Management for Professionals

Marc Helmold · Ayşe Küçük Yılmaz · Triant Flouris · Thomas Winner · Violeta Cvetkoska · Tracy Dathe

# Lean Management, Kaizen, Kata and Keiretsu

## Best-Practice Examples and Industry Insights from Japanese Concepts

Springer

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Having no problems is the biggest problem of all.
Taiicho Ohno (大野 耐- 1912–1990)

# Acknowledgements

The increasing (especially the digital) interconnection and the unlimited exchange of data and information has led to a maximized transparency of value-adding activities and global supply chains. This is leading to the question how to generate a competitive advantage for companies in the producing, trading, service or healthcare industries. In this context and as a consequence, there is a paradigm shift nowadays to manage the value chain from the supply side over the entire production towards the customers. Only the integrative approach from the customer order, planning, procurement, production and logistics up to the reverse logistics process will enable enterprises to make decisions for the management of their business actions. Moreover, due to the concentration on core competencies and the allocation of value-adding non-core activities (outsourcing) to supply networks, new processes and flows are created that need to be coped with. Lean management is the ideal way to concentrate on processes and activities, for which the customer is willing to pay.

Even though the concept of lean management is not new, companies understand that the implementation of this framework will lead to significant improvements in all areas from raw material suppliers to the end customers. Lean management is no longer focusing on the own operations activities but is managing the exchange of information and the exploitation of advantages across global supply and value-adding chains. What opportunities are evolving to differentiate against competitors in the future? What are the customers´ expectations in terms of demanded products alongside the traditional requirements of price, quality and delivery? What are the additional value-adding activities and services within the supply chain to differentiate? Gradually declining advantages like increasing wages, volatile exchange rate parities and yet challenging logistics chains necessitate more sophisticated and complimentary levers to further optimize cost alongside the value chain.

The basis for the next step and the Lean Management Vision 2030 is already set: On the one hand, the rising interconnection and automation generate the necessary process optimizations; on the other hand, this trend leads to reduced labour-intensive and manual production, which elevates the integration of all supply chain partners. The future challenges to obtain a competitive advantage lead to a new lean management concept of creating and manging value-adding supply networks over the entire value chain. Thus, it will be possible to satisfy more and more demanding customers in increasingly transparent and open markets. In this context, new Internet-based information and communication strategies and concepts will be the ideal

conjunction of stakeholders´ interest within the entire value chain. Pioneering companies like Tesla, Porsche, Alibaba and Amazon set the new benchmarks and meet the customer expectations in terms of growing expectations of lead times and availability of products.

The book has been developed by six top experts in lean management. It includes principles, methods and guidelines for successfully implementing lean management into the own organization or enterprise. Besides the overriding paradigm of lean management and Kaizen, several concepts like Kata, Pecha Kucha, Nemawashi or Keiretsu Networks are described. Furthermore, the authors give best practices in operations research; automotive, railroad and civil engineering; and aviation through practical explanation and cases at the end of each chapter. Thus, it has been possible to create a unique book, which combines theory and practice examples in the most ideal way.

The book would not have been possible without the implicit and indirect support of practitioners, academics and students at doctoral and master's levels. For practical relevance, the authors appreciate the input from professionals in many industries and from public organizations. Additionally, many of the impulses come from students of different and diverse universities. The authors hope that the book will also contribute to understand other countries and cultures in a better way, as they are convinced that diversity and intercultural experience in enterprises is a key success factor in a highly competitive environment. We would like to thank our colleagues, students and friends for giving us the impulse to write this book with many USPs.

**Berlin, Eskisehir, Athens, Skopje**
**March 2022**

Prof. Dr. Marc Helmold
Prof. Dr. Ayşe Küçük Yılmaz
Prof. Dr. Triant Flouris
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**Thomas Winner** Prof. Dr. Thomas Winner is a professor at IU International University of applied Sciences. He teaches civil engineering and is the director of civil engineering at IU International University of applied Sciences. From 2009 to 2020, he worked as a civil engineer in structural engineering and in project management. Among other things, he worked on the basic renovation and expansion of the Pergamon Museum in Berlin as well as on various new construction projects. In addition, the creation of static-constructive reports was part of his field of activity. Since 2019, he is a professor and is available to companies in the construction industry in an advisory capacity. In this function, he improves the performance of planning and executing companies.

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# List of Acronyms and Abbreviations

| | |
|---|---|
| A3 | Problem-solving Method |
| AHP | Analytic Hierarchy Process |
| AI | Artificial Intelligence |
| AM | Additive Manufacturing |
| AR | Augmented Reality |
| BDA | Big Data Analysis |
| BIM | Building Information Modelling |
| BSC | Balanced Score Card |
| BST | Bombardier Sifang Transportation |
| BME | Bundesverband Materialwirtschaft, Einkauf und Logistik |
| BMW | Bayerische Motorenwerke |
| BOS | Alstom Operating System |
| CSR | Corporate Social Responsibility |
| DEA | Data Envelopment Analysis |
| DIN | Deutsche Industrienorm |
| DSCM | Downstream Supply Chain Management |
| ERP | Enterprise Resource Planning |
| EV | Electric Vehicle |
| EXW | Ex Works |
| HOAI | Fee Table for Architects and Engineers |
| IOP | Internet of People |
| IOT | Internet of Things |
| IPO | International Procurement Office |
| ISO | International Organization for Standardization |
| IU | International University Bad Honnef |
| JIT | Just-in-Time |
| KPI | Key Performance Indicator |
| LHE | Lean Higher Education |
| MPS | Mercedes Benz Production System |
| MRO | Maintenance, Repair and Overhaul |
| OEE | Overall Equipment Effectiveness |
| OKR | Objectives Key Results |
| PDCA | Plan, Do, Check, Act |
| PDSA | Plan, Do, Study, Act |

| | |
|---|---|
| PE | Physical Education |
| PESTEL | Macro Analysis |
| PPS | Production Planning System |
| QCC | Quality Control Cards |
| SFM | Shop Floor Management |
| SCM | Supply Chain Management |
| SWOT | Strengths, Weaknesses, Opportunities, Threats |
| TIMWOOD | Seven Types of Waste in Manufacturing |
| TPS | Toyota Production System |
| TÜV | Technischer Überwachungsverein |
| UN | United Nations |
| USCM | Upstream Supply Chain Management |
| USP | Unique Selling Propositions |
| VPS | Volkswagen Production System |
| VR | Virtual Reality |
| VSM | Value Stream Mapping |
| VUCA | Volatility, Uncertainty Complexity, Ambiguity |
| VW | Volkswagen |
| 3M | Muda, Muri, Mura |
| 5R | 5 Rights |
| 5S | Seiri, Seiton, Seiso, Seiketsu, Shitsuke |
| 7R | 7 Rights |

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# Lean Management: Introduction

1

*Where there is no Standard there can be no Kaizen.*

Taiichi Ohno

## 1.1 Definition of Kaizen (改善)

Lean management is a modern concept for process optimization throughout the value chain (Helmold & Terry, 2021). Lean management focuses on making inefficiencies (waste) transparent and on altering these into value-adding activities (Ohno, 1990). The value chain reaches in this context from the upstream (Suppliers) over the own operations to the downstream side (Customers), as illustrated in Fig. 1.1 (Slack & Brandon-Jones, 2021). Inefficiencies are everything, e.g. an activity, a process, 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 (Helmold, 2021). 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, 2020). The philosophy has its roots in Japan and operations but is presently widely spread across the world and industries. Lean management focuses on the following:

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



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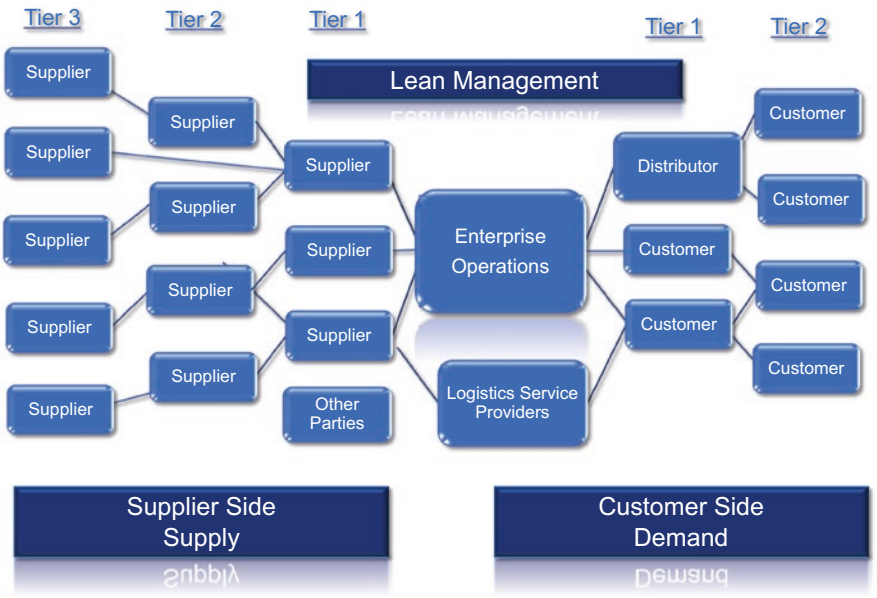


**Fig. 1.1** Lean management across the supply chain

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 & Samara, 2019). The five principles are the following:

1. Identify value in all processes 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, 2020). 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 & Brandon-Jones, 2021). 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. Breaking the total work process into a collection of smaller parts and visualizing the workflow in this regard facilitates 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 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 (Helmold, 2021).

## 1.2 Lean Management Introduction

In contrast to the traditional manufacturing concepts, 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 1.2 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. The lean management concept also takes into consideration that waste can be created through overburden ("Muri") or through an imbalance in workloads ("Mura"). Working from the perspective of the

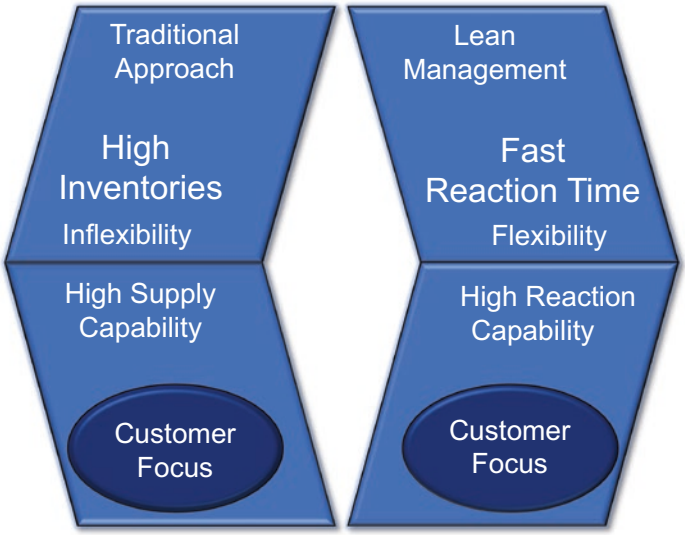


**Fig. 1.2** Lean management versus traditional concept. (Source: Author)

client who consumes a product or service, "value" is any action or process that a customer would be willing to pay 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 the 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 (Sinha & Matharu, 2019). 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 Productions system (TPS) has been adopted by many companies in all sectors on a global scale (James et al., 1997). The TPS has been applied by many OEMs in the automotive industry, railway area and other business sectors. Alstom Transportation is applying the Alstom Operations System (AOS), the Porsche Production System (PPS) and the Daimler Production System. However, it is not always successful, as the activities are only partially introduced and not rolled

out in total. Second, 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 15–50% (Liker, 2020).

## 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 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 U.S. Army to manufacture 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 the line-side. 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 Systems (MRP).

### 1.3.3 Toyota Production System (トヨタ生産方式)

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 (TPS, Toyota Seisan Hōshiki – トヨタ生産方式). 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 (Furata, 2021). 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 (Pascual, 2013). Figure 1.3 displays the meaning of Kaizen as Change for the Best or Change for Improvement. Also, information management could be made

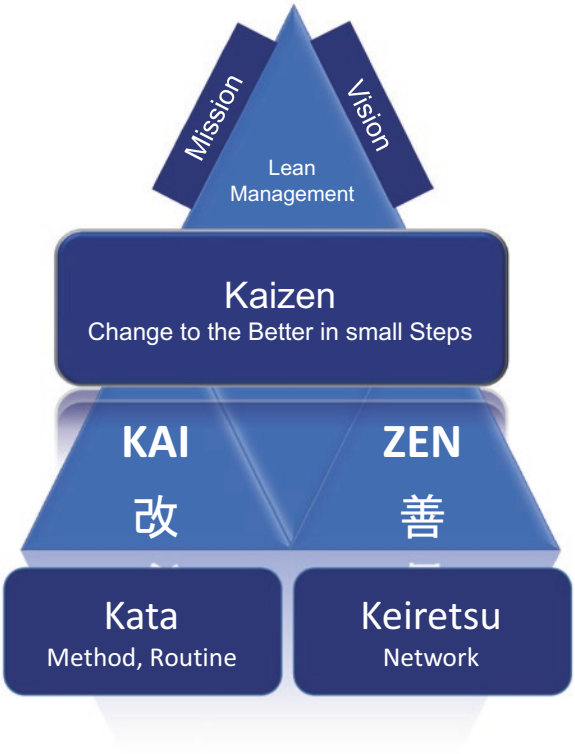


**Fig. 1.3** Lean management and Kaizen. (Source: Author)

much simpler and more accurate (Liker, 2020). Kaizen must be part of the mission and vision of the enterprise. Together with Kata (Methods, Routines) and Keiretsu (Networks), Lean Management is the ideal philosophy and paradigm to focus on value-adding activities across the value chain and with all relevant stakeholders (Helmold, 2021).

