Basics in Lean Management

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The Toyota style is not to create results by working hard. It is a system that says there is no limit to people's creativity. People don't go to Toyota to "work" they go there to "think".

Taiichi Ohno (1912–1990)

1.1 Definition of Lean Management

Lean management is a modern concept for process optimization throughout the value chain (Helmold and Samara 2019). Lean management is focusing on making inefficiencies (waste) transparent and on altering these into value-adding activities (Ohno 1990; Helmold and Terry 2016). The value chain reaches in this context from the upstream (suppliers) over the own operations to the downstream side (customers) (Slack et al. 1995). Inefficiencies are everything, e.g. an activity, a process, and a product, which is considered as something for which the customers are not willing to pay for or to spend financial means. The customer is the central point in the lean management concept. The primary objectives in the lean management philosophy are to create value for the customer through the optimization of resources and create a steady workflow based on real customer demands (Ohno 1990). It seeks to eliminate any waste of time, effort, or money by identifying each step in a business process and then revising or cutting out steps that do not create value (Bertagnolli 2018). The philosophy has its roots in Japan and operations, but is presently widely spread across the world and industries. Lean management focuses on:

- Putting the customer into the focus of operation
- Defining value and value-added from the standpoint of the end customer
- Eliminating all waste in all areas of the value chain

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- Continuously improving all activities, processes, purposes, and people
- Putting the people into the centre of value-adding services and processes

Lean management facilitates shared leadership and responsibility; continuous improvement ensures that every employee contributes to the improvement process. The management method acts as a guide to building a successful and solid organization that is constantly progressing, identifying real problems and resolving them.

Lean management is based on the Toyota production system which was established in the late 1940s. Toyota put into practice the five principles of lean management with the goal being to decrease the amount of processes that were not producing value; this became known as the Toyota Way. By implementing the five principles, they found that significant improvements were made in efficiency, productivity, cost-efficiency, and cycle time. Lean management incorporates five guiding principles that are used by managers within an organization as the guidelines to the lean methodology (Helmold and Samara 2019). The five principles are:

1. Identify value in all process of the value chain.
2. Conduct value stream mapping.
3. Create a continuous workflow.
4. Establish a pull system in which the customers are the focus.
5. Facilitate a continuous improvement culture.

Identifying value, the first step in lean management, means finding the problem that the customer needs solved and making the product the solution. Specifically, the product must be the part of the solution that the customer will readily pay for. Any process or activity that does not add value, meaning it does not add usefulness and the customer is not willing to pay for it, importance or worth to the final product is considered waste and should be eliminated (Liker 2004).

Value stream mapping refers to the process of mapping out the company's workflow, including all actions and people who contribute to the process of creating and delivering the end product to the consumer. Value stream mapping helps managers visualize which processes are led by what teams and identify the people responsible for measuring, evaluating, and improving the process. This visualization helps managers determine which parts of the system do not bring value to the workflow (Slack et al. 1995).

Creating a continuous workflow means ensuring each team's workflow progresses smoothly and preventing any interruptions or bottlenecks that may occur with cross-functional teamwork. Kanban, a lean management technique that utilizes a visual cue to trigger action, is used to enable easy communication between teams so they can address what needs to be done and when it needs to be done by. Breaking the total work process into a collection of smaller parts and visualizing the workflow in this regard facilitate the feasible removal of process interruptions and roadblocks.

Developing a pull system ensures that the continuous workflow remains stable and guarantees that the teams deliver work assignments faster and with less effort. A pull system is a specific lean technique that decreases the waste of any production

process. It ensures that new work is only started if there is a demand for it, thus providing the advantage of minimizing overhead and optimizing storage costs.

The last principle is the continuous improvement and can be regarded as the most important step in the lean management method. Facilitating continuous improvement refers to a variety of techniques that are used to identify what an organization has done, what it needs to do, any possible obstacles that may arise and how all members of the organization can make their work processes better. The lean management system is neither isolated nor unchanging, and, therefore, issues may occur within any of the other four steps. Ensuring all employees contribute to the continuous improvement of the workflow protects the organization whenever problems emerge. Management has to create an environment and culture, in which all employees can work in line with the five principles (Ohno 1990; Bertagnolli 2018).

