

Leaner processes for greater competitiveness

Build it in.



Lean production

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Powering Business Worldwide



1. Introduction

Lean production gives companies a competitive advantage in the global market. Only through Efficient Processes and Continuous Improvement is it possible to respond to customer changing at increasing requirements.

The idea of "lean production" has been discussed since the early 1990s. Yet implementing the principles of lean production still poses enormous challenges, especially for small and medium-sized business.

This White Paper discusses how design, logistics and production processes can be optimized for the purposes of lean production and how Value Added Services can support the deployment of Lean.

Having the right relationship with supplies and requesting the right services will support the implementation of the lean principles - avoiding waste - relatively quickly and easily. "Lean production means no longer drawing boundaries between suppliers and manufacturing sites.

The entire value chain is in competition," stresses Prof. Hartmut Reinhard from the Cologne Technical College in an interview. It is recommended that small and medium-sized enterprises in particular consult external experts who bring experience and independent feedback on the company's work in implementing lean processes.

Companies that have already implemented lean production at their plants and have gained experience and are in an ideal position to provide their customers with advice when it comes to identifying and exploiting potential for optimization.

Services such as pre-assembled component groups, customer specific labeling, component assemblies ready for final placement are several of the tools that a supplier has in their toolbox to support the design, logistics and production leaner.

This results in an optimized value chain spanning from the supplier to the manufacturer and -best case - all the way to the end customer.

2. The lean concept

The term lean was first used by John Krafcik in 1990 as part of a study at the Massachusetts Institute of Technology (MIT). The term describes a type of production that was primarily seen among Japanese manufacturers at the time. With flat hierarchies, group work, a high degree of automation and the willingness to work towards continuous improvement in all processes, Japanese car manufacturers had managed to become twice as efficient and flexible as their European and American competitors – and at the same time achieve significantly better quality.¹



Image 1: The aim of introducing lean production is to avoid waste.

A key aspect of the lean concept is the prevention of waste: anything that does not directly serve the product in question is regarded as waste. This applies to a very wide range of areas:²

- Time
- Manpower
- Space
- Material
- Money

However, lean production is not a closed theory that can be brought straight into a company as a standard solution. Instead, the term covers various principles and methods, which can be used to make in-house production more streamlined. However, without customized adjustments to these processes and your own creativity, it is simply not possible. That is why lean expert Daniel T. Jones defines the term "lean" as follows: "Lean is actually a new business model that provides a far better service for customers, employees, shareholders and the company as a whole. First and foremost, this superior service provides just what the customer wants, without problems, delays, annoyance, errors and crisis measures."

In lean production, all stages of work and processes focus on adding value to the product. Non-value-adding activities are reduced to a minimum. The aim is to organize the entire manufacturing process as intended for the product, for example, by reducing the interfaces between the various stages of work. In turn, these stages are coordinated with one another as efficiently as possible within the framework of lean production in order to ensure that the product can pass through the manufacturing stages as quickly as possible. Thus, there is a shift from a function-oriented view to a process-oriented view.⁴

¹ TERRASSE online, © Ernst Klett Verlag, Lean Production fact sheet

² cf. Bleher, N. (2014): "Das Konzept der schlanken Produktion" (The concept of lean production), p. 9.

³ Daniel T. Jones is the founder and Chairman of the Lean Enterprise Academy in the UK. Together with James P. Womack, he published the pioneering book on lean principles and processes in production: *The Machine that Changed the World*. (Cf. Lean Enterprise Institute (undated). Daniel T. Jones, URL: <https://www.lean.org/WhoWeAre/LeanPerson.cfm?LeanPersonId=2>, accessed on 02/01/2017.

⁴ cf. Kammel, A.; Groth, U. (1994), p.31.

2.1. Types of waste

Within the framework of the lean production philosophy, the overarching objective is to reduce waste. This may also include features of the product that are not used by the client and all activities that are not part of production, such as warehouse stocks. Ultimately, this also requires a change in employee attitudes to identify and prevent waste in all its forms.