The thought process of lean was thoroughly described in the book The Machine That Changed the World (1990) by Womack, Jones and Ross; 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 falls.

### 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 (Elis, 2009). Indeed, lean consciousness and methods are only beginning to take root among senior managers and leaders in all sectors today (Belekoukias et al., 2014). Value chain networks in the present times are complex and international structures of supply and demand. In particular, Japanese makers show how suppliers are sustainably integrated into the own value chain and activities (Helmold & Terry, 2016). The Japanese networks are described as "keiretsu networks", in which suppliers and customers are integrated systems throughout the value chain (Helmold & 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 & Gregory, 2008). In the future, competitiveness will be decided on who has the most flexible and efficient value network including value streams from raw material suppliers over the own operations to the distribution to the customers (Helmold & Terry, 2021; Fig. 1.4).

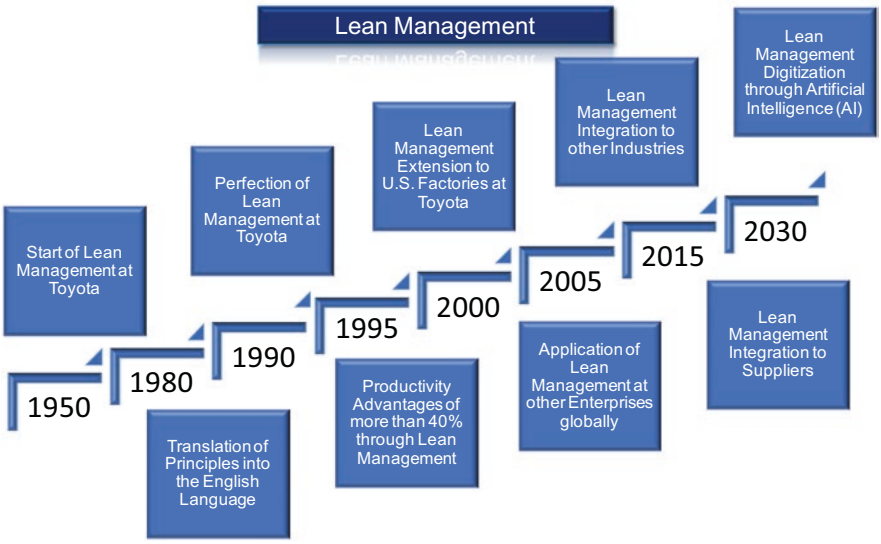


**Fig. 1.4** Time line and development of lean management. (Source: Author)

## 1.4 Lean Management Origins and Lean Thinking in Japan

### 1.4.1 Lean Thinking as Part of the Japanese Society

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 make 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 (Sahoo, 2019). 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 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. 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 1.5 shows how lean tools of


**Fig. 1.5** Visualization in Tokyo Metro. (Source: Author)

visualization are integrated into 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 is the example of lean management and artificial intelligence in 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 Impacts of Bushido on Lean Management

Bushido (Jap.: 武士道) is the definition for the code of ethics and ideals that dictated the samurai way of life in ancient Japan (Nakano, 2020). The moral values of samurai warriors stress 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 samurai to be tempered by wisdom, patience and serenity. The seven virtues are shown in Fig. 1.6 and are defined as follows:


**Fig. 1.6** Artificial intelligence in a bakery in Tokyo. (Source: Author)

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 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. Compassion 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 means they must be respectful of their elders, and they must respect life and 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.

Loyalty is even shown after the death of people. Fig. 1.7 shows a funeral meeting (Jap.: Sogi Houjiki 葬儀ほうじき). Nearly all Japanese funerals are conducted Buddhist-style, regardless of what religion the family practices. Also, almost all involve cremation, to the point that even the local government sometimes bans traditional burials. The Ososhiki is the actual Japanese funeral service and contains several ceremonies. It starts 1 day after the Otsuya with a Sougi or Soshiki, which is the funeral ceremony itself. It follows a similar procedure to the Otsuya, with a priest chanting a sutra and the bereaved burning incense. After the Sougi, there is a Kokubetsushiki, or memorial ceremony, where the friends and acquaintances of the bereaved pay their respects to the dead and offer condolences to the family. Lastly, there is a cremation ceremony. This is a very private ceremony conducted only with

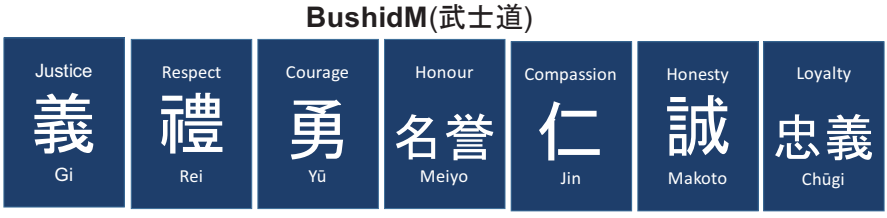


**Fig. 1.7** Seven virtues of Bushido. (Source: Author)

the family. After the body has been cremated, the family uses chopsticks to pick the bones out of the ash and place them in a burial urn which is then interred inside the family grave. Black is the color of mourning in Japan. While in recent years dark blue and dark grey are becoming more acceptable, black is still preferred over all other colours. It can't be stressed enough that you must never attend a Japanese funeral without the appropriate attire – to do so would be the ultimate sign of disrespect.

### 1.4.3 Ikigai (生き甲) as Part of the Lean Management Philosophy

Ikigai (Jap.: 生 き 甲 斐, meaning of life) is a Japanese concept that means the reason for being. "Iki" in Japanese means life, and "gai" describes value or worth. The ikigai is the life purpose or the bliss of a person or group. It's what brings you joy and inspires you to get out of bed every day. Ikigai is loosely translated as "that which is worth living for", "joy and the goal in life" or, to put it casually, "the feeling of having something for which it is." it's worth getting up in the morning". In the Japanese culture, the often lengthy and thorough self-exploration in the pursuit and search for Ikigai has an important meaning. It is a very personal process and the result can therefore be very different from individual to individual. If a person finds or has his ikigai, it gives him a feeling of joie de vivre and thus inner satisfaction. In connection with the self-understanding of the cultural identity of Japanese society, discussions are held in the media on the questions of which social ideals should serve as the basis for Ikigai, what can be regarded as Ikigai (and what not) and whether people can be searched for according to Ikigai and should (or not) assist in an organized manner. Figure 1.8 depicts the concept. There are four dimensions, describing (1) What to love for, (2) What the world needs, (3) What one is paid for and (4) What one is good at. The combination of these four categories is considered the "Ikigai" and leads to the Mission, the Vocation, the Profession and the Passion of individuals and groups (Fig. 1.9).

### 1.4.4 Nemawashi (根回し) as an Essential Part of Decision-Making

Nemawashi (根回し) in Japanese means an informal process of quietly laying the foundation for some proposed change or project by talking to the people concerned, gathering support and feedback and so forth. It is considered an important element in any major change before any formal steps are taken, and successful nemawashi enables changes to be carried out with the consent of all sides. Nemawashi literally translates as "turning the roots", from ne (根, "root") and mawasu (回す, "to turn something, to put something around something else"). Its original meaning was literal: in preparation for transplanting a tree, one would carefully dig around a tree some time before transplanting and trim the roots to encourage the growth of smaller

**Fig. 1.8** Funeral gathering of the family

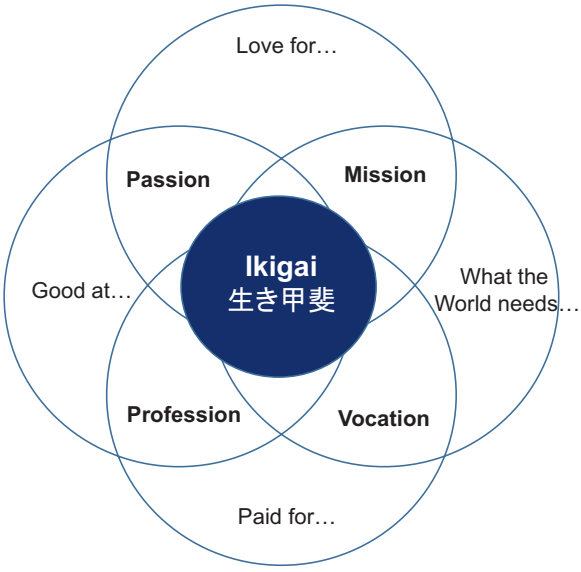


**Fig. 1.9** Ikigai (生き甲) elements. (Source: Author)

roots that will help the tree become established in its new location. Nemawashi is often cited as an example of a Japanese word that is difficult to translate effectively because it is tied so closely to Japanese culture itself, although it is often translated as "laying the groundwork". In Japan, high-ranking people expect to be let in on

new proposals prior to an official meeting. If they find out about something for the first time during the meeting, they will feel that they have been ignored, and they may reject it for that reason alone. Thus, it's important to approach these people individually before the meeting. This provides an opportunity to introduce the proposal to them and gauge their reaction. This is also a good chance to hear their input. This process is referred to as nemawashi.

## 1.5 Case Study: Lean Management in Porsche

Practical examples by Porsche 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%. The throughput time could be improved by more than 53%. This caused a positive situation of inventory by 50%. 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 & Terry, 2021). 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% of its parts were delivered three 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
- to be customer oriented

**Fig. 1.10** Lean management and Kaizen at Porsche. (Source. Author)

- 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 1.10 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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# Kaizen (改善), Kaikaku (改革) and Innovation Management

2

*Perfection is not attainable. But if we chase perfection, we can catch excellence.*

Vince Lombardi

## 2.1 Distinction Between Kaizen (改善) and Kaikaku (改革)

Kaizen's philosophy is continuous improvement in small steps. But in reality, improvement is not uniform, but discontinuous, sometimes faster and sometimes slower. With Kaizen, we sometimes face major obstacles and get stuck. In this case, we have to change the system, the framework conditions, in order to be able to improve further. A concentrated effort is required to make a breakthrough for Kaizen. This method is referred to as Kaikaku and helps improve quality in production (Japanese 改革, Reformation, Transformation). Kaikaku is called "breakthrough kaizen" or "kaizen lightning". Kaikaku means "revolution in thought and action" and "improvement of great significance" (Radenkovic et al., 2013). With a concentrated use of force, it temporarily accelerates the speed and scope of Kaizen. Kaizen is the continuous improvement of an activity with the purpose of increasing the performance in a production system, usually less than 20 or 30% in a given period of time (Radharmanan et al., 1996). Opposite of Kaizen is Kaikaku, which represents drastic change or radical improvement that is usually a result of big investments in technology and/or equipment (Imai, 1986). This way of making improvements can be considered impossible to constantly improve the process, so based on that, there is a need to conduct radical change in the company (Pfeffer, 1998). Kaikaku is not like Kaizen, which is started by all employees; Kaikaku usually starts from the top management of the company and then goes to lower levels of workers (Yamamoto, 2013). This is because Kaikaku represents crucial strategic changes. Table 2.1 compares Kaizen and Kaikaku (Helmold, 2021) and shows the differences between the two methods.



M. Helmold et al., *Lean Management, Kaizen, Kata and Keiretsu*, Management for Professionals, https://doi.org/10.1007/978-3-031-10104-5_2

**Table 2.1** Kaizen and Kaikaku

| Differences between Kaizen and Kaikaku | |
|---|---|
| Kaizen (改善) | Kaikaku (改革) |
| Lots of small, incremental improvements in all areas of production and other value chain processes | Major and selective improvements aimed at more complex and strategic projects |
| Systematic analysis for all areas and projects in the value chain | Systematic analysis and synthesis of individual and selected projects and improvement measures |
| Involvement of many teams and individuals in all functions | Involves fewer people, as only selective projects are implemented |
| Starts with management and involves all employees as part of a Kaizen culture | The participating organizational parts of selected projects are geared towards the improvement goals |
| Use and application of mostly tactical and operational measures | Driven by top management, strategic measures |
| Continuously proceeding in all areas with improvements | Limited to a certain time and duration for selected projects |

Source: Author

## 2.2 Definition of Kaizen (改善)

Kaizen is a Japanese management concept and targets improvements in small steps. Kaizen means all personnel are expected to stop their work when they encounter any abnormality and, along with their supervisor, suggest an improvement to resolve the abnormality. In Kaizen, the quality is the aim of daily life, not only during working hours. The improvement should be gradual and infinite. It should pursue perfection. The employees should be continuously engaged in the company's life and improvement of every aspect of the company (processes, products, infrastructure, etc.). This improvement throughout all aspects of life is related to the great attention that is paid to the needs and requirements of the customer.

Kaizen focuses on teams (quality circles) and promotes teamwork and team spirit; however, it also recognizes the individual contribution. It emphasizes the engagement of each worker to the concept and vision of the company so that employees will identify themselves with the enterprise, its culture and objectives. The important aspects of Kaizen are the following:

- What is wrong? Not who is wrong?
- How to eliminate waste (Muda)?
- How to decrease quality costs?