1.2 Lean Management Versus the Traditional Concept

In contrast to the traditional manufacturing concepts, the lean production is based on a reduction of throughput times, low inventories, and the permanent elimination of non-value-adding activities throughout the value chain (Ohno 1990). These (non-value-adding) activities are unnecessary and represent waste or "muda" (Japanese = 無駄).

Figure 1.1 shows the two concepts, the traditional and the lean one. Both concepts are directed towards customers. The lean management concept's foundation is based on the optimal reaction capability and not based on inventories. Inventories increase the cost of capital and have negative impacts on the shareholder value, whereas short cycle times lead to small inventories. Lean manufacturing or lean production, often simply "lean", is a systematic method for the elimination of waste ("muda") within a manufacturing system. Lean also takes into account waste created through overburden ("muri") and waste created through unevenness in workloads ("mura"). Working from the perspective of the client who consumes a product or service, "value" is any action or process that a customer would be willing to pay

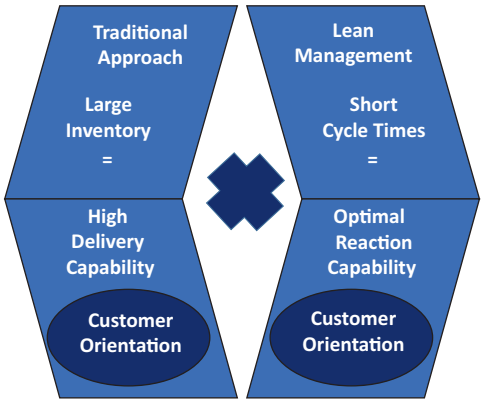

Fig. 1.1 Lean management versus traditional concept. (Source: Author's source)

for. Essentially, lean is centred on making obvious what adds value by reducing everything else. Lean manufacturing is a management philosophy derived mostly from the Toyota Production System (TPS) (hence the term Toyotism is also prevalent) and identified as "lean" only in the 1990s. TPS is renowned for its focus on reduction of the original Toyota seven wastes to improve overall customer value, but there are varying perspectives on how this is best achieved. The steady growth of Toyota, from a small company to the world's largest automaker, has focused attention on how it has achieved this success.

The key to acquiring and keeping customers is by offering value. To do this, we must first understand our customers and what they are willing to pay for – this is what we call "value". By definition, everything else is waste, diminishing value to the customer and reducing profitability. Put simply, lean thinking (or Toyota Way トヨタウェイ) is delivering value from the customer's perspective and eliminating waste (or muda 無駄). Lean is the combination of the five aforementioned complementary, interconnected principles, each geared towards increasing value to the customer by improving efficiency. By applying these simple principles, any business in any sector can not only provide a better service or product to their end users but also make fundamental, sustainable improvements in profitability. The Toyota Production System (TPS) has been adopted by many companies in all sectors on a global scale. The TPS has been applied by many OEMs in automotive industry, railway area, and other business sectors. Bombardier Transportation is applying the Bombardier Operations System (BOS), Porsche the Porsche Production System (PPS), and Daimler the Daimler Production System. However, it is not always successful, as the activities are only partially introduced and not rolled out in total. Secondly, lean principles are not synchronized with the supply side and may thus not show the desired effects and results. It does not make sense to establish only single lean instruments. It is of the utmost importance and a fundamental aspect of the lean concept that principles are applied in a total approach that involves the suppliers. In this respect, it is the crucial role of procurement and supplier relationship management to transfer this competency to its supply chain. Inefficiencies throughout the supply chain can thus be identified, waste can be eliminated, and processes can be harmonized in order to strive for continuous improvements. Continuous improvement (Japanese: kaizen) means small steps and is part of the lean philosophy. Data show that the complete transfer of lean principles to the own operation and the supply chain will lead to significant productivity improvements and significant cost reduction advantages of up to 15 to 50 percent (Liker 2004).