Within the framework of lean production, a distinction is made between eight types of waste which are to be prevented and/or reduced as far as possible with the aid of lean processes:⁵

Type of waste 1: Transport

Internal transport is a necessity in production. Materials, tools and resources need to be transported to and from the production site. At the same time, however, transport also costs time and manpower – and is, therefore, also a waste factor that should be kept to a minimum. Unnecessary transport can be prevented, for example, by sensibly organized and/or designed workplaces and processes. Possible lean approaches to preventing or reducing waste in transport are:

- Optimizing the material flow
- Product, value and process orientation
- PULL control using Kanban
- Just-in-time provision.



Image 2: Internal transport is unavoidable but should be designed to be as efficient as possible.

Type of waste 2: Warehouse stocks

Warehouse stocks are indicators that can highlight faults in other areas. Excess warehouse stocks are often the result of poor planning. For example, high warehouse stocks of raw materials are necessary when there are problems with suppliers (key phrase: delivery reliability). High scrap rates are to be balanced out with high interim warehouse stocks of components. High warehouse stocks can also build up as a result of long set-up times or different production speeds within the production process. High warehouse stocks of finished goods should ensure speedy delivery, given long lead times and fluctuations on the sales market. Lean approaches intended to prevent stock waste include:

- Just-in-time provision
- PULL control using Kanban
- Optimizing takt time
- Linking up with suppliers
- Introducing a Kanban control
- Reducing batch sizes
- Introducing a one-piece flow (employees supervise the product through the various production stages instead of lingering at a workplace)

Type of waste 3: Motion

Excess motion is understood in lean production as inefficient processes in production by humans. For example, this may be reaching out for a tool, reaching for objects that are too far away or walking to tool stores. Possible lean approaches to prevent unnecessary motion include:

- The 6S concept (Sort, Straighten (Systemize), Shine, Standardize, Sustain, Safety)
- Standardization



Image 3: Waste caused by inefficient workflows can be prevented through lean approaches.

Type of waste 4: Wait

The cause of long lead times is generally wait times. A distinction is made here between waiting workers and waiting products. Unnecessary wait times are caused, for example, when processed products are only passed on in complete batches as the following work stage cannot begin until the batch has been fully processed – even if the entire quantity is not needed for the current order. Lean methods to prevent unnecessarily long wait times include:

- Multi-machine/process handling
- Material flow in U layout
- Single minute exchange of die (reduction of set-up times)
- Andon Board (display of the production status)

Type of waste 5: Overproduction

In the case of overproduction, more products are produced than customers can actually purchase. In turn, this results in warehouse stocks that are not actually needed. The following lean methods are suggested to prevent overproduction:

- Leveling and smoothing (to prevent warehouse stocks and demand fluctuations)
- One-piece flow
- Mixed model production.

Type of waste 6: Wrong processes/technology

These are processes and process stages that are unnecessarily complex when manufacturing the product. The following lean methods can be used to minimize this type of waste:

- Kaizen
- Quality circles
- Suggestion schemes
- Reducing the complexity of the process and inputs used
- Developing skills and adjusting powers to reduce handovers and/or loops

⁵ cf. Lean-Production-Expert.de (undated): 7 Verschwendungsarten (7 Types of waste), URL: <http://www.lean-production-expert.de/lean-production/7-verschwendungsarten.html>, accessed on 02.02.2017 and cf. Sixsigmablackbelt.de (undated): 7 Arten der Verschwendung (7 Types of waste) – Muda – 7 Verschwendungsarten – 7 Mudas, URL: <http://www.sixsigmablackbelt.de/7-arten-der-verschwendung-muda/>, accessed on 02/02/2017.

Type of waste 7: Scrap/reworking

Scrap is generated when incorrect parts are produced or due to improper processing. If something needs to be reworked or even disposed of entirely, this is a waste of resources, capital and time. The value already added to that point may need to be added again in part or in full. Lean methods to avoid such waste include: Verschwendung sind:

- Internal customer-supplier relationship (internal customers are treated like external customers)
- Internal/follow-up reviews
- Automation, i.e. autonomous (intelligent) automation
- Zero-error methods
- Belt stop system (error reporting via a ripcord at the workstation and rectification of the defect)
- Improving the workplace environment through 6S
- Highlighting quality through visual management

Type of waste 8: Unused creativity of employees

An important but often unnoticed type of waste is the failure to use the potential and skills of your own workers. There is no doubt that the inclusion of workers in the process design results in greater motivation, saves time and also comes with further improvements. For successful lean production it is vital to get the workers excited about the process. They are the ones who have to live through the changes and integrate them into their daily work. Integrating workers into the process and giving them the appropriate training is, therefore, a key factor for the long-term success of introducing lean production.

