North stars

This month, LMJ talks to a number of lean companies in Scandinavia. Taking you to Sweden, Denmark and Norway, we look at how lean is implemented in these countries and at how local culture shapes the way companies understand and deploy it.

On our tour of northern Europe, we meet champions like Volvo and technical wholesaler Solar, as well as firms that have managed to transform themselves and overcome enormous difficulties by adopting lean thinking, like LEGO.

The use of lean is widespread in Scandinavia, which is demonstrated by the array of sectors featured in this special: we have specialists in medical testing devices and port terminals looking to dramatically improve the way they operate, hospitals and toy manufacturers.

While Denmark is perhaps the lean champion of the area, with a very good understanding of the methodology commonly found throughout society, Norway and Sweden also offer some great examples of operational change.

In the next few pages, you will have a chance to learn about the status of lean in these countries. Joakim Hillberg of the Swedish Lean Forum, Jens Kristian Jørgensen of the Confederation of Danish Industry and Daryl John Powell of the Norwegian University of Science and Technology in Trondheim introduce the specials on Sweden, Denmark and Norway respectively.

Sweden's take on lean

Joakim Hillberg, co-owner of Revere AB and chairman of the Swedish Lean Forum, has worked with lean in and out of Sweden for over 20 years, supporting companies and organisations in their implementation efforts. He shares his thoughts on the advancement of lean in the Scandinavian country.

At the last annual Swedish Lean Forum conference, in October 2011, there were over 500 participants from different types of industrial companies but also from schools, hospitals, government agencies, police, software companies, finance, travel companies, media, universities. Probably from most sectors of Swedish society. This is quite unbelievable considering how lean started in Sweden.

Some of the earliest efforts with lean thinking in Sweden were in the 1980s. One of Shingo's books was translated and there were efforts on using kanban, but the main area of focus was "just" reduction of tied-up capital. In the 1990s, two important companies engaged in a much more focused effort to change their production systems; these companies were SAAB and truck company Scania. SAAB might not currently be a role model, but without its work with lean the company would have probably disappeared much earlier: it had many Japanese senseis coaching and training people in the business, which became, in retrospective, a centre for developing Swedish lean competences. Scania already identified its need for change in the 1990s and more or less made a carbon copy of the Toyota House.

But it wasn't until after 2000 that lean started to get wider recognition in Sweden. It was then that Lean Forum was started as a non-profit organisation with the aim to spread lean thinking. It was a quite small industrial club at the beginning, but it has grown into a 5,000-strong network of members from very different areas.

Just to give you an idea of the dramatic expansion of lean in the country, there are currently more than a hundred annual open lean events or seminars in Sweden. And these are not just for industry: more than 80% of health care organisations and more than 30% of municipalities in the country are now working with lean in some way.

Additionally, in the last few years two important national initiatives have been started:

- The Production Leap, a national support programme for sustainable lean development in small and medium sized industrial companies. So far, the initiative has seen more than 10,000 people attending seminars, 1,000 people going through a 10-day training university course in lean (whilst going to work at the same time) and coaching offered to over 100 companies implementing lean. As an effect of this course, there are now at least ten universities in Sweden offering some sort of executive course in lean.
- Verksamhetslyftet, a training programme for the public sector founded in 2009. Its purpose is to support the development of lean in municipalities and healthcare. The programme has so far given more than 1,000 people a basic training in lean, which has resulted in a large number of implementation initiatives.

Research is also growing, with the launch just recently of a national lean research network. A simple example of the effectiveness of this initiative is the number of student dissertations on lean, which has increased from a couple per year to over 50 per year over the last decade.

The literature base is expanding: at the beginning there merely were some translations from Japanese or English, but today there are around 30 books in Swedish, with about half of them written in the country. This is quite impressive in a country with a population of 9 million, especially considering that most people are fluent in English.

The Swedish lean journey is in many ways similar to that experienced in other countries. It was very tool-based at first, with a strong focus on 5S, SMED, etc. and has recently become more focused on strategy and work with lean principles. There are some differences, however: the use of Kaizen Blitz and Kaizen events is not prevalent at all in Sweden. They only appear in global companies where it is mandatory.

This can probably be attributed to Sweden being a collective society: for example, most Swedes attend kindergarten early on, when they are 1- or 2-years-old, and there they are already taught to co-operate. Using the Toyota House as a model for describing lean and an organisation's production system is also very common, due to Scania's early work.

Looking briefly at the future of lean in Sweden, the methodology will continue to evolve becoming increasingly perceived as an enterprise-wide system. The respect for people principle is also expected to gain momentum. There is an increased understanding of the fact that, if you want to reap the full benefits of a leaning organisation, there have to be gains for all parties. Furthermore, there is a need for more research to be published, to expand the evidence and knowledge base on lean.

In this special on Sweden, *Stefan Hollertz* and *Björn Stenvall* present three case studies of companies the Production Leap helped on their improvement journeys.

