



REPORT

FCLT PROJECT | LEAN MANAGEMENT

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Lean management

The concept of Lean Management is mainly based on Western approaches of management, which have been incorporated into the Japanese philosophy of production. Henry Ford developed the assembly line production in 1913. He knew that the division of work can be increased if the employees stay at their working place and the parts to be assembled are passed on to the workers. The working rhythm was now determined by the assembly line and not longer by the workers. To increase productivity and make it more efficient, the work had to be standardized, simplified and designed new. The principles of Ford can be summarized as follows:

- workers and their tools should be arranged in order of execution. Thus, long distances are saved.
- the worker always remains in his place. The parts to be assembled are brought to the assembly line by the assembly line.
- the assembly line transports the assembly parts to the worker at the same intervals and in the required quantity.
- all processes are always performed with the help of the work division.

But thinking about Ford it is important to emphasize that ideas or principles respective his philosophy had also been there around for a long time (e.g. King Henry with his production of galley ships; Eli Whitney with manufacturing muskets; and Marc Brunel with production lines for the royal navy).

Taylor developed from the mass production of Ford rather a specialty. A reason for his development was that Fords' production lines were not flexible and there was a distance between the management that did the thinking and the workers that did as they were told. He divided the production area into direct and indirect production areas. Unskilled workers took only a few installations and were led by qualified employees. In order to continually improve the work process, inspectors were busy discovering errors in material supply and processing. At Taylor, therefore, the process as a whole was constantly analysed. The focus was on avoiding waste and making the work as easy as possible. With the savings, wages were increased or employees trained.

This has allowed to specialize workers and expand the assembly line production. Fords' mass production changed into a flexible mass production, which had prevailed in Europe until the late 1950s; at Renault, Mercedes or Volkswagen. With these ideas, Toyota continued to work. Toyota wanted to overcome the disadvantages of mass production, such as the high stocks of semi-finished and finished products and the high costs. The aim was to produce only on the basis of received orders. It is important to mention that they saw their principle by visiting supermarkets. They recognize that the shelves only got replenished when customers removed products, enabling the supermarket to purchase only what the customers were buying and therefore minimizing their stocks. This resulted in a demand-oriented production, which, however, required a reduction in the throughput times. The developed production system is now referred as the Toyota production system (TPS). This is not just a production system, but rather a philosophy for avoiding waste. For better understanding of the TPS it is necessary to look at the key statements of the creator Taiichi Ohno:

- "The basis of the Toyota production system is the absolute elimination of waste."
- "Cost reduction is the goal."
- "After World War II, our main concern was how to produce high-quality goods. After 1955, however, the question became how to make the exact quantity needed."

Combining his statements, the definition of TPS can be "the TPS is a production system which is a quantity control system, based on a foundation of quality, whose goals is cost reductions, and the means to reduce cost is the absolute elimination of waste."

Furthermore, a lean process (TPS or another) is characterized by a flow and predictability that severely reduces the uncertainties and chaos of typical manufacturing plants. This results in the fact that it is not only financially and physically leaner but also emotionally leaner than non-lean facilities. The emotionality leads to the aspect that people work with a greater confidence, with greater ease, and with greater peace than the typical chaotic, reactionary manufacturing facility.

A main fact for establishing the TPS was the recognition of the importance of involving their entire workforce in making improvements. Furthermore quality and respect for their people became very important and they developed the concept of Just-in-Time (JIT) together with Jidoka, which are forming the two main pillars of TPS. As part of a study conducted by the Massachusetts Institute of Technology (MIT), which was carried out in the 1980s, the researches of the automotive industry created principles for a development and production system called lean production. These principles could be applied not only to the production areas, but to all areas of company service provision.

Lean principles

The Lean principles show how increased performances are achieved while reducing the effort. The principles help to recognize the value of the product and organize activities that are value-adding in the best possible order. With help of the principles all corporate activities should be carried out without delay and increased efficiency.

Value

The basis for analysing production processes is the first lean principle, the determination of the value. The value can only be defined by the end users view of the product. Customers prefer products that are developed according to their imagination. However, companies often define the value only through production and construction. It is important to produce under the consideration of local needs and to supply the products directly.