1.3 Historical Origins of Lean Management

1.3.1 Early Developments of Lean Management

Early developments of lean management tools reach back into the early times of industrialization. With increased customer demands, entrepreneurs were trying to implement processes that would accelerate and increase the production. Eli Whitney

is most famous as the inventor of the cotton gin. However, the gin was a minor accomplishment compared to his perfection of interchangeable parts. Whitney developed this about 1799 when he took a contract from the US Army for the manufacture of 10,000 muskets at the unbelievably low price of $13.40 for each gun.

For the next 100 years, manufacturers primarily concerned themselves with individual technologies. During this time our system of engineering drawings developed, modern machine tools were perfected, and large-scale processes such as the Bessemer process for making steel held the centre of attention. As products moved from one discrete process to the next through the logistics system and within factories, few people concerned themselves with:

- What happens in between processes
- How multiple processes were arranged within the factory
- How the chain of processes functioned as a system
- How each worker went about a task

1.3.2 Ford and Taylorism

This changed in the late 1890s with the work of early industrial engineers. Frederick W. Taylor began to look at individual workers and work methods. The result was the studies of time management, the time per one cycle and standardized work operations. He called his ideas scientific management (Hounshell 1988). Taylor was a controversial manager and personality. The concept of applying science to management was sound, but Taylor simply ignored the behavioural sciences. In addition, he had a peculiar attitude towards factory workers. Frank Gilbreth (Cheaper by The Dozen) added motion study and invented process charting. Process charts focused attention on all work elements including those non-value-added elements which normally occur between the "official" elements. Lillian Gilbreth brought psychology into the mix by studying the motivations of workers and how attitudes affected the outcome of a process. There were, of course, many other contributors. These were the people who originated the idea of "eliminating waste", a key tenet of JIT and lean manufacturing. Although there are instances of rigorous process thinking in manufacturing all the way back to the Arsenal in Venice in the 1450s, the first person to truly integrate an entire production process was Henry Ford. At Highland Park, MI, in 1913, he married consistently interchangeable parts with standard work and moving conveyance to create what he called flow production. The public grasped this in the dramatic form of the moving assembly line, but from the standpoint of the manufacturing engineer, the breakthroughs actually went much further. Ford lined up fabrication steps in process sequence wherever possible using special-purpose machines and go/no-go gauges to fabricate and assemble the components going into the vehicle within a few minutes and deliver perfectly fitting components directly to lineside. This was a truly revolutionary break from the shop practices of the American System that consisted of general-purpose machines grouped by process, which made parts that eventually found their way into finished products after

a good bit of tinkering (fitting) in subassembly and final assembly. The problem with Ford's system was not the flow: he was able to turn the inventories of the entire company every few days. Rather it was his inability to provide variety. The Model T was not just limited to one colour, which was black. It was also limited to one specification so that all Model T chassis were essentially identical up through the end of production in 1926. (The customer did have a choice of four or five body styles, a drop-on feature from outside suppliers added at the very end of the production line.) Indeed, it appears that practically every machine in the Ford Motor Company worked on a single part number, and there were essentially no changeovers. When the world wanted variety, including model cycles shorter than the 19 years for the Model T, Ford seemed to lose his way. Other automakers responded to the need for many models, each with many options, but with production systems whose design and fabrication steps regressed towards process areas with much longer throughput times. Over time they populated their fabrication shops with larger and larger machines that ran faster and faster, apparently lowering costs per process step, but continually increasing throughput times and inventories except in the rare case (like engine machining lines) where all of the process steps could be linked and automated (Hounshell 1988). Even worse, the time lags between process steps and the complex part routings required ever more sophisticated information management systems culminating in computerized materials requirements planning (MRP) systems.

1.3.3 Toyota Production System (TPS)

As Kiichiro Toyoda, Taiichi Ohno, and others at Toyota looked at this situation in the 1930s, and more intensely just after World War II, it occurred to them that a series of simple innovations might make it more possible to provide both continuity in process flow and a wide variety in product offerings. They therefore revisited Ford's original thinking and invented the Toyota Production System.