A leap of faith

The Production Leap offers companies with 30 to 250 employees support in their practical change process. It contributes to their progress towards efficient production and a strong, sustainable capacity for change.

Its work aims to create permanent lean changes in selected medium to large manufacturing companies. The Production Leap applies a standardised and well-tested process that lasts for eighteen months, called The Wave. A broader understanding of lean and some guiding principles are established in the company. Following the initial phase, new ways of working are developed, introduced and stabilised in a pilot group. Their design is based on the guiding principles and the challenges and problems found in the company.

A basic course in lean production for two people, the company's change managers, is required. The Production Leap's coaches and experts pay one-day visits every other week during the first ten to twelve months. When the company is strong enough to take over, this interval is lengthened to four weeks.

Tradition and change

At AB Furhoffs Rostfria, handicraft and high tech go hand in hand, with a long-term investment in lean sustaining the company's efforts to achieve excellence.

In the Skövde plant, the fourth generation is now running the metalworking company whose roots stretch back to the end of the 19th century. The company's pride in its origin is easy to see: Sweden's only school for coppersmiths is still run here.

Furhoffs mainly operates in two areas: building products (primarily heating, ventilation and sanitation) and customer specific products, such as radar antennae.

"Of course, it was difficult to get started, but we knew that it was a long take-off run," says production manager Jan Adolfsson. "We also knew that we had a lot of areas where improvements would quickly be evident."

Both Jan and Björn Furhoff, CEO and owner, saw the importance of getting everyone on their side to introduce a new way of thinking. They ran into territorial jealously and other problems, but they chose to set the good example and eventually got everybody on board.

"We have two strong trade unions here, but no opposition," Furhoff says. "They were included from the start, from setting the fundamental values. Like us, they are aiming to secure jobs and a long-term approach."

By combining modern handicraft with efficient production, Furhoffs is maintaining its competitiveness (the work with the Production Leap is done, and the company is now driving its lean programme alone). Competition comes from other materials, such as plastics and cast iron, but also from other manufacturers of stainless steel products. The company's goal is to re-invest 10% of turnover.

"Daring to take time from production and talk, for instance about good order and clarity, 5S and planning is so rewarding - we earn the time back many times over," Adolfsson says.

Having ambitious change managers who can keep the enthusiasm and activities alive is pivotal. At the same time, it's important that management is passionate about lean and sets a good example.

Out of the box

Emballator Lagan Plast AB in Ljungby develops, produces and markets plastic packaging for foodstuff, pharmaceuticals and chemical products. It kicked off its lean journey in 2005, joined the Production Leap in 2008 and won the Swedish Lean Prize in 2011.

Customer contacts are not only more frequent than before, they are also considerably more effective and rewarding for all parties. The company runs an operator exchange, where operators from the company and its customers link up and exchange experience as well as demonstrate how the respective manufacturing processes work.

"It once was our sales reps who handled the contacts," quality, environment and hygiene manager Anette Larsson says. "Commitment and job rotation means that broadly speaking anyone of us can answer questions."

Despite more than doubling volumes and turnover from 2004 to 2011 and having 50% more customers, there are only eight more people in the company. Both customer satisfaction and delivery precision have increased. The real gains, however, are in the customers' confidence in a functioning and more efficient way of working, which is supported by proud employees.

Emballator Lagan Plast AB went from being threatened with closure about eight years ago to transferring production from Denmark to Ljungby, Sweden, in existing premises: all of this thanks to a more efficient utilisation of floor space and more efficient production. The company traditionally had gigantic electricity bills and one way of measuring consumption with respect to the production is to divide the kilowatt-hours by the number of kilos of plastic consumed. Without focusing on electricity consumption, this ratio has dropped from 2.41 to 1.73 between 2004 and 2011.

"This naturally affects environmental considerations and willingness to invest since our owners see the effects of getting rid of waste at all levels," managing director Christian Silvasti says. "Now, when we are investing in the facilities, we are investing in closed cooling systems, we heat the premises with waste heat, etc."

Leaders contribute in every possible way, also releasing capital for ventures and investments.

Company of the Year

Construction specialist JM AB has worked with lean for several years, winning understanding and support from its workforce. In 2011, the company won the Swedish construction sector's lean prize.

JM's lean transformation started in 2009, when parts of the production management team attended a course arranged by Chalmers Professional Education. A project was started, with the overriding goal of achieving flow in the production and minimising waste by working more intelligently.

Many lean initiatives are implemented at managerial level, with courses for managers who are then expected to spread the philosophy in the organisation. JM chose a different strategy.

"We invested in courses for everybody who is involved in production; both office workers and craftsmen," John Eklund, manager of production development, says. "In this way, we have succeeded in building up a broad lean competence and a shared vision of the business."

To maintain the commitment and drive in the development work, JM is continuing to invest in training. Further education courses in lean are being combined with specialist training for various professional categories. John Eklund sees several positive effects of the investment, including increased delivery precision and reduced number of accidents. He also thinks that job satisfaction has increased and that personnel feel more involved in the company's development than before.