Defining the correct value is difficult because the ideas of companies and customers are often very different. The companies want to produce products they have always produced. Customers would like to have different variants offered. In this way, companies are relying on measures such as increasing product diversity to meet customer requirements, direct delivery and low costs in order to determine or increase the value. Instead, they should consider the value together with the customers and analyse what exactly is desired. Companies need to find ways to get in touch with their customers. After completion of the product definition, the target costs are determined. For this purpose, all costs must be determined in the adjusted production process. All visible waste has already been eliminated. Subsequently, the selling price can be determined on the basis of the current market situation. Companies that operate value-added are looking for bundles of product features and prices offered by competing companies in the market. In order to be competitive in the market, the company can discover the reduced costs of using the Lean principles. The aim is to eliminate all obsolescent processes and waste. Because the customer does not consider e.g. waiting, reworking, and a lot of other wasteful things to be something that he should pay for. Thus, it is possible to set target costs that are well below the cost of the competitors. The savings, resulting from the application of Lean principles, can be reinvested by the companies. For example, the product price can be lowered to increase sales. New services can be added to the product so that additional value and jobs can be created. An increase in sales could also be achieved by expanding the service and distribution network. It is also possible to create a new product with the savings achieved in order to increase sales in the long term. If the target costs are fixed, all further steps can follow. This means that as soon as the value has been determined, the value stream for order processing, production and product development can also be checked.

In summary, it is important to note that the specification of value is the key foundation for lean management. It is definable by the wishes of the customers and characterizes a specific service to meet customer needs. Specifying the value requires a comprehensive orientation to the customer in order to reveal customer problems, objectives and intentions. This is the only way to avoid waste and to carry out a continuous improvement process.

Value stream

The value stream is determined by analysing all operations for the production of the product (the value). In order to streamline operational processes, the current value stream is first identified. This creates transparency across all process steps and makes waste visible. In order to derive change, it is important to always consider the value stream taking account of customer wishes. During the current recording, two types of waste are visible. This is, on the one hand, the waste, which can be eliminated immediately. This includes unnecessary inventory, overproduction or out-dated and unclear work instructions.

On the other hand there is the inevitable waste that is based on current technologies (e.g. machine failures). The current state of the value stream is derived from the target state. The generation of an optimal value creation process from the point of view of the customer is striven for and necessary measures for the streamlining of the production process, which is defined. Furthermore, it is important to look at both the value-adding and the non-value-adding steps, which make up every process. The Lean principles are enabling it to remove or minimize those non-value adding steps. Moreover it is important to look at the value stream from the point of view of the product (the value) and not to look at individual departments or even companies. (Value stream mapping is a possibility to do this.)

The analysis of the value stream can go beyond the investigation of own production.

Flow

After the company has accurately defined the value, recorded the value stream for a particular product, and eliminated unnecessary steps, the next Lean principle can be applied. The value-generating processes are now to flow. This means that tasks can be carried out more precisely and more efficiently if the product is continuously processed from the raw material/product to the finished product. Work steps are more effective when the product and the product needs are at the forefront. The aim is to achieve a continuous flow, which includes all necessary work steps for the order processing, provision of a product or the construction. Creating a flow is unfamiliar to many companies. Still, most companies organize the work departmentally. In order to make an optimal contribution to the value-added process, the work of the departments and the defined functions have to be redefined. The fact that the value stream flow constantly requires a personal interest of the employees leads to the necessity to take the needs of the employees into account.

A flowing value stream means an expiration without unnecessary movements, without queues and without interruption. To achieve this, many changes are necessary (for example, in the nature of cooperation, in the organization, and also in the career pursued by employees). To allow flow, three steps are required:

1. The concentration of the work organization is based on the actual object, the specific construction, the specific order and the product itself.
2. The limits of careers, functions and jobs are ignored. These are traditional and allow only limited value-oriented work. If these organizational barriers are overcome, a continuous flow of the product is possible and the work organization can concentrate on the actual object.
3. Work practices and tools have to be considered. In order to continuously improve the design, ordering and production, the rejects, standstill and reflux have to be avoided.

Companies can use this lean principle for every task of their company. The approach is always the same.