The term Kaizen is Japanese and can be translated to "change for the better". The main goal of Kaizen is to continuously improve working areas, processes and products by integrating the people of the affected areas. Usually, Kaizen is realized through workshops. Their typical duration can vary from 3 to 5 days. The aim of a Kaizen workshop is to implement the improvements during the time of the

workshop. Kaizen is a framework combining the change of the company culture together with the daily implementation of the principles (Liker, 2020). The 10 principles of Kaizen can be described as follows:

1. Say no to status quo.
2. If something is wrong, correct it.
3. Accept no excuses and make things happen.
4. Improve everything continuously.
5. Abolish old, traditional concepts.
6. Be economical.
7. Empower everyone to take part in problem-solving.
8. Before making decisions, ask "why" five times to get to the root cause.
9. Get information and opinions from multiple people.
10. Remember that improvement has no limit; never stop trying to improve.

A useful tool in the context of Kaizen is the P-D-C-A cycle. PDCA is an iterative four-step management method used in business for the control and continuous improvement of processes and products. It is also known as the Deming circle/cycle/wheel, the Shewhart cycle. Since the 1950s, the PDCA cycle has been recognized as a simplified illustration of the elementary steps of a continuous improvement process:

Plan: Analyse the current situation and define improvement plan.
Do: Implement the defined solutions.
Check: Evaluation of improvement results.
Act: Definition of counter actions in the case of deviation from objectives; standardize the best solution.

After improvement, it is important to standardize and implement the action so that the process or activity cannot return to the old state. If this is secured, one can aim for the next improvement.

## 2.3 Kaizen Versus Innovation

Kaizen is the concept of small improvements in small steps, as shown in Fig. 2.1 (Ohno, 1990). In contrast to an innovation, which is a top-down approach, Kaizen involves all team members (Bertagnolli, 2020). It means improvement and continuous improvement in personal life, home life, social life and working life. When applied to the workplace, this philosophy means continuing improvement involving everyone, i.e. managers and workers alike (Kaizen Institute, 2019). The principles of Kaizen are customer knowledge and transparency (Helmold & Terry, 2021). Thus, it is possible to improve a process without major investments. Kaizen in any organization is fundamentally important for a successful continuous improvement culture and to mark a turning point in the progression of quality, productivity and labour–management relations (Kaizen Institute, 2019) (Fig. 2.2).

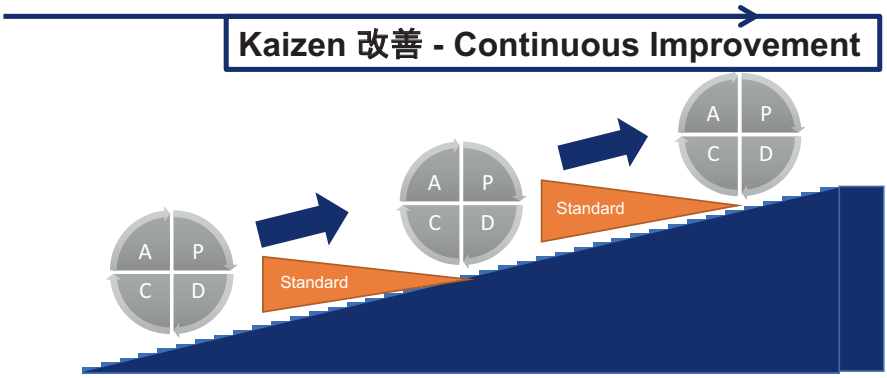


**Fig. 2.1** Kaizen cycle (P-D-C-A). (Source: Author)

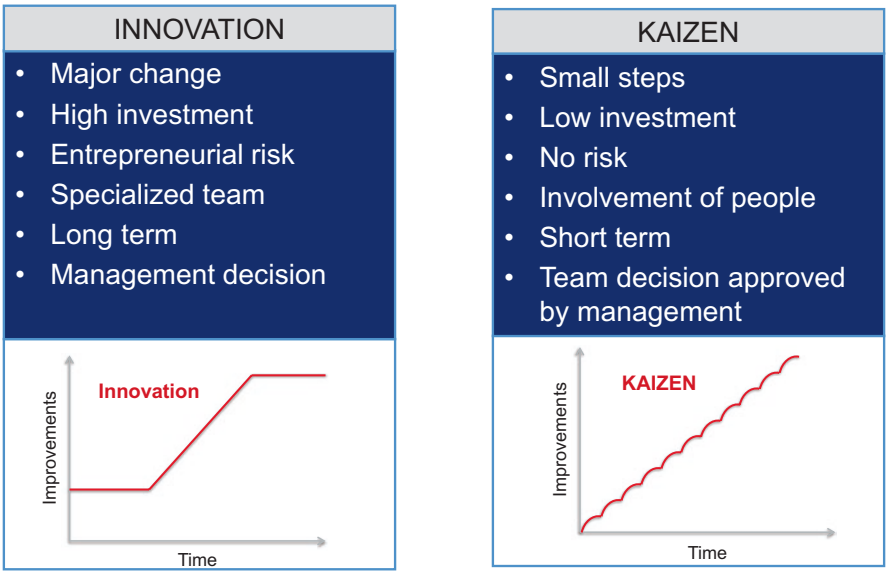


**Fig. 2.2** Innovation versus Kaizen. (Source: Author)

## 2.4 Visualization Management

Visualization management is a significant part of Kaizen. Figure 2.3 displays that 83% of the issues are perceived with the eye sense so that visualization is a crucial part for implementing Kaizen. Figure 2.4 shows the war room in the Alstom Transportation IPO in China.

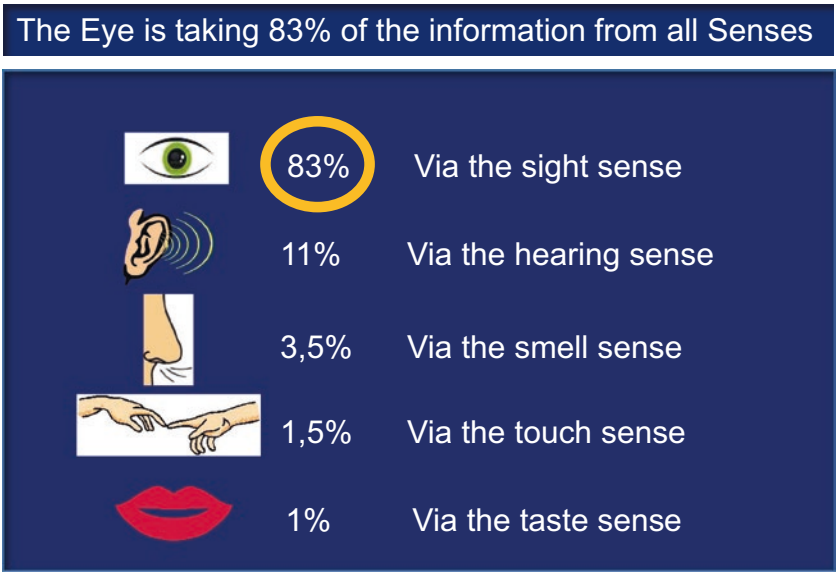


**Fig. 2.3** Visualization senses. (Source: Author)

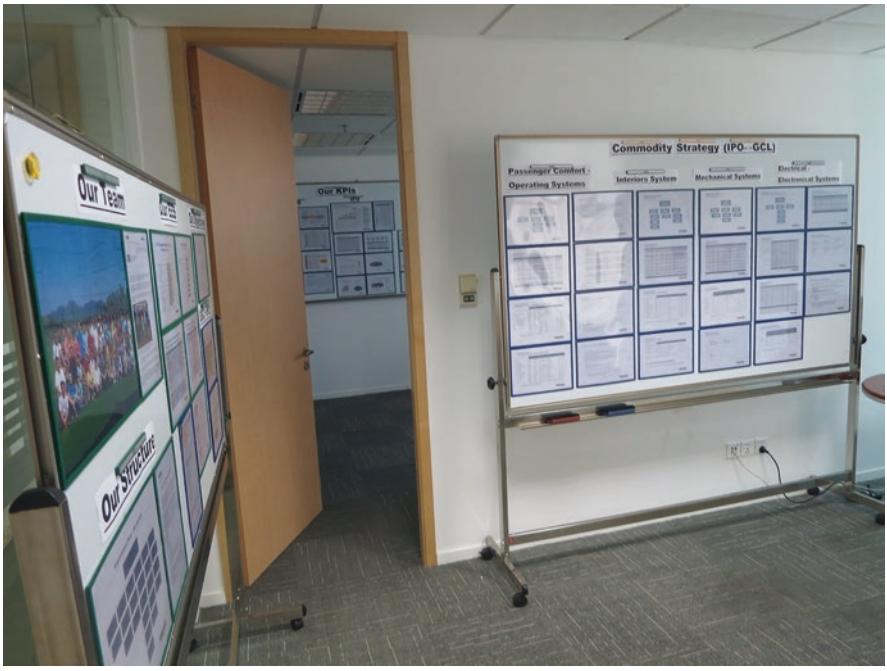


**Fig. 2.4** Visualization examples. (Source: Author)

## 2.5 Case Study: Mercedes' Lean Management System

"The best or nothing" – Gottlieb Daimler's claim characterizes the Mercedes-Benz brand and is anything but easy to live up to. What originally referred primarily to the ideas and ingenuity of the company's founder has since become more pragmatic (Follmann et al., 2012). Daimler is now a global organization with over 260,000 staff members and requires a clear vision, experienced and competent managers and employees, stable processes and a strong corporate culture. The success of the automotive company hinges on the efforts of each individual. One of the important success factors to this end is a far-reaching production system. Production systems have a long tradition and clear principles. Back in 1831, for example, General Carl von Clausewitz recognized the importance of robust processes, avoiding waste and ensuring continuous improvement as necessary to achieve goals. The best-known production system currently used is that of Toyota. The production system used by Mercedes-Benz Cars (MBC) also has a long tradition and has become one of the driving factors behind the success of the premium Mercedes Benz brand – with a pronounced focus on technology, innovation, quality, safety and sustainability. In 2000, this system was bundled as a closed system for the first time – the Mercedes-Benz Production System (MPS) – by leveraging different developments in the company. This laid the foundation for lean management principles in production and, somewhat later on, in administration. From a critical perspective, initial success was confronted by the challenges of early lean initiatives. Improvements in the individual business units, for example, could not be made at the expense of other business units (e.g. the historical conflict of assembly processes being compromised in the name of logistics and vice versa, or assuming that active involvement of managers in optimization measures is all that is required to safeguard changes and prevent relapses from occurring). To meet these challenges and facilitate implementation of the MPS, all resources were bundled at MBC in 2008. The organization was restructured, and four new consulting fields were defined: strategic and tactical target definition, methods and tools, qualification and Mercedes-Benz culture. Today, almost 4 years after the go-ahead, an initial conclusion can be drawn. The introduction of centralized MPS was done in 2008. The framework provided all employees a standardized basis for the decentralized lean support organization at Mercedes-Benz Cars and anchored it in the "Strategische Planung und Mercedes-Benz Produktionssystem" (Strategic Planning and Mercedes-Benz Production System) centre. This centre is, among others, responsible for assisting business units in implementing the MPS throughout Mercedes-Benz Cars. Activities started in the production area and have since carried over to administrative areas such as Human Resources and IT.

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# Kata (形) – Behavioural Transformation Towards Lean Management

# 3

*Logic will get you from A to B. Imagination will take you everywhere.*

Albert Einstein

## 3.1 Definition of Kata (形)

The term kata comes from Japanese martial art and describes the detailed definition of movement sequences. Through practice and application, these become routine and internalized to such an extent that they are practically reflexively carried out without thinking. Transferred to the management of organizations or companies, kata means the development and anchoring of routines in thinking and acting on all organizational levels.

The aim of the kata coaching developed by the Japanese car manufacturer Toyota against this background is to anchor and increase the competence for problem-solving as a core competence in the entire company by developing appropriate learning and behavioural routines (Liker, 2004). In addition, regardless of people, ways must be shown to continuously question processes and activities and to improve them systematically and sustainably (continuous improvement process, CIP) and to be able to react flexibly to new things (learning organization). Employees should develop the ability to deal productively and creatively with uncertainties, problems and changes, thereby increasing the company's performance.

Kata is not a method, but – as a management task – the establishment of a general thought and action scheme in order to reach a target state without knowing the way to get there. Kata takes place continuously on all levels. The procedure remains the same, regardless of the given circumstances: normal daily actions serve to improve processes. There are no defined milestones to reach a desired target state; the respective improvement takes place on the process level, not on the planning level, because the current situation at the place of the event (Gemba) is reacted to (continuous improvement and adaptation) (Follmann et al., 2013). Since the improvement routine is embedded in the workflow of the employees onsite, kata is independent of the path or goal: the method can be used in every situation because the goal is not set and its achievement is practiced, but the procedure (Helmold, 2021). Security is



M. Helmold et al., *Lean Management, Kaizen, Kata and Keiretsu*, Management for Professionals, https://doi.org/10.1007/978-3-031-10104-5_3

created through behavioural routines, not leadership. Kata is based on the following principles like orientation towards the mission or vision of the organization, general behavioural routines, flexibility (towards problems), continuous improvement (CIP), mutual respect and leadership, as depicted in Fig. 3.1. A distinction is made between the two levels: improvement kata and coaching kata.