"The strong collaboration between our employees is quite clearly the greatest gain for us," he concludes.

People at the wheel – Volvo's lean journey

Torbjørn Netland, a Fulbright visiting research fellow at Georgetown University in Washington DC, and a researcher at Norway's NTNU/ SINTEF, and *Ebly Sanchez*, Volvo Group's VPS competence programs director, present this case study on the Volvo Production System and explain the vital role people play in the company's lean transformation.

A fundamental lean transformation, leading to sustained continuous improvement and improved business results, is always produced by the most valuable resource all organisations already possess: people. Far too often, companies radically underestimate the role of people while overemphasising tools and methods. This lack of connection between the appropriate focus on people and a holistic learning process with the implementation creates a false start, leading to overspending, lower-than-expected effects, union conflicts, and lower credibility of the lean transformation process.

Based on our industrial and theoretical insight, we uphold that the more high-tech, high-value and customised the production gets, the more important the role of people will be in the lean transformation. We see this in the Volvo Group and elsewhere in industry. Thus, we argue that focus on people involvement and people development is the single most important factor for the successful implementation of lean in the high-customisation industry. Production of customer-specific and high-tech products requires much higher levels of flexibility in the technological and organisational set-up and more advanced human capabilities than repetitive mass-production. Here we find Volvo's lead.

The Volvo Group is the largest Scandinavian manufacturing company with more than 90,000 employees globally. Since its founding in Gothenburg, Sweden, in 1927 it has been a Scandinavian train engine for industrialisation and growth. Volvo develops and produces trucks, buses, components for aircraft engines, construction equipment, and drive systems for marine and industrial applications. While consumers in particular think of traits like safety, quality and environment when seeing the Volvo logo, researchers in production management typically think of Volvo's stronghold in the humanisation of work: the experiments of work organisation in the Kalmar and Uddevalla plants in the 1970s-80s made Volvo become a synonym with a much more humane, democratic, autonomous, and team-based production system than the contemporary focus on extreme standardised assembly line production. Some believe that this thinking was abandoned with the closure of the mentioned plants in the early 1990s – they could not be more wrong. Humanisation of work is still a stronghold of the Volvo Group, and an essential contributor to Volvo's sustained success.

THE VOLVO PRODUCTION SYSTEM

Volvo looks different today than it did 20 years ago. Since the sale of Volvo Cars in 1999, the remaining Volvo Group has grown considerably and globally. Naturally, its corporate culture and operations have become much more diverse, dispersed and dynamic over the last decade. Moreover, several Volvo companies experience extensive price competition from new economies such as China, and needed to embark on lean manufacturing initiatives in order to

reduce production costs while improving quality and reducing delivery times.

These are reasons why in 2005 Volvo Group decided it needed a common corporate-wide improvement programme to allow for better use of resources, sharing of best practices, reduced duplication of lean efforts, and a shared improvement language. In 2007, the Volvo group launched the Volvo Production System (VPS).

The VPS has an implicit focus on people. It emphasises the Volvo Way, people and teamwork as cornerstones of how to operate. More than other companies, Volvo allows decentralised solutions and a high degree of autonomy as long as people have been heard and included in the process. A joint optimisation of people and technology is always strived for, which might be different for different situations, cultures and environments. Two practical examples of what we mean by the people focus in Volvo are:

- One of the company's most successful plants is the trucks plant in Curitiba, Brazil. Here, autonomous shopfloor teams are working alongside a traditional mass-production production line. The inspiration for this human-centred organisation in a traditional technological set-up came from Volvo's Swedish plants. These teams are the driving force to implement and maintain improvement, and have over time proven very successful in an area of the world more known for hierarchical and directive production management.
- In a relatively small factory in Gothenburg, Volvo Penta builds customised ship engines. Here the heavy and technologically complex product rarely moves, while a team of operators have close to full responsibility and autonomy for how and when the engine is built. This offers a high degree of flexibility to trained employees that are able to make customised products without sacrificing lean improvements. Making the workplace more stimulating and interesting for modern and future employees is more important in the long run than maximal efficiency gained through repetitive and dull work.

As seen, different solutions share a common core in the belief in people. This is not to say that these plants are excellent in all ways and cannot improve, which is why Volvo is working on the VPS with a firm idea that it is a good strategy.