Basically it should be noted that after the value analysis and the avoidance of non-value-creating workflows the value stream has to flow. The departmental thinking is replaced by the flow orientation of the value-adding processes. The continuous improvement of processes in the value stream requires a management system such as Management by Objectives or Balanced Scorecard. Key to these strategies is the management of the employees.

Pull

After the value and the value stream has been determined and has been made to flow, the pull principle now comes closer, with the goal of the best possible customer orientation. The

manufacturing process is rolled up from behind. The control flow starts at the end of all processes with the task of executing an incoming customer request. To this end, a check is carried out to determine which process is connected to the customer to make the output available to the customer. This process goes backwards in the process chain, until a predecessor process, where input is no longer required. Then the workflow starts in the process chain. This creates a material flow, which counteracts the flow of information. Pull describes a system in which no work process starts without an internal or external demand being received (ideal system). The required demand is real and only services are produced that are directly requested. This is all done at an agreed time.

An instrument for implementing the pull system is the supermarket. The approach of the customer is going to the supermarket and taking as much as needed. The delivery process produces just as much as it was previously taken by the approach of the customer. This makes it possible to control the complete production without first setting up a production plan.

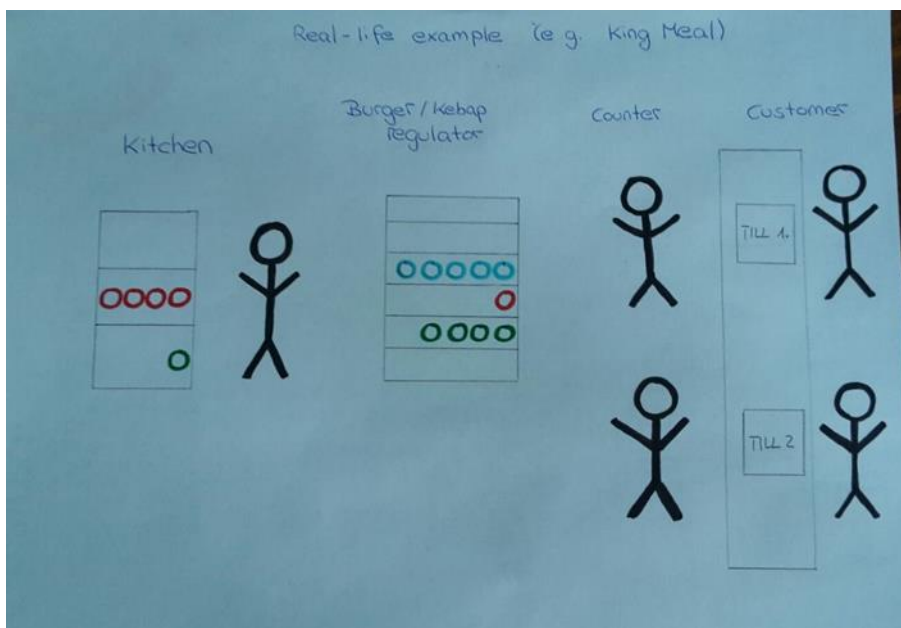


Figure 1. Real-life example

Description:

1. As each burger or Kebab is consumed ...
2. They are removed from the regulator ...
3. And then replenished by the kitchen staff

→ Not made to a forecast and pushed at the customer!

(Striving for) perfection

The previous four principles are to be constantly optimized by the principle of perfection. This means that the entire process flow is continuously optimized.

It is clear that perfection remains unattainable because there will be always an optimization needed. A continuous improvement of the work processes is necessary, since the conditions change again and again.

In order to uncover the need for improvement, a very high transparency in the company is required. Quality levels that have been achieved must also be ensured, as well as work processes that are standardized. Perfection, of course, also includes the avoidance of waste and reactive power. Perfection means to deliver exactly what the customer wants, when they want it at an acceptable price with zero waste. When striving for perfection it is important to involve every employee within your company in implementing lean tools such as Kanban and Kaizen to drive continuous improvements of each and every aspect of your company.

The attention should also be paid to the solution of small problems. Only when all problems are eliminated, the pursuit of perfection can work. Many small problems can also grow into a very big problem.