### 3.1.1 Improvement Kata

The improvement kata is a neutral learning routine that is independent of the given circumstances, with which a final state that corresponds to the corporate vision is aimed for step by step and experimentally via defined stage goals, so-called target states. The target states are derived from a well-founded understanding of the actual state (work steps, sequences and times; process properties; process indicators; result indicators) (Kaizen Institute, 2019). The solution is not specified because it results from the procedure and can neither be forecast nor planned. The unknown solution is gradually developed in a regular examination of one's own actions and the given framework conditions and is only found at the end of the process.

The improvement kata is based on the following four elements:

Understanding of the vision and thus the direction of development.
Recording the current situation.
Determination of the next target state in each case.
Step-by-step approach to the next target state (via PDCA cycle).
Obstacles provide indications of the need for action.
The independent striving for continuous improvement requires employees to consciously and openly examine their level of knowledge. They have to develop

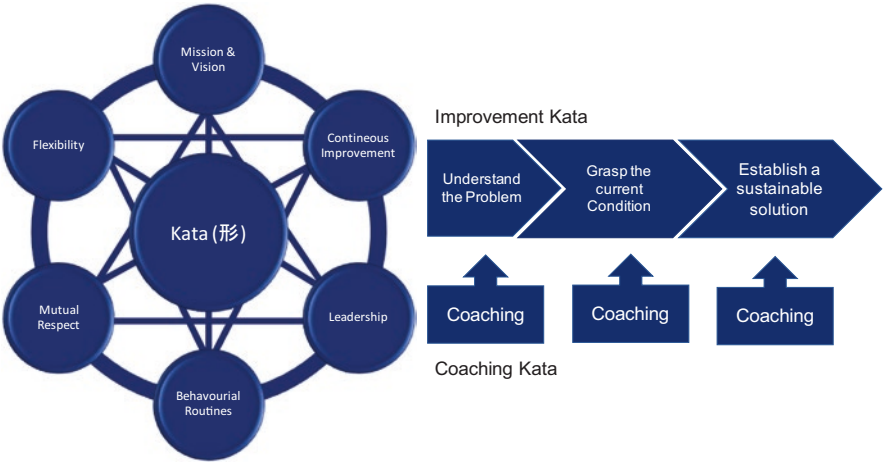


**Fig. 3.1** Elements of kata

their own abilities and skills step by step in the sense of lifelong learning and thus broaden their horizons. In doing so, they have to combine two thought systems of the human brain:

The fast subconscious system that accesses stored knowledge via pattern recognition and leads to reflex-like actions.

The slower conscious system that systematically pervades events and creates new insights and results through analysis and targeted linking.

The employees need support in the form of the coaching kata.

### 3.1.2 Coaching Kata

The goal of coaching kata is to enable (direct) executives to support employees in developing their own systematic, experimental solutions on the way from the current status quo via target states to the final state and the employees applying the improvement kata to routine to be let. Coaching kata therefore does not provide a specific solution.

A manager, as a coach, therefore has the task of increasing the employees' confidence, self-confidence and self-motivation so that they can meet and master growing challenges. As a prerequisite for the success of kata coaching, a trusting, mutually respectful relationship between manager and employee is essential.

Coaching kata is based on four questions. They are the starting point for approaching the desired target state. With this sequence, the coach trains the mental pattern and the (behavioural) routine of the employees in order to clarify and apply the improvement kata in every process or situation:

What is the current state and what is the desired end state?
What are the obstacles on the way to the final state?
Which conclusions can be drawn from this and which next steps can be derived from it?
By when can the first results be expected and what has been learned?

Coaching kata is practiced by many companies that want to anchor the lean concept and the principle of continuous improvement (CIP), as it can also create the conditions for proven lean management methods (such as Kanban) to be beneficial because in this case employees have already internalized the pursuit of improvement.

## 3.2 Lean Management Transformation as Part of Kata

Innovative management and agile processes have positive effects on the performance of the organization in terms of quality cost, delivery and customer satisfaction. However, it is necessary to establish organizational infrastructures required for effective lean implementation and continuation (Fatma, 2015). The Cultural Web,

developed by Gerry Johnson and Kevan Scholes in 1992, provides one such approach for looking at and changing your organization's culture. Using it, you can expose cultural assumptions and practices and set to work aligning organizational elements with one another and with your strategy. These infrastructures must integrate cultural elements, as illustrated in Fig. 3.1. The challenge to implement and sustain innovative and agile management processes lies in the need to identify the organizational culture infrastructure that will allow this system that was first used by Japanese firms to operate well in other organizational contexts. The values and norms that underlie lean processes may create conflict with the culture that already exists within the organization; such divergence retards adoption and performance (Helmold & Samara, 2019). Johnson and Scholes identified six distinct but interrelated elements that contribute to what they called the "paradigm", equivalent to the pattern of the work environment, or the values of the organization. They suggested that each may be examined and analysed individually to gain a clearer picture of the wider cultural issues of an organization. The six contributing elements (with example questions used to examine the organization at hand) are as follows:

### 3.2.1 Stories and Myths

These are the previous events and happenings, both accurate and not, which are discussed by individuals within and outside the enterprise. This element deals with the questions, which events and people are remembered by the company or not. It indicates what the company values and what it chooses to immortalize through stories. Questions concerning the stories and myths are the following:

- What form of company reputation is communicated between customers and stakeholders?
- What stories do people tell new employees about the company?
- What do people know about the history of the organization?
- What do these stories say about the culture of the business?

### 3.2.2 Rituals and Routines

The rituals and routines category refers to the daily actions and behaviours of individuals within the organization. Routines indicate what is expected of employees on a day-to-day basis, and what has been either directly or indirectly approved by those in managerial positions. Questions in this category are the following:

- What do employees expect when they arrive each day?
- What experience do customers expect from the organization?
- What would be obvious if it were removed from routines?
- What do these rituals and routines say about organizational beliefs?

### 3.2.3 Symbols

This element, symbols, deals with the visual representation of the company; how they appear to both employees and individuals on the outside. It includes logos, office spaces, dress codes and sometimes advertisements. Question are the following:

- What kind of image is associated with the company from the outside?
- How do employees and managers view the organization?
- Are there any company-specific designs or jargon used?
- How does the organization advertise itself?

### 3.2.4 Control Systems

Control systems are the systems and pathways by which the organization is controlled. This can refer to many things, including financial management, individual performance-based rewards (both measurement and distribution) and quality-control structures (Helmold et al., 2017, 2019). Questions that must be tackled in this respect are the following:

- Which processes are strongly and weakly controlled?
- In general, is the company loosely or tightly controlled?
- Are employees rewarded or punished for performance?
- What reports and processes are used to keep control of finance, etc.?

### 3.2.5 Organizational Structures

This aspect refers to both the hierarchy and structure designated by the organization. Alongside this, Johnson and Scholes also use it to refer to the unwritten power and influence that some members may exert, which also indicate whose contributions to the organization are most valued by those above them.

- How hierarchical is the organization?
- Are responsibility and influence distributed in a formal or informal way?
- Where are the official lines of authority?
- Are there any unofficial lines of authority?

### 3.2.6 Power Structures

This element refers to the genuine power structures and responsible individuals within the organization. It may refer to a few executives, the CEO, board members or an entire managerial division. These individuals are those who hold the greatest influence over decisions and generally have the final say on major actions or changes.

- Who holds the power within the organization?
- Who makes decisions on behalf of the company?
- What are the beliefs and culture of those at the top of the business?
- How is power used within the organization?

### 3.2.7 Cultural Web to Change

As above, the first step of changing the culture of the organization is to analyse elements of the cultural web as they are in the present. The next step is to repeat the process, examining each element, but this time considering what one would like the culture, beliefs and systems to be. This can then subsequently be compared with the ideal culture, and the differences between the two can be used to develop achievable steps towards change within the company. One will likely only then realize the true strengths and weaknesses of the organization's current culture, what the various hindrances are to growth and how to go about changing specific elements to develop and achieve success. A new strategy can evolve from this by looking at introducing new beliefs and prioritizing positive reinforcement of current, successful ones. Hopefully, by integrating this system of analysis, managers can find themselves able to break free of ritual and belief systems within a company to achieve real change and innovation (Fig. 3.2).

## 3.3 Need for Cultural Change Towards Kaizen

Successful organizations do not prosper by devoting a ruthless approach to chip away at costs, relentlessly reducing all decision-making to a reduction in headcount. The purpose of lean culture change is to secure the future of the entity by uniting its people to deliver to the voice of the customer. In the not-for-profit sector, lean culture change drives organizational success by adding value to existing consumers and winning loyalty (Pascual, 2013). It is about developing resilient service provision, developing core staff competencies and attracting and retaining the best people. The lean culture reverses the polarity of the organization shifting from a fire-fighting mode to a planning mode, where prevention of problems rather than reacting after the event of failure becomes the norm. Healthy, positive, organizational cultures are characterized by a long-term continuity perspective, with a focus on tactics to resolve immediate short-term problems. The dominant culture should support and reward cross-organizational working. Implementing lean thinking is a cultural change that requires leadership because in the end it's all about people. Here are 10 guidelines your leader can do right now to change the culture:

**Challenge People to Think**
If you are not thinking, you're not learning new things. If you're not learning, you're not growing – and over time becoming irrelevant in your work. The most successful leaders understand their colleagues' mindsets, capabilities and areas for


**Fig. 3.2** Cultural lean management paradigm. (Source: Author, adopted from Johnson et al., 2018)

improvement. They use this knowledge/insight to challenge their teams to think and stretch them to reach for more.

**Lead by Example**
Leading by example sounds easy, but few leaders are consistent with this one. Successful leaders practice what they preach and are mindful of their actions. They know everyone is watching them and therefore are incredibly intuitive about detecting those who are observing their every move, waiting to detect a performance shortfall.

**Take Lots of Leaps of Faith**
Making a change requires a leap of faith. Taking that leap of faith is risky, and people will only take active steps towards the unknown if they genuinely believe – and perhaps more importantly, feel – that the risks of standing still are greater than those of moving forward in a new direction. Making a change takes lots of leaps of faith.

**Create an Environment Where It Is Acceptable to Fail**
Failure should be encouraged! That's right. If you don't try, you can't grow; and if growth is what you seek, failing is inevitable. There must be encouragement to try and it's ok if you try and it doesn't work. An environment where you can't fail creates fear.

**Eliminate Concrete Heads**
"Concrete heads" is the Japanese term for someone who does not accept that the organization must be focused on the elimination of waste. People feel threatened by the changes brought about by lean. As waste and bureaucracy are eliminated, some will find that little of what they have been doing is adding value. The anxiety they feel is normal and expected. To counteract this, it is critical that people are shown how the concept of work needs to change.

**Be a Great Teacher**
Successful leaders take the time to mentor their colleagues and make the investment to sponsor those who have proven they are able and eager to advance. They never stop teaching because they are so self-motivated to learn themselves.

**Show Respect to Everyone**
Everyone desires respect. Everyone. Regardless of your position or power, ensure you show everyone respect. Everyone wants to be treated fairly.

**Motivate Your Followers**
Transformational leaders provide inspirational motivation to encourage their followers to get into action. Of course, being inspirational isn't always easy. Some ideas for leadership inspiration include being genuinely passionate about ideas or goals, helping followers feel included in the process and offering recognition, praise and rewards for people's accomplishments.

**Develop a True Team Environment**
Create an environment where working as a team is valued and encouraged, where individuals work together to solve problems and help move the organization forward. Individuals who will challenge each other and support each other make teams more successful.

**Encourage People to Make Contributions**
Let the members of your team know that you welcome their ideas. Leaders who encourage involvement from group members have shown to lead to greater commitment, more creative problem-solving and improved productivity. Constant change is a business reality, and organizations must continually adapt to their environments to stay competitive or risk losing relevance and becoming obsolete. For each change, leaders must define it, create a vision of the post-change world and mobilize their teams to make it. Fundamentally, a change of culture occurs when people start behaving differently as a result of a change in the climate of the organization. There

are many different models of how an organizational culture is shaped by the prevailing climate and how it can be assessed. Leaders who protect the status quo through control must surrender to change in order to secure the future for their organization. Don't be the leader who rewards herd mentality, and me-too thinking. Don't be the leader who encourages people not to fail or not to take risks. Be the leader who both models and gives permission to do the exact opposite of the aforementioned – be a leader who leads. The culture of an organization is learnt over time. It can be taught to new employees through formal training programs but is more generally absorbed through stories, myths, rituals and shared behaviours within teams. Organizational culture will impact positively or negatively on everything you try to do, whether you want it to or not.

## 3.4 Transformation and Adaptability of Strategies and Tools

Fierce competition, globalization and the present COVID-19 pandemic are leading to significant challenges for enterprises and organizations. As a consequence, it is necessary to have appropriate countermeasures, corrective actions and tools to overcome the crises. On the contrary, those enterprises and organizations that have not the right strategies and management tools will not survive.

In this context, challenges in management are characterized by high complexity, unpredictability and uncertainty. Managers must have therefore effective, quick and pragmatic concepts for structuring and resolving problems. The classic management literature is often too theoretical or too detailed for this. A short, concise introduction to a tool is sufficient to give modern managers the food they need for thought (Kieviet, 2019). This is where this book starts. It clearly presents effective strategies and management tools as well as the most important concepts. It describes possible applications and makes it easier to interpret the results. The book offers the manager a pragmatic and effective help to gain transparency about existing concepts and tools, to find the right tool for the respective situation and ultimately to use it effectively to obtain a long-term sustainable competitive advantage (Helmold & Samara, 2019).