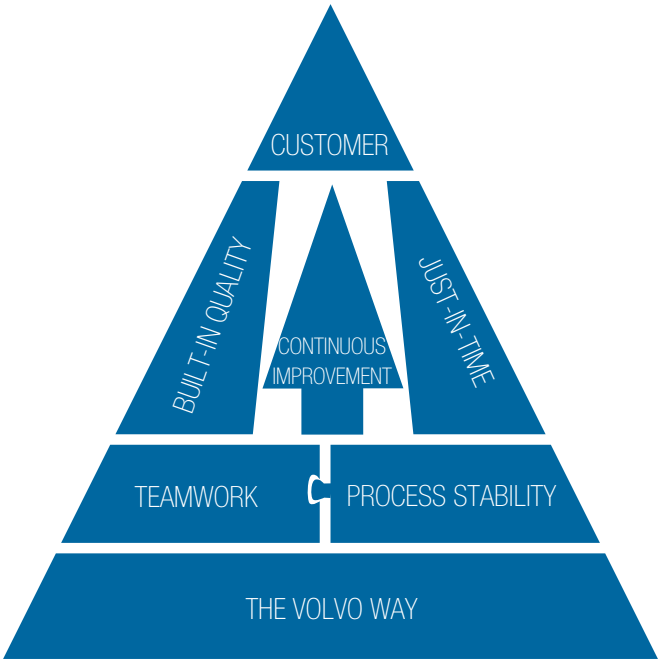

Figure 1: The Volvo Production System for the order-to-delivery processes

INTO THE FUTURE WITH PEOPLE AT THE WHEEL

Volvo believes that building attractive work places is much about building people capabilities. If people are involved and allowed to learn, they will be pleased to help improve their workplaces and increase the competitiveness of their employer. The idea is to spread the thinking before the tools. Therefore, Volvo launched a new capability growth strategy in 2011 that will accelerate the implementation of the VPS by focusing solely on increasing the knowledge level around the world through extensive training and education.

In conclusion, Volvo builds on the Scandinavian tradition of people involvement, people development and team building to succeed with the Volvo Production System globally while retaining the need for local solutions. We do not pretend that we have the solution for all types of lean improvement issues in industry; however, we do believe that having an autonomous team with the correct implementation capabilities will be the single most important factor for successful lean transformation in mass-customised industries. Knowing that high-tech, high-value, and high-customisation will be the main attributes of future high-growth industries.

Denmark: fairytale lean

Jens Kristian Jørgensen is the director of leadership development and productivity at the Confederation of Danish Industry (DI), which has played an important role in spreading the knowledge about lean in the Scandinavian country. In this article, he introduces *LMJ*'s special on Denmark, explaining the current status of lean there and how local culture affects its development.

In partnership with

Confederation of Danish Industry

Lean got momentum in Denmark after 2000, when it became a very popular method to increase productivity. Through trial and error lean revealed its potential and it became obvious that it is not just a box full of tools: it is now widely recognised as a philosophy and a way of life in many companies.

But what is the status of lean in Denmark today? Let's start with some data. Our annual survey for 2011 shows that about 56% of Danish manufacturers are working with lean. Furthermore, lean in these companies is quickly moving from the shopfloor into other business areas, like administration and R&D. Within the next 12 months we expect the number of manufacturing companies working with lean outside the shopfloor to increase by 50%.

The survey also shows that more and more non-manufacturing companies are starting lean journeys. Lean has now become a part of strategic planning for an increasing number of businesses, the responsibility of its implementation moving to the lines.

I have been asked how culture in Denmark shapes the way lean is implemented. While I don't think Danish culture has a specific advantage when it comes to deploying lean, I do believe that the way that many Danish companies are managed does have an impact on lean implementation and the ability to sustain results.

Most Danish companies are characterised by a very flat organisational hierarchy and a very small power distance. As a result of this, decisions are often delegated to the employees. Generally, you will find that employees in Danish companies place great confidence in their leaders. Working in teams is very common, and people are trained to respond to delegated work responsibly.

This is a perfect recipe for motivation and success and makes it easier to get started with lean. The flipside is that a great number of teams/employees has created their own standards and has a "delegated right" to make a lot of decisions. In lean, management must set the direction and a lot of leaders find themselves in a position where some of the delegated power must be withdrawn without demotivating people. Not always an easy job.

There is a strong lean community in Denmark. Networks keep it together and true knowledge sharing acts as an important incentive to foster lean change in companies throughout the country. It now seems that we have entered a positive self-perpetuating spiral creating more and more people and businesses with a lean ethos. There is an increasing number of small and large companies providing great examples of lean implementation, and you are introduced to some of these firms in the articles contained in this focus on Denmark.

LMJ speaks to LEGO, and discovers how lean has helped the company to get back in the saddle after a challenging few years.

Safe as houses

I admit it, I might be slightly biased when it comes to LEGO. Like millions of other people around the world, I have always been a great fan of the bricks made by the popular toy manufacturer. The name of the company means "play well", *leg godt* in Danish, and while this may refer to the actual games children (well, most of the times it's children) play with the bricks, it could refer just as easily to the performance of the company as a whole.

Six years ago, LEGO was in a deep crisis, losing ground to its competitors and reducing headcount from over 9,000 to just over 4,000. Kent Kjaerhus, director, LEGO Continuous Improvement at LEGO Systems A/S, says: "We were not really listening to the voice of our customers. We did not deliver what we promised and we were not flexible as much as the customer needed us to be when they made changes in their orders, in terms of mix and quantity. The lead time for our average product was in general nearly a year, and we worked with plans typically set at the beginning of each year that were difficult to modify and adapt to changing customer requirements." That is when LEGO realised that things had to change, and started its systematic lean journey.