Methods

Standardization

To achieve one of the main goals of Lean Production, the continuous improvement, it is important to standardize the work steps. According to Brunner, this standardization is the basis for continuous improvement and the transfer of responsibility to individual employees.

At Toyota, standardization is one of the foundations of the entire production system. Standardization is a detailed description of every single process in the process chain of automotive production. The workflows for the creation of an automobile are determined at Toyota with the aim of optimizing human movements. If this optimal sequence of work steps is documented on relevant worksheets and is suspended during production, it is assured that the work steps are always carried out in the same order. Waste in the form of unnecessary movement is avoided.

However, under standardization in Lean Production, it cannot be understood that employees are treated as machines that only perform simple activities. If the standardization is applied correctly in a company, it is a necessary step to lay the foundation for flexibility. It also gives employees the opportunity to develop new skills and find more variety in the workplace.

The standardization of production at Toyota is much more than the documentation of the order of operations that an employee has to carry out. Liker describes three elements that make up Toyota's standardized work. The standard of a task is determined by the cycle time, the sequence of the work steps, and the area for small parts storage. At Toyota, the descriptions of the standardized tasks are displayed, but they are not in the direct view of the line workers. The workers should have internalized their tasks without having a look at the description. The notices of the work description serve to enable team and group leaders to check whether they are respected.

In principle, standards ensure that work steps are carried out in the same way independently of the executing person. The purpose of standardization is to achieve standard work, which ensures that the most efficient, and least wasteful ways of doing, are performed in a repeatable manner (e.g. through standard operating procedures SPOs). Standards are not static, but are constantly being further developed by the team. If individual processes are optimized, the standards are also adapted, which as new conditions represent the starting point for improvements. Furthermore, standards play an important role in flexible staffing. Workers can easily switch between individual tasks. This gives companies the opportunity to react quickly to demand fluctuations and thus increase their productivity. All negative deviations from these standards are losses and wastes, which must be steadily reduced.

The example of the world famous companies Burger King and McDonald's shows what can be achieved with standardization. Only through the standardization of their products McDonald's and Burger King gain a leading market position. Burger King and McDonald's are synonymous with standardized products. Whether you buy a burger in Berlin, Las Vegas or Helsinki, quality is always the same. The standardization of all the factors of the process and of all process steps makes this system working.

Teamwork

The second, essential component of Lean Production is the teamwork. According to Liker, a team consists of five to eight workers and is led and supported by a team leader. The team leader also ensures to meet the production objectives and ensures that the standard procedures are being followed. The team leader reacts and helps immediately if a line worker has a problem.

By combining employees in teams, which are then responsible for a clearly defined range of work, employees are having a higher identification with their work and a greater commitment.

Teamwork is used in lean companies at various levels. On the one hand, the team concept is a corporate culture that attempts to achieve harmony between management and the workforce. On the other hand, the team concept also includes relationships with suppliers and dealers, which are characterized by close and forward-looking cooperation. The team concept in lean companies also refers to the three fields of application of product development, quality circles and workgroups in manufacturing.

Work and sport have many similarities (e.g. with a rowing or a football team). First of all the team spirit decides about victory or defeat and not the individual star of the respective team. Ohno transfers this team spirit to the production of a product. According to experience, ten up to fifteen employees are necessary to process the required raw material into a final product. In this case, the collaboration of the team determines how many products can ultimately leave the assembly line as a whole and not how many parts have been processed by a single employee.

In summary, teamwork has three main advantages: problems can be solved quickly and effectively in a team because the individual team members can support each other in case of disruptions and have a wider knowledge base. Furthermore, teams organize themselves by catching up in case of production loss caused by a disruption. The third advantage is the considerable reduction in complexity, for example in product development. In the case of teamwork, an effort reduction, possible loss of time or conflicts within the team can have a negative effect on the result.

Production – related

Just-in-time (JIT)

Definition and development of the just-in-time philosophy

The term Just-in-Time (hereinafter referred to as JIT) refers back to the Toyota production system and was developed by Taiichi Ohno. He thus created a base for the Toyota production system. It means that in a flow process the parts required for assembly arrive at the right time and in the required quantity on the conveyor belt. A company that uses this flow of parts continuously can approach a zero stock level.

