustainable production systems to increase the competitiveness of Swedish companies! A focus in the project is to utilize the strengths and possibilities caused by the Swedish cultural context.

SwePS has resulted in an increased knowledge through an extensive education program, exchange of knowledge within networks and case studies in companies. Here, the focus has been on their development areas related to Lean Production. The findings based on the participating companies’ current and future challenges, with regards to the areas of improvement and development work, assembly, materials handling and logistics, and cooperation in supply chains and production networks.

Objective

The purpose of the project is to strengthen the position of Swedish companies by educating staff members in and implementing the Lean Production philosophy based on the strengths, possibilities and the prerequisites of Swedish companies.

Results and deliverables

The following results have been accomplished:

- A broad base with personal in the companies (3000 people), have been given shorter education increasing the knowledge of what Lean Production means and can contribute to the implementation and maintenance of such a company culture.
- Leaders and lean coordinators (50 people) have taken extensive lean programs. They can facilitate the reformation of the production system and are able to support the management in there leadership and supply the organisation with tools as the improvement work proceeds.
- Increased knowledge on important considerations designing and implementing Lean in Swedish companies. The Lean philosophy and overall principles are found valid, however, it is difficult to directly implement Lean Production methods and tools, due to specific conditions, context, culture etc. An adjustment is needed to match the company’s technical, physical and business context as well as the cultural, human and organizational context and following methods are developed to support this area:
  - A Lean Navigator – A dialogue tool for improvement and development work.
  - Value-mapping for analyses of supply chains in production networks
  - Dialogue-based Attitude assessment in relation to realization of planned changes
- Development of the public web-site called “www.leanresan.se”. Here, subareas within Lean are described together with industrial story-telling described (practical Lean journey descriptions in A3-sheets and ppt-presentations). This web-site facilitates continuous experience sharing from the SwePS-project, other companies, activities or implementation areas, and future industrial research projects.
- A network within the area of production and logistics has been developed with parties from the industry, institutes and academics. The network contributes to the exchange of knowledge and information and development within common interests.
- Education of 2 Ph.D. students and research projects for 5 post doc within university and institutes and 3 Ph.D. within the companies.
* Publications in scientific papers and popular science papers.
* Presentations of the results at scientific conferences and industry and practitioner oriented conferences.
* Updated and modernized education programs in Lean Production for undergraduate studies as well as continuing and professional studies.
* In the project, 14 case studies have been carried out or are in progress. The case studies have shown large potential in the different studied areas. In most of the case studies, the companies have continued and implemented the changes in their production systems.

**Project realization**

The project has been carried out during 2006 – 2008 in cooperation between parties from the industry, institutes and academics, in order to achieve a superior exchange of knowledge and information. The project has comprised of the following main parts:

1. Education within Lean Production for key personal (Lean game, Lean Production 7,5hp at Chalmers School of Continuing and Professional Studies, etc).
2. Implementation of a number of fundamental Lean principles at a number of production sites (14 case studies focusing on different characteristics based on the existing critical needs for development in the companies).
3. Analysis and conceptual development with a theoretical as well as an empirical base (the 14 case studies), figure 1.

The project framework setup has given rise to possibilities to find synergies between the different parts of the project. The project is a cooperation between a number of different production units within the following companies; AB Volvo, Saab Automobile, Volvo Cars, companies from Scandinavian automotive suppliers group and participating researchers from Chalmers University of Technology and Swerea IVF AB.
Figure 1. The SwePS-project help to increase the understanding about WHY, WHAT and HOW questions in the design of production systems, in Sweden, inspired of Lean Production.

Part A
Why "Swedish Production System"?
What is specifically "Swedish", strengths/conditions?

A1 In general
Important to development competitive long-term sustainable production systems which create value for
- people,
- users/customers/partners,
- owners and
- society

A1:1 In general
Context and culture needs to be regarded during change realization of production systems based on Lean.

A1:1.1 Specific for companies in Sweden
There are specific "Swedish" characteristics i.e.: Competence, high education operator level, questioning attitude/flow authority level, strive towards consensus, team-oriented ways of working, decentralized leadership, high technology level, collaboration with union
Important to be "Life balanced-orientated"

B1 in general
Important to have a common description of the companies production system!

B2 in general
Basic Lean principles are useful, but there is a varying need to regard local culture and context dependant on the sub-areas character

B2.1 in general
Those parts of Lean production where implementation foremost is influenced by cultural differences are:
- improvement work,
- team work,
- standardized work

B2.2 In general
To achieve long-term sustainable changes in ways of working, there is a need to create wide understanding, changed mind-set and behaviour within the company and partners.

Del B
WHAT within Lean Production is possible to "copy-paste"?
What factors specifically need to be regarded in companies in Sweden?