It first introduced the new production system and set it up in the Danish site, located in Billund: it then expanded the programme to the company's three other plants in Hungary (where Duplo products are manufactured), the Czech Republic and Mexico (which serves the American market).

"Our analysis showed us that we could use the same bricks for about 60% of the elements for the boxes we manufacture. The rest is the special elements which go in specific products, like Indiana Jones sets for example, and you can't predict which one of them will sell well. However, you can use forecast for 60% of the elements. We went from a push to a pull system, which allows us to respond more quickly to changing demand. We were able to reduce our average lead time with factor 14 for the finished good, which has given a very good customer satisfaction. We have achieved excellent results and growth by manufacturing products the end user is satisfied with and putting a more flexible production system in place," Kjaerhus adds. Across its sites, LEGO today employs over 8,500.

LEAN AND THE PROCESS

The manufacture of LEGO bricks requires expensive machinery. The company has hundreds of moulding machines and 100 different moulds, each of them producing a single shape of brick (or "element") and costing £50,000 on average. Additionally, LEGO deploys counting machines to make sure the right number of bricks goes into each and every other box in the packing area. Manufacturing an estimated 36 billion bricks a year, there is no doubt LEGO's operations require a lot of planning. Coloured pipes running through each of the production facilities transport the ABS plastic used to manufacture the bricks, pushing it into the moulding machines, where the substance is heated to 230 degrees Celsius and then injected in the molds. A few seconds later, a bunch of bricks are made. A conveyor belt delivers them to a box, that is then stored into a warehouse before moving to the packing area where the bricks go into the right boxes that are then shipped to the retailers or to one of the distribution centres located in Europe or the United States.

To make this whole process more seamless, LEGO started a continuous improvement programme, which saw the use of 5S and flow in the shopfloor in Billund to begin with, before moving to other departments and sites. "Culture is not something that happens by itself. It comes from strong leadership and shared practice," says Kjaerhus. "We started with shopfloor management, and contacted five ex Toyota leaders to primarily coach shopfloor managers and internal lean consultants, bringing a new rhythm in our manufacturing environment, called manafacturing diary. The line managers hold board meetings in the morning, so that within two hours we know the status of production for the last 12 hours."

Kjaerhus was initially concerned about having external consultants trying to instil Toyota principles at LEGO. People on the shopfloor also struggled to accept the way tools were going to be implemented. The consultants came from a different culture, after all, and they had their own way to implement lean tools. "It was no honeymoon, but it was necessary if we were to change our way to practice wold class shopfloor management," Kjaerhus explains.

STRUGGLES ACROSS SITES

Like many other companies with global operations, LEGO had to overcome another obstacle: spreading the same culture of excellence and the same set of goals throughout sites that are in different countries, with different mindsets and traditions. The Billund site has been there for 75 years, and has a very strong Danish mindset behind it. Kjaerhus says: "Throughout our education, we Danes are taught to be critical and question everything. People are not afraid to speak their minds, even if they are talking to their boss. The Danish way of doing things is looking at problems in a practical way, and all employees take part in it."

The Monterey plant in Mexico has different issues: workers there tend to see their leaders almost as family members. "They don't like to say no, so they will accept taking part in activities even when they don't fully buy into them. We are taking people out of the factory, on picnics for example, to find out what continuous improvement means to them. The tools are going to be the same in Denmark and Mexico, but the ways they are implement differ dramatically. We can't change national cultures or lean tools, but we can change the way we implement those tools to fit different cultures," Kjaehus concludes.

LEGO's lean journey started in manufacturing, and now the company is looking at the whole value chain, from product development over production and sales and marketing. Value chain oriented KPIs will drive a more cross-functional approach to processes, and this is how LEGO pursues change, one brick at a time.

Streamlining the diagnosis

Radiometer is a Danish manufacturer specialised in the production of devices for blood gas testing, immunoassay testing and transcutaneous monitoring. It is also highly experienced in the development of IT solutions that connect these machines to hospital and laboratory information systems. *Mads Friis,* Danaher Business System leader of operations, tells LMJ how lean is supporting the company's efforts to provide customers with reliable products.

When Danaher acquired Radiometer, nobody had any experience in implementing lean. We had to start from scratch. At first we used tools mostly in production areas, namely 5S and visual management. It was very difficult to convince people this was the way to go as we could only tell them about the results that Danaher and Toyota had achieved. There were no examples from within the company and we were also lacking experienced leadership.

Change came in 2007, when Danaher showed us how to transform the way we were implementing tools. By moving away from an approach where tools were managed by leaders, we were able to give employees ownership, supporting them and rewarding good practice.