According to this definition, JIT is a philosophy of material logistics. Part of this philosophy is to optimize the flows of production holistically and not just individual functional areas such as, for example, to look at the logistics. JIT also includes production in the sense of the considerations. In this case, production is geared to output without material buffer and additionally to customer requirements.

The small sales market and the lacking capital of the Toyota Motor Company form a framework, which leads to a reduction in the production depth. The greater involvement of the suppliers

created a special relationship between them and the main producers. From this close relationship, the JIT delivery came into being, which has now been partially developed in such a way that suppliers deliver directly to the assembly line of the automobile manufacturers.

In general it can be said that JIT is a management philosophy that calls for the production of what the customer wants, when they want it, in the quantities requested, where they want it, without being delayed in inventory (technique of supplying exactly the right quantity, at exactly the right time, and at exactly the right location). Therefore a company only produces exactly what the customer actually asks for instead of building large stocks of what the company thinks the customer might want. Enabling to concentrate the resources on fulfilling what the company is paid for rather than building for stock, because each process will only produce what the next process in sequence is calling for.

Functional principle of just-in-time logistics and production

Characteristic for the JIT philosophy is the new view of storage. In traditional approaches to production planning, inventories are accepted even though they are associated with costs and capital commitment. However, they enable a continuous production flow as buffer or safety stocks. Within the framework of the JIT philosophy, the disadvantages of warehousing are to be avoided. In addition to capital commitment and costs, the reduction of flexibility, the increase in throughput times, and the obscuration of planning errors by inventories must be mentioned. A reduction in inventories is only achievable if the procurement and the production process can be restructured.

By reducing inventories, a continuous supply is required by both external and internal suppliers. However, this reduction in stocks leads to a lack of safety due to the lack of buffer stocks. In 2007, a strike of the train drivers in Germany revealed a weakness of this system. The interruption in the supply chain led to considerable production losses in the automotive industry, as the small buffer inventories were very quickly used up. These weaknesses were recognized very early in Japanese industry and were reacted by the introduction of the Kanban system, which is discussed in more detail in the following chapter.

By reducing inventories, it suggests itself to consider the JIT philosophy beyond the company. If, in the case of a JIT procurement of the individual parts, a larger incoming goods warehouse is omitted by dispensing with extensive quality controls, a direct delivery to the place of production, for example the assembly line is possible. This would be very close to the JIT philosophy in logistics and procurement. In order to achieve this idea, the respective suppliers have to adjust the production to the customer's requirements and ensure a consistent quality of the delivered parts. In addition, JIT procurement is subject to a higher risk of a delay in delivery, as the example of the locomotive in Germany has already shown. Production difficulties or a deteriorating quality at the supplier can lead to problems in their own production.

JIT suppliers are usually characterized by proximity to the customer, as the delivery of materials is often carried out once a day or even hourly in the automotive industry. Advantages of this spatial proximity are reduced transport problems, shorter transport times, higher response speed as well as better tuning possibilities.

JIT production is a core component of the JIT philosophy, but it is not so widespread in comparison to JIT procurement, since it requires a fundamental change in the way of thinking. A changeover to the JIT production requires a shift from the push to the pull principle, an alignment to customer requirements and the production of small lots in the customer clock.

In order to achieve the most important goals in JIT production, the reduction of throughput times of products and the reduction of inventories, the processes have to be optimally structured. The most important strategies for this are, according to Hansmann, e.g. the reduction of set-up times, the production of smaller batch sizes and the harmonization of material requirements.

The order-related production related to JIT only works with certain capacity reserves, as sudden demand expansion leads to capacity constraints. All in all, the JIT production has to be subject to a capacity harmonization, since an even level of utilization can eliminate permanent deficits and the essential goal of reducing the throughput times can be achieved.