Del C
HOW adopt/implement Lean Production in companies in Sweden?
Focus-areas within the SwePS-project

Material supply
- Design of material supply
- Material supply he production system

Supply chains and production networks
- Control and planning of production (push or pull)
- Production-integrated transport (River plastic trains)
- Interconnections between and within production units (intermodule)

Improvement and development work in production
- Work procedures, methods and models for implementation
- Engineering work/support functions
**Project outcomes**

The project has resulted in effects in several dimensions, it has both participated to an improved competence in industry and to a deeper knowledge about what is important to consider when companies in Sweden want to design and develop long-term and sustainable production systems based on Lean Production. The project has contributed to an extensive growth of competence, a large number of people have participated in education. More than 1400 persons have participated in minor courses in Lean Production and more than 50 persons have participated in the course “Lean Production”, 7.5 hp, at “Chalmers School of Continuing and Professional Studies”. The possibility to attend the course has been facilitated by the fact that the course has been given in different cities, from Kalmar in south to Luleå in the north. Besides Göteborg, the course has been given in seven other cities and Chalmers School of Continuing and Professional Studies has provided the project partners approximately 20 occasions to attend the course during the project period. The other participants have been from many different business and sizes of companies.

In the case studies focusing materials handling, the outcome has been very successful. All the participating companies have chosen to further develop the case study results by themselves. Promising results from an initial pilot study resulted in that the study was transformed to include the whole plant. The results from the initial case study have already been exceeded for the whole plant. This production system was awarded the Swedish Assembly Prize 2009. Other case studies within materials handling included picking time reduction and how demands from the assembler is addressed to the materials feeding system and organization. The implications these demands have on the materials feeding system and organization, have influence on the design of new material handling methods. Another case study considered change of material racks at the assembly lines of the Volvo Penta plant in Vara. The results involved the possibility to produce one piece continuous flow on customer demand instead of batch production. Now the plan is to redesign the whole assembly line. Already has the materials feeding system been redesigned, meaning a supermarket with downsizing to smaller packages. One case study at Volvo Aero has proved that simple pull based principles for production activity control (ex. Kanban), can successfully be used in planning contexts characterized by long lead times and complex flows. This is planning contexts where pull principles, are usually not recommended. In this case study was two different pull principles compared, Kanban and Conwip. The resulting comparison showed obvious advantages for Conwip. The case study also implicated that, to be able to implement in practice, the pull based planning and control principles has to be adopted to and developed to planning contexts characterized by long lead times and complex flows.

The case studies related to supply chains and production networks has contributed to the understanding, how important it is to consider the whole value stream and how the whole flow is affected (both internal and external) at changes, within the company, between customer and supplier, between plants etc. For Swedish companies it is especially important to make use of proximity to partners and suppliers in the supply chain. By developing and applying the Value Stream Mapping methodology for supply chains, large potentials could be identified. The methodology can be used inside plants and along whole supply chains. Performance measures will assess the performance of the supply chain, i.e. to what degree the logistics system will fulfill demands from production (ex. the assembler). In the case study at Volvo Bus, their production philosophy has been made clear, based on principles from Lean Production. Education involving most parts of the organization has been realized. The project has resulted in new communication links between different plants, foremost between the body plant and the chassis frame plant in Uddevalla, leading to cost reduction. Changes in the production processes have considerably reduced the assembly time and materials cost and also increased the quality. From the case study at Saab Automobile, potentials for improvements have been found. Results from the study have been presented at an industry conference.

In the case studies related to improvement and development work on-going change processes in the industrial companies were studied (flow-oriented production, standardized work, and improvement work) with the aim to identify success factors, hindrances and prerequisites to achieve efficient implementation and sustainable development. At the participating companies,
Volvo Powertrain, Volvo Construction Equipment and Ljunghäll, focus was both daily improvement work and major transformation projects, where the common challenge was to achieve changes related to attitude and willingness to adapt to standardized work. At Volvo Powertrain a pilot-line was re-built and several people educated. Philosophies where described and spread within the company. Positive differences of the operators working situation and improvement work were identified, in spite difficulties of following planned working procedures due to the stressed production situation. The case study has contributed in prioritized improvement suggestions for the company. At Volvo Construction Equipment a major Lean transformation has started including company-wide education. The transformation has reached “half-time” according to plan, with very good results related to quality, space need, productivity and lead time. Several minor-transformations of production cells are carried out during a period of 12 weeks, and are performed by a dedicated team during 12 weeks. The transformation is based on a structured plan based on Volvo Production System. The case study has contributed to further development of ways of working in the ongoing transformation by identification of “lessons learned”, success factors, and hindrances, which are documented and communicated with the company. At Volvo Penta in Gothenburg the increased part of Kanban together with other changes have resulted in positive effects, which not were obvious in the company. The pilot group, responsible for implementation of known improvements methods and tools also has shown changed attitude to contribute to development and willingness to change. At Ljunghäll AB personnel have been trained and support based on self-identified wastes is given for their further development improvement work in production. The approach has resulted in a great number of suggestions, however insights from the study is the great importance of support from management and support functions so that the personnel rapidly sees results of their engagement. At Volvo Aero work related to support functions in production have been studied with focus on production engineering areas as it has great impact on lead time and product quality. The aim was to develop a tool for manufacturing engineers to better follow-up their work, plan, and visualize their work for partners and customers. Results show that the studied group increased the part of their planned work from 32% to 50%, which was positive and resulted in increased efficiency. Results has been documented in the Licentiate thesis "Some Findings on the Management of Production Engineering”.