We measure improvement mostly in the form of productivity gains, which is now increasing at a pace of 8-9% every year. Our performance with quality and delivery also improved, but we are still struggling with inventory. We experienced many problems with missing parts and on-time delivery after we first reduced it. As a consequence we had to increase it again and we are now gradually reducing it, ensuring all processes are in order before we do it.

Radiometer has manufacturing operations and R&D in several countries, from Denmark to Poland, Switzerland and the USA. We are very aware of the cultural issue. We are looking at specific behaviour having realised the importance of training employees. Ownership should be built from the top down, but also from the bottom up: we ran lean education programmes that have proven very successful. We now have a Kaizen leader for every 60 workers. We develop our workforce, always promoting good communication across sites in different countries and different areas of the business. One system doesn't necessarily fit all, so we encourage each site to find its own way to work.

It is critical that the products we deliver are used correctly, and it's with this in mind that we develop systems that are user-friendly, while providing our customer with training that helps them to become more efficient themselves. We have a strong tradition of producing innovative products – in 1954 we invented the first blood gas analyser. We are working to support a closer collaboration between production and product development. Breaking down silos is necessary if we are to succeed in our lean journey.

At Solar, an international technical wholesaler specialising in electrical, heating, plumbing and ventilation components, supply chain efficiency and communication are the two most important enablers of a leaner way of doing business. Group process manager *Klaus Petersen* looks back at the journey.

Working with suppliers for a leaner future

Solar adopted lean to break down the many strategic goals that we have in bits that people in different areas of the business could understand, and to eliminate silo-thinking to start to see the actual processes.

Some of our processes are very long, and we created teams around them so that people had a clear goal in mind regardless of the function they performed. This helped us to achieve tremendous results in our customer service performance. This is what lean is about for us; it is about developing our business.

We took our time to explain to suppliers what was in it for them as lean was implemented. They realised it was a completely new way of working that we were promoting: we have suppliers on a waiting list now. By developing a common value stream you can achieve common improvement. We are the facilitators and suppliers love to work with us, perhaps because we don't hold a simple workshop in a meeting room. We focus heavily on flow, and we have common KPIs (we use joint value stream mapping and we often link ERP systems together). We look at the entire value stream.

The magic happens when people start talking, which ultimately translates into better service to our customers. We have great stories about our suppliers: one of the latest things we did was taking one supplier and looking at the work it does with Solar in three countries. Three Solar companies in different nations now have a common way of doing business with that supplier.

There is a good communication structure around people. Weekly board meetings give managers a chance to address problems. We find it very important to measure commitment, and to check that we have people with the right capabilities. Solar uses evaluation tool Navigator, an employee survey that is used to examine our ability to create value for the customer and that at the same time allows workers to evaluate management performance. Sickness leave has dropped dramatically because people feel they can make a difference and love coming to work now.

We figured out a way to measure the development of management too. From the very beginning we had a great relationship with our HR director, who came up with the idea of identifying what we wanted our managers to be and five management principles they would follow. They are used to assess management performance through the analysis of data. We couldn't believe the improvement in numbers when we first checked the development of management. We had to check them three times.

Competences are universal for us and we share best practice across all areas of the business and even across borders. The Solar lean programme is standardised, but we always listen to different approaches which might have been identified in the different countries where we have operations.

Norway, a lean champion

Daryl John Powell works for the Department of Production and Quality Engineering at Trondheim's Norwegian University of Science and Technology and for SINTEF Logistikk. He talks about the status of lean in Norway.

Norway is perhaps more famous for its natural wonders such as fjords, mountains, Northern lights and midnight sun than for its thriving manufacturing industry. Yet, the country boasts a variety of companies drawing on its abundance of natural resources to shape modern products from traditional materials like aluminum and wood. Giants Hydro, Aker Solutions and Norske Skog are major international players, whilst many innovative smaller companies, such as Teeness and Noca, focus on niche markets to further strengthen a robust sector which has seen consistent rises in both productivity and income.

SFI NORMAN

This eight-year research programme aims to develop new and multi-disciplinary research on next-generation manufacturing, and create theories, methods, models and management tools that enable Norwegian manufacturers to thrive in the global market. Norman was established by the Research Council of Norway as a Centre for Research-based Innovation in 2007: it's the result of the collaboration between 16 leading Norwegian manufacturing companies from a wide range of industries, the Norwegian University of Science and Technology and research institution SINTEF.

In 2009, the Norman companies were surveyed to find out the extent to which lean practices had been adopted and applied. A questionnaire was developed that allowed each company to evaluate itself on a Likert scale for the following 10 lean practices:

1. **Workplace Organisation**
2. **Total Productive Maintenance (TPM)**
3. **Kaizen**
4. **Total Quality Management**
5. **Standardised Work**
6. **Quick Changeovers**
7. **Heijunka**
8. **Pull Systems**
9. **Supplier Relationship Management**
10. **Customer Relationship Management**

The results showed that whilst many companies had begun to apply the basic foundations of lean (such as 5S, continuous improvement, supplier development, etc), the deployment of the fundamental elements of just-in-time production (from Heijunka to Kanban and SMED) were not so evident.