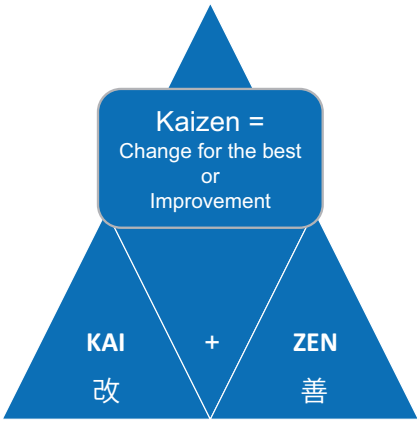

Fig. 1.2 Lean management and kaizen. (Source: Author's source)

This system in essence shifted the focus of the manufacturing engineer from individual machines and their utilization to the flow of the product through the total process. Toyota concluded that by right-sizing machines for the actual volume needed, introducing self-monitoring machines to ensure quality, lining the machines up in process sequence, pioneering quick setups so each machine could make small volumes of many part numbers, and having each process step notify the previous step of its current needs for materials, it would be possible to obtain low cost, high variety, high quality, and very rapid throughput times to respond to changing customer desires. The concept of the TPS is based on a paradigm of permanent and continuous improvement, the kaizen philosophy. Figure 1.2 displays the meaning of kaizen as change for the best or change for improvement. Also, information management could be made much simpler and more accurate (Liker 2004). The thought process of lean was thoroughly described in the book *The Machine That Changed the World* (1990) by Womack, Jones, and Roos; the authors described that lean principles are based on five elements:

1. Specify the value desired by the customer.
2. Identify the value stream for each product providing that value and challenge all of the wasted steps (generally nine out of ten) currently necessary to provide it.
3. Make the product flow continuously through the remaining value-added steps.
4. Introduce pull between all steps where continuous flow is possible.
5. Manage towards perfection so that the number of steps and the amount of time and information needed to serve the customer continually fall.

1.3.4 Lean Management in Today's World

This continued success has over the past two decades created an enormous demand for greater knowledge about lean thinking. There are literally hundreds of books and papers, not to mention thousands of media articles exploring the subject, and numerous other resources available to this growing audience. As lean thinking continues to spread to every country in the world, leaders are also adapting the tools and principles beyond manufacturing to logistics and distribution, services, retail, healthcare, construction, maintenance, and even government. Indeed, lean consciousness and methods are only beginning to take root among senior managers and leaders in all sectors today. Value chain networks in the present times are complex and international structures of supply and demand (Helmold and Terry 2016). Especially, Japanese makers show how suppliers are sustainably integrated into the own value chain and activities (James et al. 1997; Helmold and Terry 2016). The Japanese networks are described as "keiretsu networks", in which suppliers and customers are integrated systems throughout the value chain (Helmold and Samara 2019). Future lean management concepts and supply chains will be configured in a transparent and optimal way, so that wasteful activities and processes can be eliminated at the earliest point of time (Srai and Gregory 2008). In the future competitiveness will be decided on who has the most flexible and efficient value network including

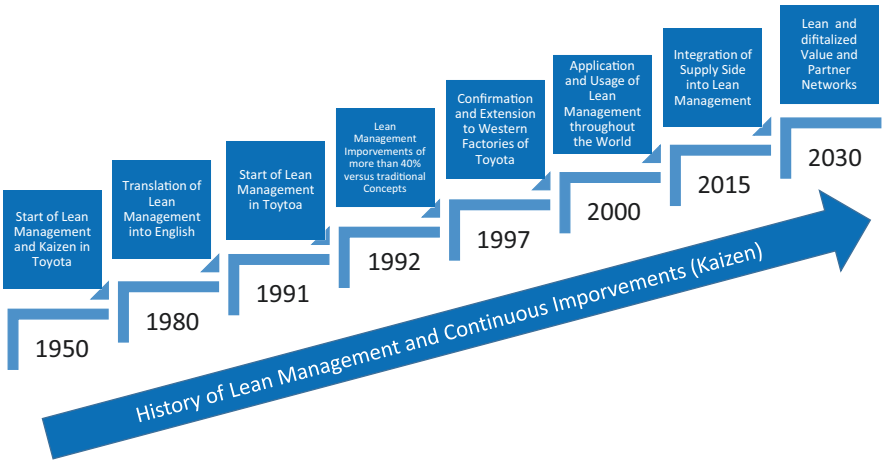

Fig. 1.3 Time line and development of lean management. (Source: Author's source)

value streams from raw material suppliers over the own operations to the distribution to the customers (Helmold and Terry 2016) (Fig. 1.3).