As a rule, the need for corporate transformation and change is associated with changing market conditions or economic, technological or social changes, as a result of which the company suffers from a decline in sales, rising operating costs and decreasing customer relevance or customer loyalty. Often, it is the big trends and developments, such as digitization or the trend towards sustainability. The example of the publishing house or the music industry makes it clear how existentially threatening such changes can affect a company. These examples also make it clear that business transformation is not just a question of the need for change but also a question of the ability to change. While economic, technical and social change represents an existential threat for one company, it is a guarantee of success for adaptable and agile companies and offers a wide range of business opportunities. E-commerce, cloud computing and the green economy are intended to illustrate this

symbolically at this point. Entire new industries and business fields are emerging here that would never have emerged without technological change and social and political pressure. Even if some companies suffer from constant, increasingly accelerating change, as a rule every change brings improvement with it – improvement for consumers, the environment and society. So change means evolution. The art of making use of change for one's own company therefore lies in continuously helping consumers, the environment and society to improve their quality of life. This creates new ideas, new business areas, new revenue models, new industries ... and ultimately lasting success, supported by more sales and more emotional and loyal customer relationships. With this in mind, whenever possible, contribute to improving the quality of life of your customers, the environment and society – and always remain adaptable.

## 3.5 Lean Transformation Strategies

Lean management transformation describes an optimizing change in business activity and/or working methods emanating from the company management, which can only include partial areas as well as the company as a whole. The need for lean management transformation is usually based on external factors. These can be, for example, tougher competitive conditions, fundamental changes in the law or general social and technological change, such as that brought about by digitization or the trend towards sustainability.

The aim of the business transformation is always to strategically secure business operations over the long term and thus create the basis for lasting and sustainable success (Klasen, 2019). It is not an approach to the realization of short-term one-off effects. It does not concentrate on individual fields of action but rather captures the change process as a whole. In addition, the focus of the business transformation is not on individual persons or groups of people but rather integrates the entire economic, social and societal environment of the company. Lean management transformation strategies aim at this

- To secure and increase sales sustainably.
- To reduce operating and other costs.
- To intensify customer satisfaction and customer loyalty.

The term was first put into circulation by the management consultancy Gemini Consulting in the early 1990s. Their consultants Francis J. Guillart and James N. Kelly published a book in which they processed the experiences from their everyday work and at the same time detailed lean management transformation as a formula for the long-term success of companies in a constantly changing market economy.

The basis of their considerations was the view of companies as living organisms. This should enable them to react flexibly to fluctuations and changes in the market in order to insist on it permanently, economically and profitably. Lean management transformation projects are usually very complex and lengthy. There are several

reasons for this. On the one hand, lean management transformation projects tend to be used in larger companies. This is less due to the size of the company itself or the financial possibilities, but rather because the management of a stock corporation or group has to answer to shareholders, partners, investors and supervisory boards, whose own financial future depends heavily on the success of the company. Owner-run companies, on the other hand, often suffer from sticking to the once tried and tested rituals for too long. The emotional relationship to the past is significantly higher and often proves to be the greatest brake on change in management and the workforce.

In addition, many lean management transformation projects are initiated far too late by those responsible. Often the course of the crisis or the process of economic, technological or social change is already very far advanced. And companies can often no longer make up for the lost time. One industry that has had to experience this in a painful way is the photography industry. Former industry giants such as Kodak, Agfa or Pollaroid, who, despite great efforts, were never able to build on the great successes of bygone days. The principle of hope seems omnipresent, and statements such as "this trend will definitely pass" or "we'll get in when the others have made their mistakes" are not uncommon. This may sound ironic to some. It has always been one of the outstanding virtues of German entrepreneurship to develop and occupy markets through innovations, inventiveness and engineering skills (Fig. 3.3).

Since lean management transformation strategies are essential for the future and sustainable success of the company, these projects are always the responsibility of the management (Sahoo, 2019). In addition to a large number of internal and external experts, industry and company experts, lean management transformation projects are usually accompanied by a specialized management consultancy that guides the company through the four relevant project sections of lean management transformation in a targeted and efficient manner (Womack et al., 1990). The reframing goal setting and goal definitions are

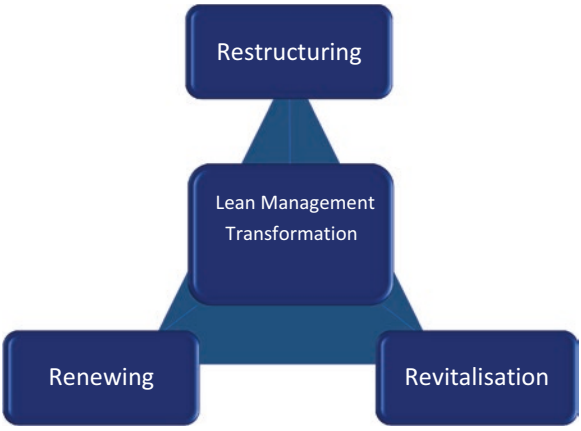


**Fig. 3.3** Lean management transformation elements. (Source: Author)

- Restructuring – structural reorientation of the company.
- Revitalizing – product development and innovation.
- Renewing – consistent internal and external implementation.

As a rule, lean management transformation is a project that encompasses the company as a whole. In the context of product and innovation development, however, it can also happen that only an encapsulated area of a company is subject to business transformation. As a rule, however, these projects are also the harbingers of a long-term lean management transformation process (PM, 2018). Either way – the impetus for lean management transformation always comes from outside. Companies that embark on such management projects are usually market-oriented (rather than resource-oriented), and the structure of these companies usually follows strategy (and not the other way around). Lean management transformation strategies are not a short-term affair (Helmold et al., 2019). They are subject to consistent, self-critical analysis, vigilance and the highest level of empathy and demand discipline and consistent action from management and staff. The changes are often carried out over several years according to a fixed plan and gradually realign the company (evolution instead of revolution).

Figure 3.4 shows a conference of Panasonic Automotive, in which managers from all parts of the world gathered to discuss the Panasonic strategy. Part of the conference gathering is to understand the mission, vision, strategic objectives and the kata of Panasonic.

## 3.6 Case Study: Volkswagen Production System (VPS)

The US car manufacturer Henry Ford initiated the first revolution at the beginning of the twentieth century by introducing assembly line production. Their triumphal march went so far that fans in Germany would have preferred to write "progress" with a "d" in the middle. Half a century later, Toyota began to replace the myth with its Toyota Production System (TPS). The famous American think tank Massachusetts

**Fig. 3.4** Kata conference of Panasonic in Japan. (Source: Author)

Institute of Technology (MIT) in Boston named Toyota the "machine that changed the world" and that triggered a "second revolution in the auto industry".

Toyota's success was based on lean production. Its three principles determine industrial production worldwide to this day: just-in-time production, in which parts are delivered to the assembly line at the right time without being kept in stock; Kaizen, the constant improvement of production; and Jidoka, the early avoidance of mistakes.

In contrast, VW is now employing a strategy that is intended to overtake the Toyota system. In essence, it is about four thrusts:

In the future, not only vehicles of one class – such as the VW Polo and the Skoda Fabia – will share the substructure and many components. In years of detailed work, VW managers have identified parts that they can use in all models and brands. That "cost a lot of energy", says VW boss Winterkorn: each brand had different requirements, and each vehicle developed a lot of special requests that first had to be brought under one roof.

The selected parts were combined in so-called construction kits, which vehicle developers can use in the future. The latest and most important is the so-called modular transverse matrix (MQB), which contains common components for all models of the VW brand with a transverse engine. The modular principle was invented by the premium subsidiary Audi, which has a modular longitudinal construction kit for models with a longitudinally seated engine. The inventors from back then are now in key positions in Wolfsburg: Group boss Winterkorn, VW production manager Waltl and group development director Ulrich Hackenberg. With the modular principle, VW is reducing the complexity in development and production. By purchasing larger quantities per part, the costs are reduced considerably.

All of the Group's vehicles are designed in such a way that they can be manufactured using the same machines. VW can buy large quantities of the same production machines and thereby reduce costs. "An order for 5,000 identical robots from the Kuka brand was recently placed", says a VW manager. "That would have been unthinkable in the past".

VW wants to assemble four different models per assembly line in the future, even from different group brands. This eliminates overtime in those factories whose vehicles are particularly in demand and idle times where sales of a particular model are stagnating. In short, flexibility increases dramatically.

All production workers are trained uniformly. Nowhere does VW want to accept a loss of quality just because the employees fail to meet the corporate standards. The standardized training is made possible by uniform technology.

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# Keiretsu Networks (系列 ネットワーク)

# 4

*All of management's efforts for Kaizen boil down to two words: customer satisfaction.*

Masaaki Imai

## 4.1 Definition of Keiretsu Networks

A keiretsu network (系列 ネットワーク) or keiretsu value chain network (Japanese: integration, order or system of stakeholders, partners and suppliers) represents a means of mutual security, especially in Japan, and usually includes large manufacturers and their suppliers of raw materials, systems and components (Ahmadin & Lincoln, 2001). Keiretsu groups are defined as clusters of independently managed firms maintaining close and stable economic ties, cemented by a governance mechanism such as presidents' clubs, partial cross-ownership and interlocking directorates. Within the broad definition lie two distinctive variations. The horizontal keiretsu are conglomerates covering several industries linked by cross-shareholding, intra-group financing and high-level management by a central (often shadowy) body of directors. The vertical keiretsu networks are groups around one big manufacturer and consist of a multi-layered system of suppliers focused on the core company (Gabrowiecki, 2006). Keiretsu networks have received much attention in the European automotive and transportation sector through the success of Japanese companies like Toyota, Mitsubishi or Hitachi and other conglomerates in achieving improved customer service, better inventory control and more efficient overall channel management (Freitag, 2004). Keiretsu, which is a form of Japanese business network, shares many of the goals of several business functions. The concept of a keiretsu network was introduced by Toyota in the mid-1980s (Imai, 1986) and transferred to affiliates and suppliers outside Japan (Kalkowsky, 2004). Figure 4.1 depicts the example of a Keiretsu network structure including the core business functions and enterprises of bank, insurance and finance companies. These core businesses are surrounded by companies in leading industries like automotive, food or machinery and electrical applications. In addition to this, keiretsu networks may include supporting businesses such as warehousing, transportation or component



M. Helmold et al., *Lean Management, Kaizen, Kata and Keiretsu*, Management for Professionals, https://doi.org/10.1007/978-3-031-10104-5_4

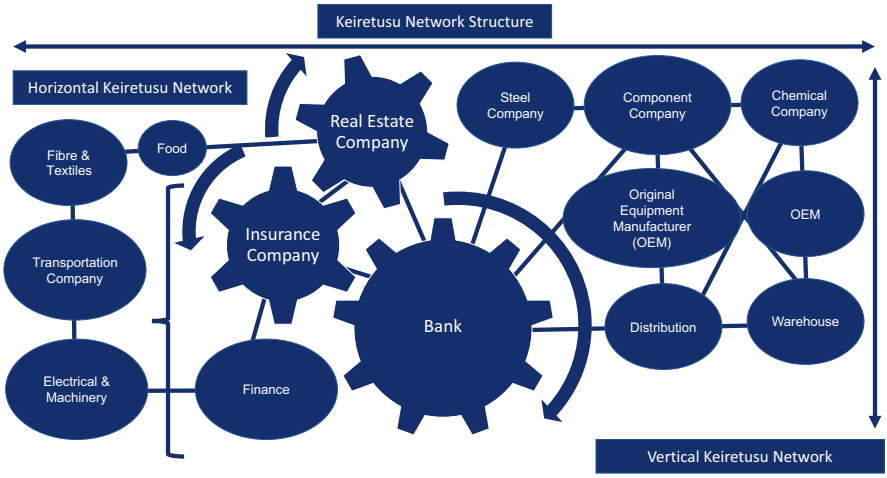


**Fig. 4.1** Keiretsu network structure. (Source: Author)

supplies. Keiretsu networks are differentiated into horizontal (same layer) and vertical keiretsu networks (different layers).

Keiretsu networks often include partial ownership of the respective supplier as collaborative keiretsu or supply networks (Shun Cai et al., 2013). Control relationships between pairs of firms represent a form of bilateral exchange. The school of keiretsu may lead to broad functional and cultural changes for those companies that use the system (Freitag, 2004). Keiretsu networks with financial and commercial connections develop quasi-administrative ties through cross-shareholding, as Keiretsu networks have two sides: (1) horizontal relationships based on mutual support, and (2) vertical structures based on asymmetric exchange and control between financial firms and industrial firms. In various articles and books, Liker explains the Toyota way and the principles of keiretsu supply networks (Liker, 2004). Many OEMs and their suppliers have meanwhile adopted this system (Liker & Choi, 2005).