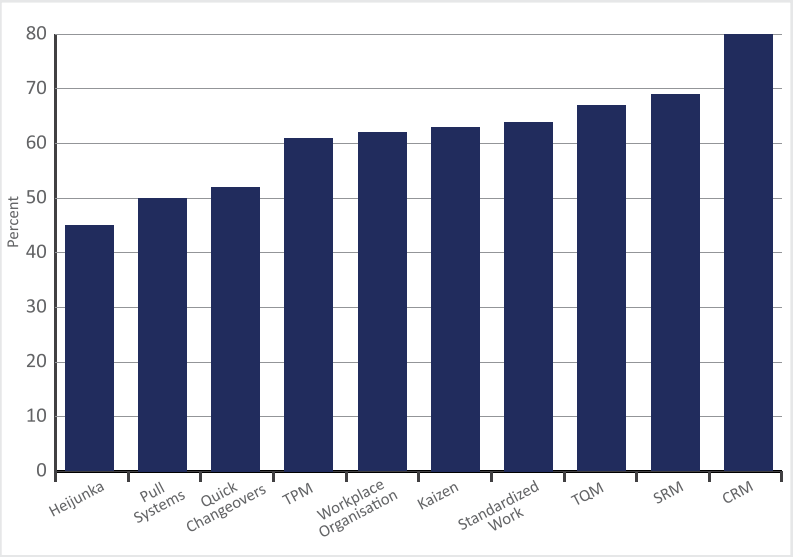

Figure 1: Aggregation of lean practices within the SFI-Norman companies

In 2011, Lean Consulting AS also conducted a survey called "Lean in Norway". The survey was sent to 300 people in private and public businesses, and had a response rate of 36%. Interestingly, the results of this study also showed that many of the fundamental lean practices (visual management, 5S, value stream analysis, A3 reporting) had been applied, but there was again no evidence of the application of flow production concepts or pull production.

We suggest the reason for the limited application of pull production in Norway is due to the type of production environment inherent to the Norwegian manufacturing industry. Few producers in Norway have high volume, low variety discrete production environments suitable for Kanban-based pull production. Much of the production in Norway is in low volume, high variety engineer-to-order type environments; or process-type industries that require control mechanisms alternative to Kanban.

Current research at NTNU and SINTEF is exploring other control mechanisms for the application of hybrid push-pull production in these types of industries, for example POLCA for low volume, high variety, make- or engineer-to-order companies; and every-product-every (EPE), cyclic scheduling for the process-type industry.

The following three case studies provide examples of lean implementation in Norway. All of these companies were supported in their change implementation by SINTEF, the largest independent research institution in Scandinavia.

DEPARTMENT OF CLINICAL LABORATORY MEDICINE, ST OLAV'S HOSPITAL

St. Olav's Hospital, the University Hospital of Trondheim is integrated with the Norwegian University of Science and Technology (NTNU), and is owned by the Central Norway Regional Health Authority. The main duties of the Hospital are patient treatment, the teaching of patients and their relatives, research, and education for health professionals.

In 2009 the Department of Clinical Laboratory Medicine at St. Olav's Hospital ran a project called SMART to create improvements in their own processes using lean methodologies and tools. The pilot project had been designed to support the initial phase of SMART through the introduction and use of the value stream mapping. Training was conducted in lean and value stream mapping for the employees in the clinical laboratory through three workshops that were combined with lectures and practical exercises with the mapping of the processes for bacteriological urine samples received from remote outpatient clinics.

Based on the current state value stream maps, a number of internal and external improvement opportunities were identified, and a future state map was created. By applying various lean practices in the lab environment, a significant reduction in response times has been realised. For example, by redesigning the layout of equipment, it was possible to achieve better flow of samples, and by creating standard operating procedures, variation in processing time was eliminated.

NOCA

Established in 1986, Noca is a manufacturer and service supplier within the electronics and electronics development industries. It offers development, prototypes, batch production and assembly for customers in the high-tech sector. Staff at every level of the organisation is highly qualified: through a combination of experience, formal education and skills, Noca has become a strong and sustainable company. In a survey conducted in the spring of 2010, customers found the company innovative, future-oriented, environmentally responsible and reliable.

Noca is located in Trondheim, Norway's "capital of technology", and has therefore access to a constant supply of new and qualified workers. The company feels very strongly about employee welfare and works continuously to maintain enthusiasm and a winning culture within its workforce. To further strengthen its skills base, it entered several strategic partnerships with organisations with specific retail expertise that are a natural fit with its service portfolio. For example, all of Noca's employees receive regular training in practical teamwork in close collaboration with Rosenborg Football Club. In 1995, the company had 20 employees and a turnover of €3m; fifteen years later it employs around 50 and turns over €8m.

NOCA - Before 5S

NOCA - After 5S

Noca mainly produces printed circuit boards and electronic products. A make-to-order producer, it deals with high levels of customization and unpredictable demand.