2.2. People first

The creativity of each and every worker is required to introduce a successful lean philosophy. Lean production is not a one-off measure "imposed" on workers by management, but rather a fundamental cultural change in the company and – in the best cases – a change in suppliers and customers too. Every single worker must continuously review their behavior and work on their own initiative and where necessary, make adjustments. However, this requires a spirit that allows for errors at the company. Workers have to have the courage to point out problems instead of hiding them. This is the only way to develop mutual solutions. In lean production, it is ultimately down to the people. Management and the workforce change their behavior together and jointly lay down a new, flexible way of thinking at the company.



Image 4: Workers are a central factor in making the introduction of lean production a success.

3. "The entire value chains are in competition" – Interview with Prof. Hartmut Reinhard

Today it is no longer just individual companies but entire value chains that are in competition. The flow of goods, information and finances decides whether the companies involved are successful or not. That is the central philosophy of Dr. Hartmut Reinhard, Professor of Management and Controlling at the Cologne Technical College, who specializes in Strategy, Turnaround Management and Outsourcing. Prof. Reinhard established the Logistics Department at the Technical College. In doing so, he was able to rely on extensive practical experience. At what is today the Deutsche Post/DHL Group, he was, for many years a member of the management team in the German organization for warehousing and outsourcing, later becoming Senior Vice President for Strategy Logistics and Controlling Logistics Globally at the corporate headquarters. For him, lean production remains a vital element for optimizing value chains, as he explained in the interview.

What would you say is the core of lean production?

Prof. Dr. Hartmut Reinhard: For me, waste reduction is the guiding principle here. Namely, avoiding unnecessary work. Lean production involves shifting the boundaries in order to make production faster, better and less expensive. Time-based management is, therefore, a key component that helps reduce response times and lead times, accelerate product development and avoid unnecessary work.

What is the difference between previous methods and the concept of lean production?

Prof. Dr. Hartmut Reinhard: For a long time there has been a trend of companies focusing on adding value and optimizing these processes. Non value-adding processes were completely disregarded. I like to tell the story of a drill manufacturer who had a lead time of 14 days for an order. After analyzing their processes, it turned out that the value-adding processes only took 5 minutes. Nevertheless, for a long time the company put its entire effort into reducing those 5 minutes to 4 minutes, instead of turning the 14 days into 7 days, for example.

You spoke earlier about shifting the boundaries: what exactly did you mean by that?

Prof. Dr. Hartmut Reinhard: Now, lean production means no longer drawing boundaries between individual companies. The entire value chains are in competition. That means that it is not only how good my company's performance is, but also that of my suppliers and my clients that is important. Lean is not simply a case of "Am I doing this right?"; but also of "Am I doing the right thing?". I should be asking myself at regular intervals where my part of the value chain starts and where it stops. Can the boundaries be moved? Is it even right for me to do this work myself, or should I get someone else involved too?

That brings us to the subject of outsourcing. What are the advantages of outsourcing in your opinion?

Prof. Dr. Hartmut Reinhard: Let's look at the logistics industry as a prime example of outsourcing. In recent decades 90 percent of transport business has been outsourced from the actual manufacturers or producers to logistics companies that provide transport, storage and value-added services for various clients. This improves the service and reduces the price. This is based on what is referred to as the effects of scale produced by bundling orders. If the right person in the right place performs the right tasks, the laws of the division of labor are effective. The greater the quantity produced and the more frequently the production stages are carried out, the better the learning curves and the greater the potential for cutting costs. So if you use external specialists for a job that is not one of the core competences of your own company, but is one of the specialists' core competences, they can perform this work at a better price due

to their greater experience. In turn, by bundling their capacity they operate far more effectively, reducing fixed costs without sacrificing quality. In addition, your own company can focus on its core competences.