- Keiretsu refers to the Japanese business structure comprising a network of different companies, including banks, manufacturers, distributors and supply chain partners.
- Before the keiretsu system, the primary form of corporate governance in Japan was the zaibatsu, which referred to small, family-owned businesses that eventually evolved into large, monopolistic holding companies.
- A horizontal keiretsu refers to an alliance of cross-shareholding companies led by a Japanese bank that provides a range of financial services.
- A vertical keiretsu is a partnership of manufacturers, suppliers, and distributors that work cooperatively to increase efficiency and reduce costs.
- A drawback of the keiretsu system is the easy access to capital, which can lead a company to take on too much debt and invest in risky strategies.

## 4.2 Birth of Keiretsu Networks

It is widely accepted that the formation of enterprise groups called keiretsu was established in Japan after the Second World War by Toyota and other huge enterprises. On the other hand, some authors indicate that the roots of above-mentioned groups were in the Meiji period. After Japan had broken with the two-century policy of isolation, the young Meji government created the initial infrastructure for future industrialization. Moreover, it was actively involved in establishing and expanding companies. The result of this policy was the creation of a zaibatsu (Kensy, 2001). The zaibatsu were family-run enterprise groups. Morikawa (1992) defines zaibatsu "as a group of diversified business owned exclusively by a single family or an extended family". Zaibatsu companies started to develop themselves very quickly because they obtained a lot of subsidies and contracts from the Meiji government. The first zaibatsu to be created was Mitsui, which was established in 1876. The next three established zaibatsu were Mitsubishi, Sumitomo and Yasuda. Mitsubishi was concentrated on shipbuilding and heavy industry and was a major player in mining, shipping, trade, brewing, insurance and banking. Sumitomo activity was focused on banking but also on mining and metals. Yasuda zaibatsu became specialized in finance, controlling an important bank, a major trust bank and two large insurance firms. These four zaibatsu were called the Big Four. They expanded their financial business, also establishing insurance companies and trust banks (Miyashita & Russell, 1994). The individual zaibatsu had a monopoly in one or two industries, but soon the whole Japanese economy was divided up between them. By the end of the First World War, each zaibatsu had launched at least one major manufacturing company in each sector and controlled, respectively, a bank, an insurance company, a shipping line and trading company. In 1930, approximately 75% of Japan's Gross Domestic Product was directly or indirectly controlled by the largest zaibatsu (Kensy, 2001). After Japan's collapse in the Second World War, the American occupational forces decided to dissolve the zaibatsu as the source of Japanese military power. They intended to destroy the economic base of the Japanese military and prevent monopolistic market concentrations. As a result, it was planned to sell shares to the public and dissolve the zaibatsu into countless smaller companies (Baum, 1994). In 1947, Antimonopoly Law came into effect. The new law made holdings companies illegal (Miyashita & Russell, 1994). In 1948, the global political situation began to change. In Europe, the cold war started and Communism began to spread in Europe and Asia. By 1948, the United States began to see Japan as a strategic buffer between the United States and the Communist countries. The United States needed a strong Japan with a strong economy rather than a weak Japan (Miyashita & Russell, 1994). The process of the dissolution of the zaibatsu was stopped. Many of them were re-established. The originally forbidden practice of using the old zaibatsu names in the names of new companies was now accepted (Morikawa, 1992). This time, companies grouped around the banks were allowed to hold shares in other companies, which made the establishment of financial links easier. They quickly achieved economic parity with the classic zaibatsu. These conglomerates were now called keiretsu. Some emerged out of former zaibatsu, but

others were just new groupings of companies (Baum, 1994). The new keiretsu companies lacked parent corporations operating as holding companies, the influence of family, common in a zaibatsu, disappeared, and member companies were independent (Katsuki & Lennerfors, 2013).

Figure 4.1 depicts a typical Keiretsu structure of leading and centred companies (bank, finance, insurance) and supplementary businesses like food, electrical or textiles.

## 4.3 Horizontal Keiretsu

A horizontal keiretsu is a group of very large companies that are independent and operate in different industry sectors. The Mitsubishi Group of companies would be one example. As mentioned above, many independent companies exist in horizontal keiretsu (Motzkus, 2010). There is no holding company that directs the activities of the group. On the other hand, there is a bank, which, together with trading company, acts as the linchpin of the group. Around them, there are the core members, usually three firms: a life insurance company, a non-life insurance company, a trust bank and one or two very large manufacturers. Together with the financial firms, the trading company and the key manufacturers give the keiretsu its identity (Rossmann, 2003). The important feature of vertical keiretsu is the companies in the same group want to do business together, so it is difficult for outsiders to break in, especially if they have to compete with companies in the group. The companies in the group are independent but usually they operate as one body. Inside the horizontal keiretsu, the key role is played by the bank (Gerlach, 1992). It can be seen that the central role during the pre-war period in capital allocation among a zaibatsu was played by the holding company. During the post-war period, with the dissolution of the holding companies, this role was taken over by large city banks as major lenders of capital. It is visible that the bank does not lend all the money the company requires but provides the largest amount and acts as a sort of guarantor for the other banks that lend money to the company. Thus, big Japanese companies have good access to financial sources. There is a close relationship between companies in the group and bank. The group usually has a bank that is the largest lender but also has important shareholders of other companies in the group. Thus, debt-holders are often shareholders at the same time. This network of mutual shareholding is characteristic of the keiretsu and is often called cross-shareholding (Hoshi, 1994). It happened very often that a group of affiliated firms issued shares and assigned them to member firms in order to protect firms against takeover by foreign competitors. As was pointed out, the second important element in horizontal keiretsu is the trading company. It has a vital role in a horizontal keiretsu of coordinating trade, not only within the group, but also among different groups and even with foreign companies (Miyashita & Russell, 1994).

## 4.4 Vertical Keiretsu

A vertical keiretsu is formed by one very large company (assembler) and hundreds or thousands of small companies (suppliers). The vertical keiretsu usually occurs in the automotive industry in Japan. A good example would be a large company like Toyota. The vertical keiretsu is also common in electronics, although many other fields have their own vertical keiretsu, including advertising, publishing, broadcasting and other non-manufacturing businesses (Miyashita & Russell, 1994). It is important that the shape of the vertical keiretsu is a pyramid. In the case of an automotive manufacturer, a few tiers of suppliers are involved: the first tier of companies supplies the car assembler, the second tier works for the first tier, the third tier for the second, and the process is continued downward. In other words, at the top of the pyramid there is the most important company (assembler) and at the bottom there are hundreds or thousands of companies (suppliers). It is common that the smallest companies at the bottom of the pyramid do not even know that they work for the world famous assembler. On the other hand, the parent company has no idea how far down its pyramid extends. It can see only two or three pyramid levels down.

Yoshihara notices that unlike horizontal keiretsu, power relations are unequal in vertical keiretsu. The assembler has much more power than its suppliers. The assembler possesses the option of terminating relations, while its suppliers can leave the keiretsu and join new keiretsu. Many suppliers also depend on the assembler for capital, technology, management know-how and manpower. According to Baum (1994), the companies in vertical keiretsu behave like one organism: giving loans, technology, development costs and long-term supply agreements from customers higher up in the pyramid to subcontractors.

## 4.5 Roles of Keiretsu Networks

### 4.5.1 Seven Tasks of Keiretsu Networks

In a keiretsu, the important role is also played by the presidents' club. The member companies of the presidents' club come from six large enterprise groups. There are large banking, finance, trading, real estate, and manufacturing corporations. Nakata (1998: 138) explains that the purpose of the club is to share information on economic conditions and other business matters. The exchange of opinions between company presidents is often carried out in order to establish new enterprises and high-level personnel matters in member companies (Kikkawa, 1995). The presidents' club does not directly influence the decision process in member companies but fulfils an important role in decision-making related to the interests of the enterprise group. There are several functions of a keiretsu, which emphasize that it has a big advantage over other competitors and contributed to the big success of Japanese group companies on the world market. Some authors argue that one of the most important functions of a keiretsu is minimizing transaction costs (Shimotani, 1995).

But according to Kensy (2001), there are seven tasks performed by a keiretsu on behalf of the members of its group:

1. Organization of overall business procedures.
2. Risk-distribution function.
3. Information function.
4. Internal financial market functions.
5. Strategic group coordination functions.
6. Symbolic functions.
7. Forward-looking structural change functions.

### 4.5.2 Organizing the Operational Activities

One of the most important functions of a keiretsu is organizing the operational activities of all group members. This function covers all sectors of activities from marketing, logistics and distributions, transport, warehousing, insurance and outlet management to ancillary administrative services and other general organizational functions. Kensy (2001) notices that an important role is played by the trading companies located in the structure of a keiretsu. The trading companies undertake the main portion of these organization functions. They serve to coordinate and generate supply and demand on the home market within a keiretsu. The organization function contributes mainly to cost savings, time savings, minimizing risk management and increasing strategic efficiency.

### 4.5.3 Risk-Distribution Function

This is the most significant function of a keiretsu. The fundamental principle of a keiretsu is long-term agreements between group companies. Furthermore, the mutual business relationships are clearer because counter partners know each other. It is also easier to plan long-term investments. Group companies hold the shares of other companies in the group. This makes it difficult for outsiders to take over a company in the group and thus gives management long-term stability (Yoshihara, 1994). Gerlach (1992) also pointed out that "large companies have the broadest scale and scope of activities, and the resulting benefits of complementary coordination among these firms, their banks, trading companies, and other large industrial companies are greatest". The companies involved in a keiretsu can better reduce risks across a diverse range of business lines than smaller and more focused companies. Furthermore, better risk management contributes to higher profits achieved by keiretsu companies.

### 4.5.4 Information Function

Fast access to information is crucial in modern business. A keiretsu provides fast access to daily updated information for their companies. The possession of relevant information gives a keiretsu a big advantage over its competitors. A keiretsu has access to information from the home market but also from overseas markets. They collect home market data and foreign data from keiretsu companies that operate abroad. Financial information comes from financial and trading links and is analysed by the main bank. The information sector is highly developed in Japan. The Japanese keiretsu was the first to own satellites: Mitsubishi was the first company to launch a dedicated satellite into space, especially for internal purposes (Kensy, 2001). The Japanese are famous for its developing communication technology. The good development information system is a fundamental component in terms of keiretsu's success.

### 4.5.5 Internal Financial Market Functions

A keiretsu provides access to funds for group companies. As it was mentioned earlier, a very important role is played by the bank inside a keiretsu. It does not only lend all the money the company requires but also provides the largest amount and acts as a sort of guarantor for the other banks that lend money to the company. Kensy (2001) mentioned that keiretsu also provide access to international money and capital markets, which are difficult to achieve for individual, small and unknown member companies. This also reduces interest charges for smaller companies.

### 4.5.6 Strategic Group Coordination Function

The keiretsu plays an important strategic role in management planning and as a general protector of group companies (McGuire & Dow, 2009). A keiretsu provides protection against competitive pressures and also against foreign market players. Kensy compares a keiretsu to an umbrella that shields smaller firms from excessive risks. It prevents speculators and hostile take-over. This is performed internally within a keiretsu by their financial institutions, which conduct management control and monitor company performance. The financial crisis that broke out in Asia in the summer of 1997 has brought a big pressure on companies to change. In order to survive the crisis, keiretsu enterprises have begun to transform themselves. In a situation when the Japanese economy slowed down, the competitive advantages of the keiretsu were the barrier to coping with the crisis. Keiretsu banks found themselves with huge bad debts from group companies, inter-group purchasing became a barrier to cost reduction, and loyal labour forces were viewed as a burden to struggling companies (Chen, 2004). The government also implemented several reforms to stop slowing down the Japanese economy. Choi (1999) explains that keiretsu companies have also been subject to the pressure of the Japanese government, which initiated

reforms in order to revitalize the economy. The financial system reform was prepared by the government of Prime Minister Hashimoto in 1997. It covered all areas of the financial sector – banking, securities and insurance. The Financial System Reform Law was enacted, which included the following points: legalization of the financial holding company, withdrawal of the full-deposit protection scheme and corporate accounting reform. The government also intended to accelerate financial restructuring by boosting foreign competition (Choi, 1999). It was obvious that all the above-mentioned measures would influence keiretsu performance. On the other hand, keiretsu companies began themselves to implement some reforms to stop the crisis, mainly in the automotive and electronic industries. The Financial System Reform Law and revision of the Anti-Monopoly Law lifted the ban on holding companies. As a result, companies could choose to establish holding companies, under which they could organize subsidiaries (Choi, 1999). The next reform was the withdrawal of the full-deposit protection scheme imposed on domestic bank mergers. Weaker banks were forced to find merger partners because depositors probably would withdraw funds from banks perceived to be at risk. The government also introduced a number of new corporate accounting reforms. It would make it difficult for parent companies to hide non-viable subsidiaries by concealing profits or losses. The Japanese government also liberalized the four areas of foreign exchange operations: capital transactions, foreign direct investment and the Tokyo offshore market. The foreign banks could start to take over failed domestic banks. In this situation, Japanese banks were forced to merge each other in order to successfully compete with powerful foreign banks (Choi, 1997). All reforms implemented by the government and the stagnation of the Japanese economy in the second half of the 1990s and at the beginning of the 2000s influenced the gradual transformation of the keiretsu structure. It was especially vital in the relationship between a bank and keiretsu companies. It was less attractive for the banks to grant loans to companies with decreasing profitability and hold shares of these companies. On the other hand, keiretsu companies did not want to hold shares of member banks when they were not able to offer the previous level of support (Choi, 1997). Companies started to seek funds on the liberalized capital market. This situation influenced weaker relations between a bank and keiretsu companies. Thus, keiretsu companies became more vulnerable to take over by outsiders. Choi (1997) argues that "these factors have already brought significant changes to the existing incorporate relationship among keiretsu member firms and may eventually dissolve the keiretsu structure". Many keiretsu companies were also forced to implement some reforms to stop the crisis and struggle with foreign competitors. In particular, automotive and electronic companies introduced many cost-cutting reforms. These reforms, mainly staff reduction, transferring of production overseas and a review of purchasing strategies, influenced the bankruptcy of many domestic companies belonging to keiretsu groups. Some of the subcontractors had to try to join another keiretsu group or become freelance. It also resulted in increasing the rate of unemployment. In 2001, the rate reached a level of 5%, the highest in post-war history of Japan. In many companies, in order to cut costs, it was common to increase the number of part-time employees. It influenced the relationship between employers and employees. Many