Benefits	Main Risks
<ul style="list-style-type: none"> • reduction in the order-to-payment timeline • reduction in inventory costs • reduction in space required • reduction on handling equipment and other costs • lead time reductions • reduced planning complexity • improved quality • productivity and flexibility increases • problems are highlighted quicker • employee empowerment • reduction in throughput times • shorter delivery times 	<ul style="list-style-type: none"> • delays in delivery • production stops

Following requirements are needed to gain those benefits:

- reliable equipment and machines
- well-designed work cells / work stations
- standardized operations
- pull production
- single piece flow
- flow at the takt of the customer
- quality improvements

Kanban

Definition and prerequisites of Kanban

Kanban was also developed by Taiichi Ohno and is used at Toyota as a tool to operate the Toyota production system as a pull system. In most cases, Kanban is a printed card, sealed in a plastic envelope that displays information about the part description, supplier, installation location and transport volume per container in the form of letters, numbers and bar codes. This paper transmits the contained information vertically and horizontally within Toyota to its suppliers.

The following figure shows an example of such a Kanban card.

Part Description				Part Number	
Conveyor belt				196819	
Quantity	10	Lead Time	2 weeks	Order Date	26.02.2017
Supplier	Finnish Company Ltd.			Due Date	12.03.2017
Planner	Maier.Y	Card 1 of 2			
		Location		Rack 2710	

For the introduction of Kanban it is not sufficient to have understood only the basic ideas and basic functions. First of all, the prerequisites must be recognized and established through appropriate measures. The ideal conditions for implementing Kanban are:

- regular demand from the customer
- low product variation
- clear flow
- small dedicated machines
- quick changeovers
- repeatable and reliable processes
- reliable suppliers

Taiichi Ohno took over the idea of the Kanban system from the supermarkets during his visit to the US. The transfer of the supermarket principle to the functional principle of the Kanban is explained in more detail in the following section.

Functional principle on the Kanban

If Kanban were introduced in a supermarket, the following scenarios would be applicable. An item is bought. Tickets with the information on the type and quantity of the items sold would then be sent to the purchasing department, who use this information to purchase new items. These cards correspond to the so-called removal Kanban of the Toyota production system. If the supermarket had its own production facility nearby, there would be the production Kanban next to the removal Kanban, which would not be transferred from the supermarket to the purchasing department but to the production department. The supermarkets have not gone that far, but Taiichi Ohno already took over this system in his factories at Toyota in 1953.

Transferred to the world of production logistics, this supermarket approach means that when only 10 units of an article are consumed, only that quantity of material has to be delivered. The impulse for the Kanban principle is triggered by forwarding the Kanban to the logistics department. When a new material container is opened, the employee removes the enclosed Kanban card and displays it visibly for the employees of the in-house logistics department. Those take the Kanban cards during their supply travel through the storage lanes between the assembly lines and thus dispose the further material order. The Kanban card then returns to the internal or external supplier, where the ten units removed are newly produced.

The already described concept of the pull principle is derived from pulling the materials from the customer or consumer.

In addition to the Kanban card already described, there are further elements for the transfer of information in the Kanban system. In the pipework construction at Toyota, for example charge carriers with large and heavy body parts by means of an electronic signal, which is requested by E-Kanban. Modern production systems are often dependent on the use of information technologies such as the E-Kanban due to their complexity and diversity of variants. Since this

is usually only possible via the integration into the PPS system, various solutions for the integration into the PPS system are offered by various software manufacturers. In principle, however, almost every transport medium can be used as an order carrier for the Kanban system, such as for example Charge carriers, crates or carts. In addition Kanban panels are often used, with the aid of which individual Kanban cards can be collected. These panels allow for the display of the economic lot sizes by means of an exemption. Similarly, by using a release area, a levelling of capacities can be implemented.

There are rules for the use of each tool, so also for the correct use of the Kanban system. When properly handled, it can be a very effective means of achieving the goals. Conversely, it can cause very great disturbances in the production process in case of incorrect handling. This is why Takeda considers it essential to comply with the following eight rules:

- each transport medium includes a Kanban,
- when the first part is removed from the container, the Kanban comes in the letterbox,
- the downstream process retrieves the parts during the upstream process,
- it is produced in the order in which the downstream process pulls
- it is only produced as much as can be used from the downstream process.
- as soon as parts are missing, must provide information to the upstream process

Respectively,

- the Kanban cards must be managed by the department in which they are used
- the Kanban cards must be treated as cash.