Thus, a classical production company can concentrate on developing products, identifying customer needs and focusing production on these needs, without requiring a high level of value added. Studies have shown that as vertical integration falls, return on investment rises. The fewer the work stages performed by one and the same company along the value chain, the greater the profit in relation to the capital invested. As a result of the greater utilization of machinery at the outsourcing partner, the ratio of capital invested to output quantity decreases. In addition, the greater utilization of capacity also makes it possible to actually use the machines until the end of their technical service life. Due to the increasingly fast pace of innovation in products, machinery needs to be replaced more and more frequently, as the requirements on the machines change before they have actually been worn out. This tends to happen all the more frequently as their utilization drops.

So can the concept derived from the theory actually be implemented effectively in practice?

Prof. Dr. Hartmut Reinhard: Definitely. For example, well-structured companies set up best practice teams at sites, made up of people who have already successfully introduced lean processes. These are then sent to other branches to pass on their experiences there.

It makes sense that the team that analyzes the processes and workflows does not come from the local organization. Employees on site are often too connected to the site and are too subjective in their assessments. An external third party need not necessarily be included, but local objectivity should be ensured. For small and medium-sized enterprises that do not have diversity on sites or in different teams, the integration of external third parties may be required. However, such teams should always be comprised of a mixture of internal and external members. Thus, the internal members benefit from the specialist knowledge of the external members and vice versa, and an objective perspective is maintained. In addition, there is a far better transfer of knowledge and the knowledge remains in the company if the teams are dissolved.

What are the disadvantages of outsourcing, in your opinion?

Prof. Dr. Hartmut Reinhard: The biggest disadvantage is definitely the release of know-how in the course of outsourcing. It should also be clear that subsequent "insourcing," or bringing back activities and processes, can be rather difficult if you yourself have not been working in that area for years. There is also a risk that the outsourcing partner becomes insolvent. Aspects such as potential damage to your public image, etc., should also be taken into account.

4. Lean production techniques in practice

As a manufacturer of electrotechnical and hydraulic components, Eaton has been using lean production techniques at all of its sites for many years. The aim is to remove any and all kinds of waste as effectively as possible – in production as well as in administrative functions. All of these efforts are based on making the value chain more efficient – from customer orders to supplier orders and everything in between.

The power management company operates worldwide in accordance with the Eaton Business System (EBS), a standardized system that contains a "toolbox" of lean processes and techniques. Building on the Toyota production system – the grandfather of the lean production concept – Eaton has developed various tools and methods for implementing continuous improvements internally. This is known as the Continuous Improvement Framework (CIF).

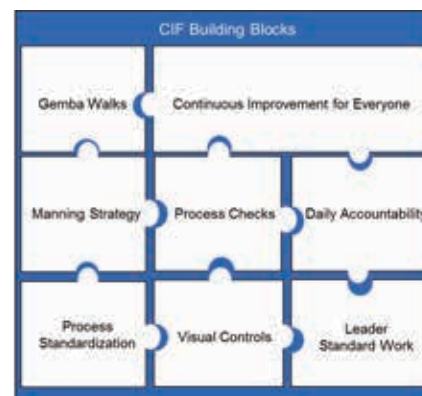


Image 5: The Continuous Improvement Framework (CIF) comprises of a variety of different methods and tools for implementing improvements.

4.1. Continuous improvement – processes and techniques

An in-house functional team ensures that the EBS is implemented at all sites in the EMEA region. Specialist continuous improvement teams, comprising of experts from the areas of Lean Manufacturing, Problem Resolution, Six Sigma and Logistics Performance Improvement, can be requested by plants and business sectors. They not only train the workers on-site but also introduce improvement projects, perform them and support employees on-site with their skills and experience. Another function, Network Design, specializes in analyzing and optimizing transport processes with a view to continuous improvement. The aim is to make the flow of goods as cost-effective as possible. To ensure that value is being created along the value chain, Eaton passes on to customers the experiences gathered internally in the Continuous Improvement function in the form of value-added services. Therefore, mutually overlapping business relationships can be established and the entire value chain optimized from the supplier to the end customer.

4.2. Rationalization potential realized

Numerous processes in logistics and production have been optimized through the use of various lean methods. Two examples show how great the potential for rationalization can be in some areas – with relatively little effort.