Hence, the industrial studies stress the need to adopt working procedures, methods and tools to local conditions and that ways of working need to be continuously developed. Companies in Sweden need specifically to in early phases achieve a wide deployment in the whole organization, and that it is crucial that individuals have an understanding of WHY, i.e. a deep understanding of why a change is needed, benefits for the company, for the own work etc. Also personal engagement is important representing "local expertise. In other words the person closest a specific task should be in person involved in development work, or, in very close dialogue with engineers and managers. Regarding management, there is a frequent change of positions and roles in companies in Sweden which shows a need of strategies to cope with this phenomenon and to strive to create continuous leadership related to changes.

There are a number of effects on experience sharing (academic and industrial). For example, several collaborations between different industrial parties have started and been further developed. Knowledge dissemination has been done through publications and conferences, both scientific and practitioner-oriented. This networking has been appreciated and fruitful as communication with colleagues from other companies and researchers has high lightened various issues of importance. The project results are planned to be presented in a number scientific works and industrial reports. Additional effects have been that SwePS-researchers has acted as coordinators in MERA-cluster and participated to exchange of experience between different initiatives within the MERA-programme, as well as contributed to initiatives to ongoing and further research programmes within e.g. AFA (project ProVÅRD) and Vinnova (project KNOP).
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Publications and dissemination of results

Results from the project have generated a number of scientific conference articles, posters, master thesis and popular science articles. A selection of these are listed below.

Presentations, seminars, workshops

- **MERA-conference**
  - Swedish Production System (SwePS) – A Competence Upgrade in Lean Production, Presentation at MERAP Programme End Conference, October 2008, Lena Moestam Ahlström, Volvo Technology & Ulrika Harlin Swerea IVF
  - Effektivare montering med förändrad materialförsörjning, Presentation at MERAP Programme End Conference, October 2008, Christian Finnsgård, Chalmers

- **Monteringsforum**
  - Montera eller promenera? Materialexponering vid line, Presentation at Monteringsforum, Mars 2009, Christian Finnsgård, Chalmers
  - Lean på svenska - ska det vara nödvändigt, Presentation at Monteringsforum, Mars 2009, Per Gullander, Swerea IVF
  - Lean-resan - ett hjälpmedel för en snabbare väg till Lean, Presentation at Monteringsforum, Mars 2009, Lena Moestam Ahlström & Johan Svenningstorp, Volvo Technology

- **SwePS workshops**
  - Workshop 1; Volvo Aero Trollhättan. Report from case-studies 4 and 7
  - Workshop 2; Volvo Penta Vara. Report from the first part of the material handling/material feeding case study 14. Swerea IVF presented a process of developing a local description/vision of a company’s own production system related to case-study 16.
  - Workshop 3; Volvo Car Corporation Göteborg. Report from case-studies 3 and 12, education initiatives and strategy, and risks within Lean operations.
  - Workshop 4; IAC Färgelanda, Topic ”Continuous improvement work”, Report from case-studies 6, 7 and 13.
  - Workshop 5; Saab Trollhättan, Topic ”Lean at low volumes and large number of variations”, Report from case-studies 2, 5 and 15.

Scientific publications

• Ongoing journal article: Harlin U, Moestam Ahlström L och Kjellberg A, (2009) Attention to people towards sustainable improvement of production systems


• Finngård, C; Wänström, C.; Medbo, L (2009) Requirements in the value stream - Between materials supply- and assembly processes. EurOMA conference, Göteborg

Reports

• LeanNavigator – Ett dialogverktyg för utveckling av konkurrenskraftiga produktionssystem inspirerat av Lean,(2009), Swerea IVF-skift 09802, Harlin, U (red), Moestam Ahlström L (red) , Medbo L., (red), Sjögren B., Wänström C, Gullander, P, Hallin M, Sigbrandt P-Å, Swerea IVF AB, Volvo Technology AB, Chalmers, Avdelningen för logistik och transport


Web based documentation

• www.leanresan.se

Popular science articles

• Ny Teknik
  o Tumme med konsoler, Ny Teknik, nr 37, 2007
  o De är Volvos svenska mästare i montering, Ny Teknik, nr 14, 2009, p 6
  o Så kan Saab spara 400 miljoner, Ny Teknik, 4 mars, 2009
  o Lär dig bli lika lean som Toyota, Ny Teknik, 4 mars, 2009