With the help of lean, the business achieved better resource utilisation and improved the quality of its products. Lean practices were first introduced in 2009, starting with value stream mapping in order to identify the shopfloor layout that would allow for a better flow of materials and information through the plant. In January 2010, the implementation of 5S began, with excellent results. Areas of the shopfloor were marked up for specific storage locations, and shadowboards are now used for tooling in various processes.

Inspired by Formula One, Noca uses a single-minute exchange of dyes (SMED) method, resulting in a setup reduction on surface mount technology (SMT) machines from a number of hours to around 30 minutes and in a reduction in inventory.

Tangible results were achieved quickly through the application of 5S: improvements in KPIs were identified, such as a 65% reduction in lead time and a 5% improvement in quality. Inventory accuracy has also improved 15%, which is a direct reflection of inventory reduction and 5S activity (less inventory meant less errors).

ALNABRU TERMINAL

This interesting case study may seem out of context at first, but it demonstrates that lean methodology and practices can be applied to environments other than manufacturing facilities and hospitals. Alnabru is an intermodal freight-terminal located at Alnabru in Oslo. It was opened in 1907, and in 2008 was rebuilt to increase its capacity. The terminal is run by a single terminal operator, CargoNet, and is used by several train operators and freight distributors.

Lean was considered as a prime candidate to improve the operational efficiency of the Alnabru terminal, as the central tenet of lean is the elimination of waste.

The project began with the establishment of a lean team on the terminal. It consisted of representatives of CargoNet, as well as representatives of each of the freight distributors – Schenker, Bring and Posten. Having coached the team on the basic fundamentals of lean production, SINTEF chose to apply a lean change methodology similar to that of the Industry Forum MasterClass Process Improvement Activity. Such a methodology uses Deming's plan-do-check-act (PDCA) cycle as a platform for diagnostic activity in order to identify improvement areas and to suggest countermeasures which will improve operational performance.

A total of three lean diagnostic workshops were held at Alnabru to investigate the potential application of lean and identify opportunities for the improvement of terminal operations. Some of the practices that were selected for application are: Heijunka and level scheduling to create improved flow of goods across the terminal; a standardised communication platform such as electronic-Kanban to authorise goods entry into the terminal and to smooth the arrival and check-in process; and standard work to remove variation in processing time for tasks such as rebooking to earlier or later trains, and customs clearance.

COMMENT

PROFESSOR *DANIEL JONES* OF THE LEAN ENTERPRISE ACADEMY COMMENTS ON THIS SPECIAL ON LEAN IN SCANDINAVIA

Scandinavia, and Sweden in particular, were in the forefront of developing human centred ways of working in response to rigid Tayloristic automation in the 1980s. Our initial benchmarking results suggested the pioneering examples of autonomous group working at Volvo and Saab could never be competitive with Toyota. What both sides in this argument missed was that tightly focused collaborative working actually depends on respecting the people involved. This meant equipping them with the problem solving skills to improve their work. Indeed lean thinkers often talk about developing people before making products.

After this course correction Volvo, Saab, Skania and a many other large Swedish firms began very successful lean programmes. These were, however, not enough to save Saab, to maintain the independence of Volvo or to keep Ericsson in the mobile phone business. These big firms were tossed by greater forces in global markets and exposed the relative weakness of small and medium sized firms in Sweden. In recent years, spurred on by the Swedish Lean Forum, lean has spread across the Swedish economy.

In Denmark, without these global multinationals, Bjarne Palstrom of the employers federation Dansk Industri played a pivotal role in raising awareness of lean. Indeed Denmark probably has the highest awareness of lean per capita of any country in the world. DI brought the leading Danish firms together in an Advanced Lean Forum and is currently carrying out a research programme to cascade lean to small firms. This is inspired and led by Fritz Nygaard, the former director of Radiometer, which was taken over by the Danaher Group from the US. The tough and rapid implementation of strategy deployment throughout Radiometer demonstrated what was possible even in a very tight labour market.

Companies like Danish Post, Danfoss, Grundfoss, Velux and LEGO have quietly been using lean to improve productivity and time to market. They have at the same time been investing in lean production facilities in Poland and Eastern Europe, which are now poised to replace jobs in Denmark. In response Danish companies are redoubling their efforts to use lean as a strategic approach to continually rethink their business models. The Solar Group, who recently won the Lean Prize in Denmark, is a case in point. Here lean is being led from the top and is also leading the process redesign and a big SAP implementation across the group. As it does so the company is discovering many new business opportunities to create additional value for their customers.

Lean has also played a significant role in transforming organisations in Norway. With very high wages firms have to not only specialise in technical niches but have to stay ahead of the competition in terms of both time to market and productivity. Lean is also key to being able to provide affordable services to customers. One of the best examples of this is Jaeger, the Toyota car dealer in Bergen, who recently won the Lean Prize in Norway and was recognised as one of the most impressive lean dealers outside Japan by Toyota.