Circuit breaker assembly

In the production of fault-current circuit breakers, around 170,000 breakers are assembled every month on six manual lines in three shifts. The takt time per unit is around 10 seconds. In the past, the assembly stations had been supplied with the required material by three employees per shift, known as pitchers. Analysis with the methods of the Eaton Continuous Improvement Framework showed that these workers had to walk a long way during their shifts to bring materials from the warehouse to the stations some 30 meters away. The supply of materials was uncoordinated, meaning that two pitchers were often working on one assembly line at the same time. They often had just one container with the required materials with them. Despite the long lengths travelled

by the pitchers, there were constant downtimes on the assembly lines because materials were missing.

After an initial joint workshop and by using various methods, the pitchers were able to do their work with significantly greater efficiency. Today, instead of three employees for material supply per shift, only two are needed. This was done, for example, by introducing transport trolleys. As employees now no longer have to walk with single material containers, but can instead process several requests for materials in one go, around 90 percent of the distance previously walked is now no longer required. Each trolley has a fixed plan to supply the assembly stations with materials. Thus, assembly downtimes due to a lack of materials have been eliminated entirely.

Coil-winding test line

Thanks to lean methods, Eaton has also managed to increase productivity significantly when testing coils. Each test line was designed for three workers, who performed different work stages – from functional testing to packaging. The analysis by the Continuous Improvement Team deployed showed that an employee was constantly waiting for the upstream work stages. In addition, a risk of accidents was identified when replacing the respective test box. Thanks to a new layout of the workstations and a redistribution of tasks for the individual employees, the entire test process can now be performed by two workers instead of three. At the same time, the output of the test lines was increased by between 13 and 32 percent. In total, the various measures lowered costs by over 100,000 Euros a year.

5. Lean services – transfer of experience to customers

Companies able to acquire extensive know-how based on their own experiences in implementing lean production and continuous improvement processes are ideally placed to use this knowledge to benefit their customers. Therefore, the entire shared value chain can be optimized – from the supplier to the end customer.

5.1. The entire company at a glance

Best practices include starting the subject of lean production with a detailed review and assessment of the processes and workflows in the company – from the perspective of the supplier in collaboration with the customer. Thus, value stream mapping provides a good basis for all further measures to reduce waste. It is a tool for recording and illustrating the actual status of a process and also looks at the flow of information and materials. At the same time it highlights the various interfaces with customers and suppliers and between departments within the company. It is possible, therefore, to gain an extensive understanding of the workflows in a process or company. Sources of waste can be pinpointed, potential for improvement identified and lead times reduced.

It then makes sense to track the costs of a product or process that are not geared toward the quality, use, service life, look or selling power of the product as part of a systematic procedure, known as value analysis. To this end, the supplier/customer team can use creative techniques to eliminate unnecessary costs. The “outsider’s perspective” made possible by an external supplier’s team is particularly useful here.

The aim should be to develop products, processes and production organizations with the greatest level of efficiency (value engineering) or to redesign them accordingly. The suggestions and solutions for increasing efficiency are therefore always tailored to the specific needs of the client.



Image 6: In the course of value stream mapping, all kinds of wastes are identified

5.2. Measures for leaner processes

Value-added services can even start at the supplier’s warehouse: If the automation and energy distribution components ordered have individual labels and barcodes, they can be harmoniously integrated into the client’s logistics and production-planning system. This means that it is conceivable for labels to be printed with the customer’s own item names and/or numbers, logos or other wording, both for individual articles and bigger package units. In terms of shipping, the customer may also receive a delivery note. If the customer is not only informed of the shipment, but is also given detailed information about packaging size and weight, material, delivery note number and number of packages, he can allocate the required resources in time at his warehouse and schedule the components for production securely. In connection with shipment tracking, the customer is also always accurately informed about which ordered goods are currently where and in what quantity. The information can either be sent directly to the contact person in question or set up in the customer’s logistics portal.

5.3. The required components are supplied in a kit.

Kitting also substantially reduces the manufacturer’s workload and simplifies logistics processes. For example, all components required by a supplier for a machine or system module can be put together in a single box prior to shipment. The corresponding commissioning by the customer is therefore no longer required – the production worker receives one box directly at his workplace that contains all the items he needs for his task. Should the customer use system boxes in production, it is generally also recommended to have the articles ordered delivered directly in the desired containers. Thus, there is no need for unpacking at the customer’s warehouse. For bulk purchasers, an order for items required in large quantities in big packs is also worthwhile: Where it is possible to transport the goods without damaging them, they are delivered in boxes, large packages or on pallets. The customer can potentially reduce packaging waste substantially in some areas.