employers were not able to guarantee lifetime employment. Therefore, employees were conscious of the fact that during their career they will have to change their workplace one or more times. Currently, keiretsu faces another problem, the shortage of a well-educated labour force. This is also a big problem for the Japanese economy. The fast decreasing birth rate will create a drop of the numbers of workers. Japan probably will have to open its job market for immigrants and attract more foreign workers. In all of the post-war period, Japan was a homogeneous society. However, in the near future, many foreign workers, especially blue-collars, will join Japanese companies. Thus, it is an interesting aspect to see how it will influence the structure and performance of keiretsu in the near future. One outstanding feature of the Japanese economy is the dominance of large business groups – keiretsu. They influence not only the economy but also maintain close relationships with the government. Furthermore, keiretsu benefited from large governmental involvement in the economic development of Japan (Chen, 2004). On the other hand, the activity of the keiretsu in the post-war period was a success. In less than two decades, the Japanese industry sector had developed the country by raising the national standard of living from the poverty level to the one of highest in the world. And much of the credit for this growth goes to the government policy that promoted the keiretsu system (Miyashita & Russell, 1994) and to keiretsu companies that were always the major players in the Japanese market.

## 4.6 Case Study: Toyota Keiretsu Structure

Toyota is famous for representing a Keiretsu network structure, as shown in Fig. 4.2. The Toyota Keiretsu is a cluster of interlinked Japanese firms, centred on a bank, which lends money to member companies and holds an equity stake in these companies. By combining forces, these companies are able to reduce costs and risk, better facilitate communication, ensure trust and reliability and provide insulation from the outside competition (Katsuki & Lennerfors, 2013). There are two types of keiretsu, horizontal and vertical. Horizontal, inter-market keiretsu are diversified networks of large companies. These included the three aforementioned descendants of the pre-WWII zaibatsu. Vertical manufacturing and distribution keiretsu are asymmetric networks where small-firm sectors are dominated by large sectors. The Toyota Group is considered to be the largest of the vertically integrated keiretsu groups (Furata, 2021). The United States and most Western countries looked unfavourably upon the keiretsu because they interpreted such a business scheme to be that of an outlawed monopoly or cartel. The Toyota Group is a terrific example of a highly successful, complex and prominent keiretsu in Japan. It is a member of the Mitsui Group, which is one of its main banks, but functions very independently of the bank. In the past couple of decades, Toyota has been on the top of the list domestically in the United States as well as abroad in terms of sales and profits. The parent firm generates, on average, $72 billion each year in sales with 72,000 employees. That equates to one million dollars in sales per employee, which is roughly six times

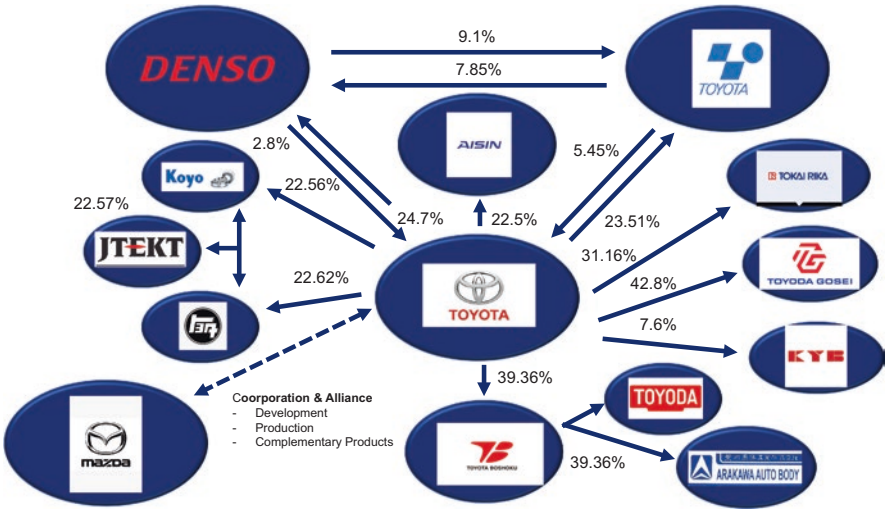


**Fig. 4.2** Toyota keiretsu network structure. (Source: Author)

that of the competitor, General Motors. Toyota has been the best-selling car in Japan for over 24 years. This alone shows the clout and power of the Japanese keiretsu. This company is the largest industrial combine in Japan and one of the largest keiretsu in the nation. Another amazing fact is that Toyota is much more than a car manufacturer. In fact, Toyota is a major participant in three telecommunication companies, it is a principal investor in a computer system development firm, and it holds stakes in an insurance company specializing in automotive insurance. Furthermore, Toyota operates four real estate firms and two financial firms and is currently exploring opportunities in the aerospace industry. Due to the prominence of keiretsu in post-WWII Japan, only those employees that worked in core firm sectors benefited. Those who were forced to work at small firms suffered from low wages, limited career mobility and job instability. Much can be said for the keiretsu system, which, as seen in the case study on the Toyota Group, can yield much power and success.

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# Kyouiku (教育) – The Learning Enterprise

# 5

*The thing is, continuity of strategic direction and continuous improvement in how you do things are absolutely consistent with each other. In fact, they're mutually reinforcing.*

Michael Porter

## 5.1 Transformation to a Learning Enterprise: Kyouiku (教育)

Kyouiku (教育) is the term for learning or education. Social education and lifelong learning (shougai gakushuu) are terms used to refer to companies, adult education and related activities in Japan. Adult education originated immediately after the Second World War with the enactment of the Fundamental Law of Education (1947; revised in the 1980s). Since the mid-1980s, lifelong learning has been the more commonly used term. Not only does lifelong learning involve going to school to learn how to read and write, but it can also involve the learning that takes place outside the classroom through volunteering, outdoor activities, sporting events and so on. Companies in Japan promote learning activities for their employees. Companies have become learning organizations. A learning organization is ideally a system that is constantly in motion. Events are taken as suggestions and used for development processes in order to adapt the knowledge base and scope for action to the new needs. This is based on an open and individualized organization that allows and supports innovative problem-solving. Mechanisms that support such learning processes are the following:

- Clear mission and visions, with common target processes.
- Orientation of the organization towards the benefit of the customers.
- Ability to cooperate and resolve conflicts, with mutual trust and team spirit.
- Process orientation and self-regulation in groups.
- New leadership style, support for new ideas (especially through leadership), idea management, integration of personnel and organizational development.
- Rewarding commitment and tolerance for mistakes in risky endeavours.



M. Helmold et al., *Lean Management, Kaizen, Kata and Keiretsu*, Management for Professionals, https://doi.org/10.1007/978-3-031-10104-5_5

- Ability to (self-)observation and well-functioning forecasting and communication systems – quicker, more precise and overview of the effects of the most important processes.

## 5.2 Learning Enterprise: Gakushyu Kigyiou (学習企業)

In order to be successful, organizations should learn and respond to changes quickly. They learn about effectively challenging conventional wisdom, manage the organization's knowledge base and make the desired changes. All organizational members take active part in identifying and resolving work-related issues. In a learning organization, employees practice knowledge management. They continuously acquire, share and apply new knowledge in making decisions. In today's world of competition, organizations that learn and apply new concepts have an edge over competitors. "All organisations learn, whether they consciously choose to or not — it is a fundamental requirement for their sustained existence". "People continually expand their capacity to create the results they truly desire, where new and expensive patterns are nurtured, where collective aspiration is set free and where people are continually learning how to learn together." Learning organization "facilitates the learning of all its members and continually transforms itself". Peter Senge, author of "*The Fifth Discipline:* The Art & Practice of The Learning Organization", popularized the term "learning organization" in the early 1990s. He defines learning organizations as "organizations that encourage adaptive and generative learning, encouraging their employees to think outside the box and work in conjunction with other employees to find the best answer to any problem" (Senge, 2006).

Senge is an advocate for decentralized leadership, a model in which all people in an organization can work towards a common goal. His Five Disciplines of a learning organization outline how that can happen:

1. **Personal Mastery:** In an interview, Senge called personal mastery the "cornerstone" of a learning organization. Personal mastery is the development of the capacity to accomplish personal goals; learning organizations make this possible by creating an environment where employees can, through reflection, develop their own sense of vision – how they look at the world, what matters to them, and what they are passionate about contributing to. Senge said, "Personal vision is the soil in which shared vision can be grown".
2. **Shared Vision:** A shared vision is only possible in an environment of trust and collaboration instead of compliance to directives from on high. Corporate leadership works together with employees towards a common vision – creating an environment where employees feel heard and are encouraged to take risks.
3. **Mental Models**: With a mental model, we understand how our deeply ingrained assumptions and generalizations affect our interactions and decisions. To paraphrase Senge, understanding the difference between hearing what someone

said, truly understanding what they said, and understanding the gap between what actually happened and what we perceived happening require reflection. "In a nonreflective environment, we take what we see as truth," said Senge.

4. **Team Learning**: Senge says that team learning can only happen when team members are "humble", when they are willing to reflect and take into account other people's views, suspending personal biases in order to work as a whole in a collaborative environment.
5. **Systems Thinking:** Systems thinking is the idea that we're part of an interrelated system – not a disjointed set of personal silos; systems thinking addresses the whole and creates an understanding of how parts are interconnected. Senge said, "Systems thinking is a sensibility—for the subtle interconnectedness that gives living systems their unique character".

   In lean management organizations, there is a sixth dimension, which has been added to the five dimensions (Helmold, 2021). This is the continuous improvement, which is an important success factor for enterprises.
6. **Continuous Improvement:** The organization must implement a culture and system of continuous learning throughout primary and secondary functions

Figure 5.1 depicts the elements of a learning enterprise.

## 5.3 Creating a Logical and Open Mind: Chiiku (知育)

Chiiku (知育) means to master intellectual knowledge and develop logical thinking for fundamental survival skills. For businesses to stay profitable, they first need stability based on a concrete understanding of their needs and priorities. Then, by using their uncovered resources, they can begin to innovate. Understanding this fundamental need for the business's survival is the foundation of future prosperity, and it should also form the foundation for developing leaders within the workplace. Chiiku focuses on this logical understanding of the business in a larger context. This is like envisioning a forest as an entire ecosystem rather than just a collection of trees. For business leaders, chiiku means to calculate the sense of urgency and communicate it at all times.

## 5.4 Leadership Development and Culture: Tokuiku(徳育)

Tokuiku(徳育) means to develop your rational interpersonal skills as a leader. Rational development (tokuiku) is different from logical development (chiiku). Logical thinking is based on cause and effect, whereas rational thinking is based on quantity and scale. Logical thinking can tell us what we ought to do, but we need to be rational to understand why it benefits each individual. It is necessary for humans to develop themselves by not staying satisfied with the current state and rationally comparing it to other possibilities. Leaders must first develop the courage to take

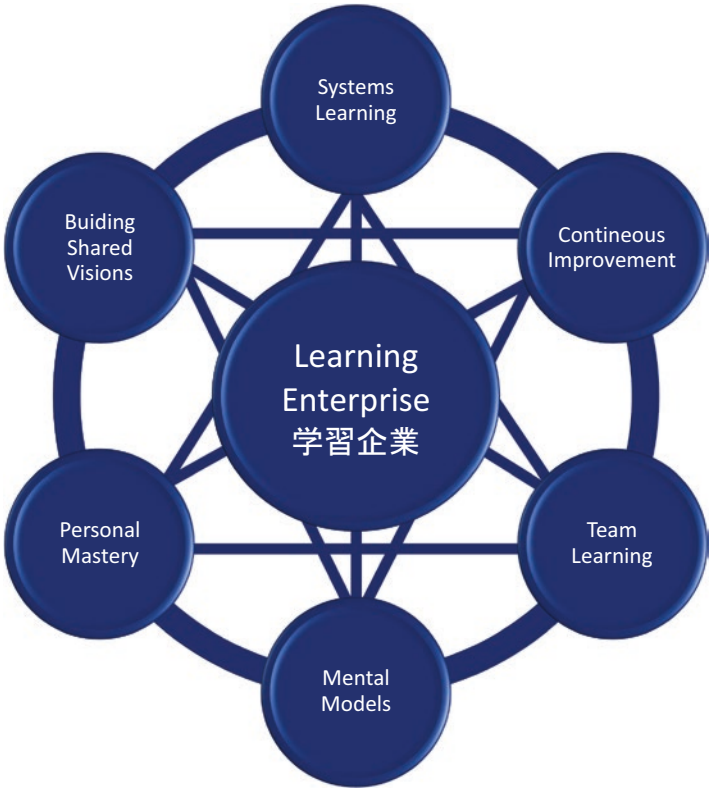


**Fig. 5.1** Characteristics of a learning enterprise. (Source: Author)

risks and surpass the status quo. This is like ensuring the survival of the forest by understanding the needs of each organism that makes up the ecosystem. While chiiku is focused on the organization's survival as an entity, tokuiku focuses on ensuring the enrichment and success of the individuals who make up that entity (Helmold, 2021).