1.4 Lean Management in Japan

1.4.1 Lean Thinking as Part of the Japanese Culture

One of the biggest parts of this involves the concept of "kata". These are general societal rules and patterns of behaviours that the Japanese exhibit in their everyday life. Since this is an ingrained part of the Japanese culture, the standard practices of business come very naturally to people in this country. As part of their culture, the Japanese are also known for being perfectionists in everything that they do. They take a great deal of pride in their work, so they take a great deal of care to train their employees to ensure the highest quality of work. Another big part of this concept of lean is listening and patience. Toyota is a company that has been heavily associated with lean. One of the things that makes this company so unique is that rather than just barking orders, they encourage workers to develop their own skills and problem-solving abilities. There is also a focus more on the long-term goals of a company rather than the short-term. These are all areas that exemplify how crucial patience is to the Japanese culture. In fact, to be considered an expert in any field, it takes a great deal of time, so patience is necessary. Lean is all about how you organize a business to make it more efficient. The purpose is to maximize value and reduce waste. The Japanese culture is known for valuing cleanliness and order, both in the way they live their everyday life and how they run their businesses. If everything is meticulously organized, you can reduce waste because you know exactly what you have and what you need. This applies to office supplies and workflow management.

Fig. 1.4 Visualization in Tokyo Metro. (Source: Author's source)

You are able to see who should be working on what to know what needs to get done. It makes the business run more efficiently. Figure 1.4 shows how lean tools of visualization are integrated inside the Japanese society and life. It shows the Tozai Line including information on connections, time, and also the location. Other lines and connections are marked in different colours. Another example of lean management and artificial intelligence is a bakery in Tokyo (Fig. 1.5), where the customer-selected products are identified through a camera on a special counter. The staff only needs to confirm, so that the price is shown to the customer. The customer can now pay via telephone payment (one scan), via card, or via inserting money into a slot. The change is given automatically. The process is very fast, waste like waiting time is eliminated, and the staff can use more time to advise and assist customers.

1.4.2 Influences of Bushido: Seven Virtues

Bushido is the definition for the code of ethics and ideals that dictated the samurai way of life in ancient Japan. The moral values of samurai warriors are stressing elements like sincerity, frugality, loyalty, martial arts, and honour until death. Bushido flourished during the Edo period from 1600 to 1878. Inspired from neo-Confucianism during the Edo period and influenced by Shinto and Buddhism, it allowed the

Fig. 1.5 Artificial intelligence in a bakery in Tokyo. (Source: Author's source)

samurai to be tempered by wisdom, patience, and serenity. The seven virtues are shown in Fig. 1.6 and are defined as follows:

1. Justice or Rectitude (義 gi)

   This is all about making sure that we have the right way when we make a decision and that we have the power to make a decision quickly. It is about

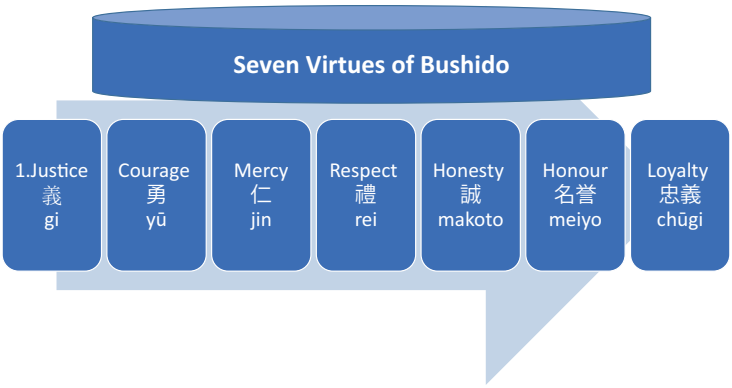

Fig. 1.6 Seven virtues of bushido. (Source: Author's source)

making sure that we do not become indecisive and that our decisions are made and based on the right reasons.