Finally, he defined the special rule that no bad parts may be passed on.

Advantages and disadvantages of Kanban

If a company complies with the rules described above, the Kanban system has some advantages. The most important advantage of the Kanban system is the avoidance of the already mentioned overproduction. It should be only produced material, which is also required. Other advantages include the simple determination of the current material stocks, the reduction of the throughput times, the possible control without a computer system, customer orientation by the pull principle, and the standardization of simple processes.

However, the advantages of the Kanban system can only be achieved with flow-oriented production of homogeneous products. In the case of workshop production, in particular in the case of heterogeneous small batches, the implementation poses considerable problems because demand is not constant and the production process often proves to be susceptible to faults.

The main disadvantage result from the low buffer stocks in production. If faults occur, production delays or standstills can follow very quickly at the downstream production sites. Variations in the production quantities cannot be controlled by an increase in lot sizes, but merely by an increase in the frequency of deposition of the materials. This can usually only be achieved by working overtime.

Jidoka

It is a series of cultural and technical issues regarding the use of machines and manpower together. Furthermore it utilizes people for unique tasks (they are able to perform) and allows the machines to self-regulate the quality. Jidoka uses tactics such as poka-yoke (methods of fool proofing the process), andons (visual displays such as lights to indicate process status especially process abnormalities), and 100 percent inspection by machines. This results in the fact that no bad parts are allowed to progress down the production line and it is supported by a culture focused on real-time problem solving. This aspect is not only necessary to protect the customer and reduce scraps, it is also a continuous improvement tool and is a key element in

making Kanban work. Moreover it is a violation of Kanban rules to allow bad parts to be transported.

Poka Yoke

This is a Japanese phrase, which means to avoid unfortunate errors. It is a concept/principle which consists of several elements that encompasses technical provisions for an immediate error-revelation and error-avoidance.

Quality-related methods

Kaizen

Kaizen has its roots in Japan and is made up of two terms. "Kai" means improve or change and "Zen" corresponds to the English word for good. Kaizen is a Japanese philosophy of life and work, focusing on the constant, systematic and gradual change for the better. It aims at the prevention and identification of errors and inefficiencies within the company. It can be said that it is a concept of making continual product and process improvements usually small and typically done by the entire workforce.

Kaizen is based on the principle of small steps and the observation of small moments, which in sum can lead to great successes. In Japan, the term kaizen is synonymous with continuous improvement in these small steps. However, Kaizen is not a method that can be used to solve problems. It is rather seen as a process-oriented way of thinking in the sense of an inner attitude, which at the same time includes goals and essential behaviour in the company. In economics, Kaizen means that all employees are constantly working to optimize business processes. They perform this optimization as an individual for their own workplace, in the team for the extended teamwork area and in the company organization for the optimization of systems and processes.

Kaizen seeks to eliminate problems associated with the wastes inherent within the processes, not just the tradition seven wastes or Muda, but also Mura (unevenness) and Muri (overburden.) The view of any process should be that it is wasteful unless you cannot find a way to eliminate it or do it in a more economical way, everything should be continually challenged and tested.

An internal document from the Toyota Motor Company shows that for Toyota the biggest sign of strength is when an employee responds to an error, assumes responsibility, and suggests how the mistake can be avoided the next time.

More precisely, Kaizen as seen by the Japanese (especially Toyota as part of the Toyota Production System) is a method of involving the workforce to come up with many ideas for improvement, each employee is expected to come up with and implement 3 to 5 improvement ideas each and every month. The power of this method is not in the individual small improvement but in the combined power of many hundreds of small improvements moving the business forward constantly.

These ideas and the many improvements are expected in every area of the company from suppliers through to customer delivery and from assembling line workers upwards to CEO. Every area and every process requires to be constantly improving if a company is to constantly cut costs, improve quality and produce products and services quicker and thus win and keep business.

The most commonly used approach in improving and correcting is the 5W method.

The 5W method works in the way children try to find a reason for a phenomenon by repeatedly asking why. A problem question always follows a clear answer. This is done until a new question is answered. The comprehensive questioning leads systematically to the roots of a problem. Few questions and premature answers, on the other hand, usually do not provide the true or complete cause of the problem and require a new approach to the problem.