Image 7: The delivery of components in kits supports the processes within the company and also paves the way for lean production.

5.4. Pre-assembly reduces costs

Value services do not only simplify the customer's logistics processes but also extend into production. Some suppliers offer to have their products shipped preassembled, with the main products equipped with the accessories ordered by the customer at the logistics centers, for example. Fully wired assemblies and combinations of materials from external manufacturers can also add value to the value chain in some cases. On certain occasions, the supplier's services extend to complete sub-product groups which the supplier delivers constructed or on a profile rail, carrier or mounting plate, depending on the customer's specific requirements. In programmable devices, such as operating interfaces, controls or soft starters, the parameters, applications or data supplied by the customer can also be implemented immediately. For customers, these assembly stages are often only peripheral processes of their production system. For the component supplier's employees, however, the corresponding handling is part of their everyday routine. With this experience, they can manufacture the pre-assembled assemblies at a significantly lower cost than their customers would be able to.



Image 8: Thanks to pre-assembly, the focus can be placed on their own core competences.

5.5. Added value through an intelligent connection system

Additional potential for rationalization can also be realized using an intelligent connection and communication system such as Eaton's SmartWire-DT. Such a system does not require a conventional point-to-point connection to the control system to wire individual switching devices, sensors and drives: instead, all devices are connected via an eight-pole line with simple plug connectors. The cable supplies power to the connected devices while also supporting data communication. Simple automation devices such as motor-protection switches or circuit breakers can also be included in the data entry.

This also results in noticeable added value in terms of lean production. In Engineering for example, logical units can be planned more easily and more effectively, reducing the project design workload by up to 70 percent, while the wiring, testing and commissioning workload can be reduced by up to 85 percent during commissioning. Even during the ongoing operation the formation of functional assemblies in the field brings significant advantages when it comes to machine servicing and maintenance. If a fault occurs, the active parts of the assembly (drive and motor) are located right next to each other. The long routes between the switch cabinet and motor are eliminated. In total, a smart wiring system can provide a reduction of up to 30 percent in the life cycle costs of an electrical installation, from project design to servicing and maintenance. Most importantly, however, the data transparency achieved can improve diagnostics and maintenance, along with system availability and use of capacity.

Main area of potential from the perspective of	Supply Chain Mgmt./		
	Production	Purchasing	Design
value-added service measures			
Customer-specific labels/barcodes	x		
Kitting	x	x	
Customer-specific packaging/notification	x	x	
Pre-assembly (including wiring)	x	x	x
Intelligent wiring solutions	x	x	x
Pre-programming	x	x	x

Table 1: Relevance of value-added services for the different technical departments in a company.

5.6. Benefits for all business areas

Lean production has an impact on the value chain as a whole and thus affects every single department and every single employee in a company. However, the potential ways of making the value chain lean are different in each technical department. Thus, the value-added services are relevant to supply chain management, the production manager, purchasing or the designer in different ways.



Image 9: Lean production is the interface between all areas of a company and entire value chains.

6. Conclusion:

Lean methodology is a tool that allows business to be more efficient and focusing on what matters to customers most. The first point of call is to use the resource made available from the methodology and the second point is to use the experts that can support the business with their experience in lean process. At Eaton we can support you in your quest for Continuous Improvement through workshops that can look at opportunities of improvements.

Eaton aim to create customer partnerships and support the growth of our customers by providing solutions. Through an extensive range of Value Added Services we seek to streamline your production line and minimize waste in all its forms. The result is an alliance between Eaton and our customers, within which the entire value chain can be optimized for lean production.

Eaton is dedicated to ensuring that reliable, efficient and safe power is available when it's needed most. With unparalleled knowledge of electrical power management across industries, experts at Eaton deliver customized, integrated solutions to solve our customers' most critical challenges.

Our focus is on delivering the right solution for the application. But, decision makers demand more than just innovative products. They turn to Eaton for an unwavering commitment to personal support that makes customer success a top priority.

For more information, visit **eaton.eu**.



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