2. Courage (勇 yū)

   This is about making sure that what we do is right and that we have the courage to do the right thing and not just what people think we should do. If we are raised in a particular way, we think in a way that we believe in. This is about making sure we do what we believe in and have the courage to do so.

3. Benevolence or Mercy (仁 jin)

   As a warrior, the samurai have the power to kill. However, benevolence is about making sure that you are balanced in how you think. It is about making sure that you also have sympathy and mercy at the right time. For the samurai it was about making sure you fought for the right reason and that if you had to kill someone, you did it for the right reason and your belief but that you also make sure that if there was no need to kill, you would have mercy and be sympathetic.

4. Respect (禮 rei)

   It is important that in everything they believe, they must have respect and be polite in everything. The way they live their life meant they must be respectful of their elders, they must respect life, and respect others beliefs.

5. Honesty (誠 makoto)

   Honesty was very important, as they believe that being honest in everything you do gives you respect and means you can be trusted.

6. Honour (名誉 meiyo)

   To live and die with honour was very important to the samurai. Everything they did was honourable which meant they did everything in what they believed with honour.

7. Loyalty (忠義 chūgi)
   Loyalty was probably one of the very important parts of what they did. They treated each other like family and would do everything within their power to protect and help their samurai warriors. Loyalty was important because this means they can trust their warriors and know they would be loyal to whatever they needed to do and not worry about losing their respect.

1.5 Case Study: Porsche Consulting

Practical examples by Porsche Consulting show that the introduction of the TPS led to radical improvements in terms of errors and defects per car (quality), serial completion time (cost and productivity), and inventory (logistics and delivery). The study reveals that the reduction of defects per car was reduced by 63 percent. The throughput time could be improved by more than 53 percent. This caused a positive situation of inventory by 50 percent. In the JIT approach, it is important that the right part comes in the right quantity in the right quality at the right time to the right place as shown in the 7R principle. This principle focuses on a zero defect as shown in the next figure. This principle was defined in the previous chapters as part of the objectives. The principles can be regarded as obtaining the right parts at the right quality and at the right time. This has to be in line with the right quantity in the right place by the right people at the right price (Helmold and Samara 2019). Companies such as Porsche have understood that the low value-adding activities of the own organization lead automatically to increasing activities on the supply side (Kalkowsky 2004). Porsche was also hampered by antiquated production methods. Some 20 percent of its parts were delivered 3 or more days too late, for example. The former head of Porsche, Dr. Wendelin Wiedeking, who had been deeply impressed by what he had seen on visits to Japanese auto firms such as Toyota, Nissan, and Honda, believed that only a radical, "lean manufacturing" cure would save the company. He flew in teams of the same Japanese consultants who had helped Toyota and gave them free rein. "A cultural revolution from top to bottom" is the way he describes what happened next, as the consultants organized the workforce into teams and one by one eliminated poor practices. Wiedeking made one now-fabled appearance on the assembly line wielding a circular saw, which he used to cut down the roof-high racks of spare parts that towered over the production line. After the lean cure of the own production facilities, Porsche extended the lean concept to suppliers and established the supplier development department in 2006 (the name of the department is FEL, Finance-Purchasing, Supply Management). This department is in charge of extending lean principles to the supply networks and to synchronize production systems. In the following section, the concept of lean supply management will be discussed. Lean principles have:

- To apply lean principles throughout the supply chain
- To integrate suppliers

Fig. 1.7 Lean management and kaizen (Source. Author's source)

- To be customer oriented
- To have a flat and transparent hierarchy
- To establish competencies to core functions
- To apply lean principles to shop floor (gemba)
- To concentrate only on essential success factors
- To reduce waste
- To continuously improve
- To apply a pull system
- To apply a learning organization

Figure 1.7 shows the Porsche production assembly including a one-piece flow. Porsche is implementing the principles of a just-in-time production system.

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