However, the number of questions plays a subordinate role, since it is important to ask for the reason of the problem. The solutions must go as far as possible down to the lowest level of the cause of the problem, to prevent that the problem will happen again.

Since the early 1990s Kaizen has also been practiced extensively in Western industrialized countries. In the German-speaking industry, Kaizen is often associated with „betriebliches Vorschlagswesen“ or „Ideenmanagement“. In many companies, Kaizen is also anchored in quality management systems under the concept of a continuous improvement process. However, the Western industrial companies often could not achieve the same results as the Japanese example Toyota. The reasoning was already mentioned at the beginning of this chapter. Kaizen is a Japanese philosophy that is closely associated to the Japanese mentality to perfection. The pursuit of perfection in Japan is a fundamental life setting and, consequently, the meaning and purpose of the Kaizen. It is not just a tool to be applied.

Total quality management

The difference between knowledge and wisdom plays an important role in the understanding of Total Quality Management (TQM). Imai represents knowledge as a commercial asset by stating that knowledge can be acquired through books or seminars. However, this knowledge remains absent if it is not implemented in action. In accordance with Imai, wisdom can be acquired through practice.

The customer is the focus of the TQM approach. This approach also includes all functional areas and employees of a company. According to Werner, quality is achieved when the company's services are suitable to meet specific customer requirements. This means not only external customers, but internal customers as well. These internal customers are the employees of other departments.

In addition, the focus is to increase customer satisfaction, the desire to be able to compete in the competitive market and to gain competitive advantages. The concept of quality refers not only to the end products or the services provided. It also refers to the business processes, the relationship to the environment and the working conditions. The focus is to constantly increase the efficiency of the company. A significant role is the continuous improvement of business processes.

On the road to customer satisfaction, the TQM concept has the following content:

- showing clear corporate principles,
- definition of company strategies to improve the quality management,
- determination of organizational responsibilities,
- development of a quality assurance system,
- training of employees.

Quality is thus not only a task of the quality assurance department. TQM is a concept that involves all employees and all the functions of a company and is understood as a method of a comprehensive corporate philosophy. This concept is often measured using DIN or ISO standards, which certify the entire company.

According to Hansmann, the pursuit of the explained TQM concept has in addition to the competitive advantages that result in a higher market share and an improved profit situation, further strategic advantages for the company. On the one hand, a high quality of the products and services offered usually results in more intense customer loyalty. On the other hand, a high quality leads to cost savings since no rework of defective products has to be carried out.

Seven wastes

Overproduction: Overproduction waste results from producing more or faster than required. It is the worst kind of waste because it causes other wastes and obscures the need for improvement. Overproduction is caused by large batch sizes, unreliable processes, unstable schedules, unbalanced cells or departments, and working to forecast / inaccurate information and not to actual demand. Overproduction can be avoided by balancing supply and demand.

Waiting: The waste of waiting time is any idle time produced when two interdependent processes are not completely synchronised and includes also the waiting for information, parts, and machines. It can result from poor man or machine coordination, long changeovers, unreliable processes, stock outs, and machine failures.

Transportation: The transportation waste is material movement that is not directly associated with a value adding process. Therefore processes between processing steps and processing lines should be as close together as possible and the material flow from process to process should be

directly without any significant delays in between. This waste can be caused by large distances between operations, lengthily or complex material handling systems, and multiple storage locations.

Over-processing: With over-processing is meant putting more into the product than is valued by the customer. Choosing poor processing equipment or inefficient processing equipment increase this waste also. Clear and standardised instructions avoid over-processing.

Movement: The waste of motion is any motion of people or equipment that does not add value to the product or service. It is caused by poor workstation layout, which means for example excessive walking, poor method design, and poor workplace organization. Work design and workstation design are key factors here.

Inventory: Inventory waste is stock in excess of the requirements necessary to produce goods or services Just-in-Time. All inventories (raw materials, WIP, or finished goods) are waste unless the inventory translates directly into sales.

Making defective parts: This waste of correction includes additional work performed on a product or service. Those defects can be caused by inadequate training, skill shortage, incapable processes, operator errors and transportation.