## 5.5 Emotional and Physical Strength: Taiiku (体育)

Taiiku (体育): Modern education systems understand taiiku as physical education (PE). It is seen as simply a way to make students exercise their bodies through sports. But physical education is about more than just building muscles and developing a sense of competitiveness. Taiiku first focuses on strengthening one's willpower and emotions to force out the right actions. For business leaders, taiiku means learning the skills to inspire a culture of immediate action, not just the words. Leaders must learn to help others break the status quo. This means learning the self-criticism mentality (hansei).

**Fig. 5.2** Lean management and culture workshop in China

Figure 5.2 shows a lean management workshop conducted by Dr. Marc Helmold at the company Victall in Quingdao China.

## 5.6 Learning from Experience: Senpai (先輩) and Kōhai (後輩)

Senpai (先輩) and Kōhai(後輩) mean "senior" and "junior", and these hierarchies permeate all relationships in Japanese society, not just at work. A senpai is usually older and of higher ranking or has been at the company for longer. They usually act as a mentor for kōhai, although in reality not all senpai are as generous or genuine about mentoring junior colleagues. This hierarchy dictates all sorts of unspoken rules in Japanese work culture, including where you sit at the meeting table, how you conduct yourself at drinking parties and what level of politeness you need to use (Sinha & Matharu, 2019). As an outsider to a Japanese company, all the etiquette surrounding senpai and kōhai culture can be bewildering, but it's something that you will pick up quickly once you're in that environment.

## 5.7 Case Study: Transformation to a Learning Organization in Google

### 5.7.1 Striving for a Competitive Advantage as Learning Organization

Google was the second most valuable brand in the world. But did you know that they ranked first place on Fortune's annual "100 Best Companies to Work For" 8

times in 11 years and held onto the title consecutively for 6 of those years. The two – their success and their employees' brand evangelism – are not mutually exclusive. Google understands that, when the workforce is engaged and motivated, they begin to feel part of a community and culture, thus achieving business excellence (Jarvis, 2011). These emotional ties are responsible for heightened productivity and loyalty – companies with engaged workforces outperform others by 202%. They also produce output that's of a higher quality and have increased sales productivity, lower absenteeism and increased profitability, among other things.

### 5.7.2 Focus on E-Commerce and Business Models

Electronic commerce or business is more than just another way to sustain or enhance existing business practices. Rather, e-commerce is a paradigm shift. It is a "disruptive" innovation that is radically changing the traditional way of doing business. The industry is moving so fast because it operates under totally different principles and work rules in the digital economy (Lee, 2001). A general rule in e-commerce is that there is no simple prescription and almost no such thing as an established business or revenue model for companies like Google.

### 5.7.3 Learning and Education as Guaranteed Right in Google

While Google's success cannot be attributed to a single practice or initiative, it is, in part, owed to its attitude towards learning. Google approaches employee learning as a right regardless of role, tenure or level. It is also considered a company-wide responsibility to enforce, rather than an obligation that falls solely on a learning and development team's shoulders (Jarvis, 2011). They know that in order to attain the success of the whole (i.e. Workforce Success), the success of each individual must be first secured. And this is achieved by empowering them with the knowledge they need to perform at their very best, in an ongoing, sustained way. When Google faces a major disruption or demands in its markets, managers will integrate employees in their perceptions of the disruption impacts or opportunities and how they respond to it. Based on a profound analysis, Google will allocate resources to the new elements and ideas (Gilbert & Bower, 2002). This enables Google to react to disruption in a quick way. Googles use the following rules for becoming a learning organization.

1. **Learning is a process, not an event.**
   Google advocates that learning is ongoing, or at least, must be if you desire to succeed organizationally. It's never a finite destination – but a continuous journey. It cannot be relegated to one-time events, like workshops and seminars. These are costly and ineffective in terms of knowledge retention – it's known that learning is only committed to long-term memory if it is repeated at spaced intervals (known as the spacing effect).

2. **Learning happens in real life.**

   At EduMe we wax lyrical about the significance of providing people with upskilling opportunities that aren't just relevant to their present need, but timely too. Just-in-time, or on-demand learning is integral to Google's learning culture – they call this learning "in real life".

3. **Learning is personal.**

   Google's third belief is that everyone learns differently. This is a given – you might pride yourself on your photographic memory, but a peer may better retain information that they hear. Not only do no two people enjoy learning in the same way, but what they need to know inevitably varies based on their role and level.

4. **Learning is social.**

   One senior leader at Google is quoted as having said, "it's very unlikely that you'll ever learn faster, or better than you will from one of your fellow employees". While there's something to be said regarding the rising popularity of self-service learning solutions (like YouTube, which 35% of all U.S. adults consider to be very important in teaching them how to do something new), a 55% majority still prefer to turn to their colleagues for support or additional knowledge on the job. Peer-to-peer learning is powerful. It meets three out of four of Google's beliefs on what constitutes a successful learning culture. It's inherently personal and tailored to the individual learner. It only occurs when an individual has a specific learning need and reaches out to someone they believe can help them bridge that knowledge or skills gap.

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# Policy Deployment and Hoshin Kanri Strategy (方針管理)

6

*There is nothing so useless as doing efficiently that which should not be done at all.*

Peter F. Drucker.

## 6.1 Policy Deployment – Hoshin Kanri (方針管理)

Hoshin Kanri (方針管理) also called policy deployment) is a method for ensuring that a company's strategic goals drive progress and action at every level within that company. This method eliminates the waste that comes from inconsistent direction and poor communication. Hoshin Kanri strives to get every employee pulling in the same direction at the same time. It achieves this by aligning the goals of the company (Strategy) with the plans of middle management (Tactics) and the work performed by all employees (Operations). Hoshin Kanri starts with a strategic plan (e.g. an annual plan) that is developed by top management to further the long-range goals of the company. This plan should be carefully crafted to address a small number of critical issues. Key items to consider when developing the strategic plan are the following:

The company's leadership develops a strong vision that answers the question "Why does the company exist?"

The management team defines important goals or a mission. When achieved, they create a competitive advantage for the company. These are important goals that usually require the cooperation of all employees in the company and are not completed in a month or quarter.

The management team, together with the management, breaks down the goals into annual goals.



M. Helmold et al., *Lean Management, Kaizen, Kata and Keiretsu*, Management for Professionals, https://doi.org/10.1007/978-3-031-10104-5_6

Once the annual goals are established, they need to be "deployed" at all levels of the organization. This "goal setting" process begins at the top and is passed on to all employees.

The actual execution begins with the next step. This step goes hand in hand with the next two.

The monthly reviews ensure that the plan is running as planned.

At the end of the year, there is an annual review that confirms the final result achieved.

## 6.2 Definition of Strategic Management

### 6.2.1 Strategic Triangle

The process of strategic management cycle is a process with three elements as outlined in Fig. 6.1 (strategic triangle or strategic cycle) (Johnson & Scholes, 1997). The three steps are (1) the strategic analysis, (2) the strategic choice and (3) the

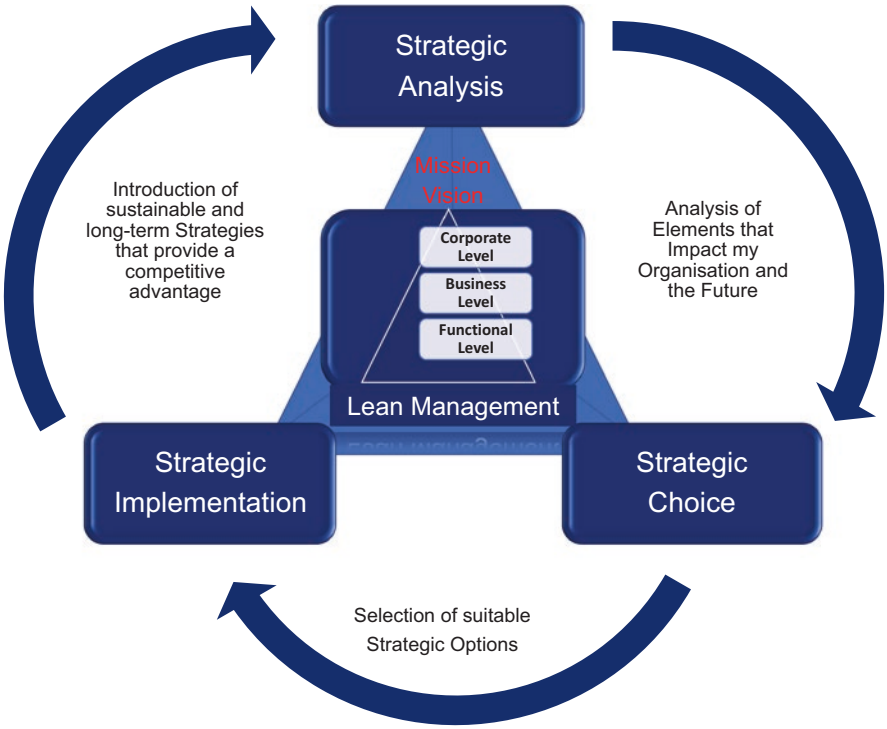



**Fig. 6.1** Strategic triangle. (Source: Compiled by the Author, adopted from Johnson & Scholes, 1997)

strategic implementation and will be described in the following sections. The triangle is raising the following questions:

1. Where are we in terms of lean management?
2. Where do we want to go?
3. How do we achieve this?

### 6.2.2 Strategic Analysis

The strategic analysis of an organization is about understanding the strategic position of the organization in terms of lean management. This stage requires a profound analysis where the organization stands in terms of lean management tools and processes (Johnson & Scholes, 1997). The existing competencies and resources of the organization need to be assessed to determine if there are any opportunities to be gained from these and to determine if they need to be enhanced in order to pursue strategic objectives and goals (Johnson & Scholes, 1997). The major stakeholders that influence the organization and the opinions or viewpoints must be taken into account as the purpose of all of the strategic analysis is to define the potential future direction of the organization. The purpose of this phase (strategic analysis) is to create a suitable starting position and to understand the key influences on the present and future state of the organization and what opportunities are afforded by the environment and the competencies of the organization (Johnson & Scholes, 1997). Assessing the strategic position consists of evaluating the following elements as shown in Table 6.1.

Since strategy is concerned with the position a business takes in relation to its environment, an understanding of the environment's effects on an organization is of central importance to the strategic analysis. The historical and environmental effects on the business must be considered, as well as the present effects and the expected

**Table 6.1** Elements in the strategic analysis

| Strategic element/analysis | Description |
|---|---|
| Environmental, PESTEL Analysis (Macro) | Analysis of the environment including political, economic, social, technology, environmental and legal factors |
| Industry Analysis, Five Forces Analysis (Micro) | Analysis of industry factors like rivalry amongst competitors, threat of new substitutes, threat of new entrants, bargaining power of suppliers and bargaining power of customers or clients |
| Core Competencies, Strengths and Weaknesses (SWOT) | The competitive advantage through superior performance in quality, innovation or technology. The superior performance leads to opportunities and missing factors to potential threats |
| Resources and Capabilities | The assets, people, materials and funds to achieve the strategic objectives |
| Value Chain Analysis (VCA) | Identification of value-added processes and waste alongside the entire value chain |
| Benchmarking Analysis | Comparison with the best-in-class enterprises in the same or similar industries |

Source: Author

changes in environmental variables. The analysis of the environment can be done via the macro and micro analysis (PESTEL (Fig. 6.2), Porter's 5 forces (Fig. 6.3)).

Additionally, strengths, weaknesses, opportunities and threats complete the assessment of the environment (SWOT, Fig. 6.4). This step is a major task because the range of environmental variables is so great. Another area of the strategic analysis is the evaluation of the strategic capability of an organization and where it is able to achieve a competitive advantage. Considering the resource areas of a business such as its physical plant, its management, its financial structure and its products may identify these strengths and weaknesses (Johnson & Scholes, 1997).

The expectations of stakeholders are important because they will affect what will be seen as acceptable in terms of the strategies advanced by management. Stakeholders can be defined as people or groups inside or outside the organization, who show interest in the activities of the organization. A typical list of stakeholders for a large company would include shareholders, banks, employees, managers, customers, suppliers, government and society. Culture affects the interpretation of the environmental and resource influences (Johnson & Scholes, 1997).

### 6.2.3 Strategic Choice

Strategic choice typically follows strategic analysis. Strategic choice involves a whole process through which a decision is taken to choose a particular option from various alternatives. There can be various methods through which the final choice can be selected upon. Managers and decision-makers keep both the external and internal environment in mind before narrowing it down to one. It is based upon the following three elements. First, the generation of strategic options, e.g. growth, acquisition, diversification or concentration. Second, the evaluation of the options to assess their relative merits and feasibility. And third, the selection of the strategy or option that the organization will pursue. There could be more than one strategy chosen, but there is a chance of an inherent danger or disadvantage to any choice

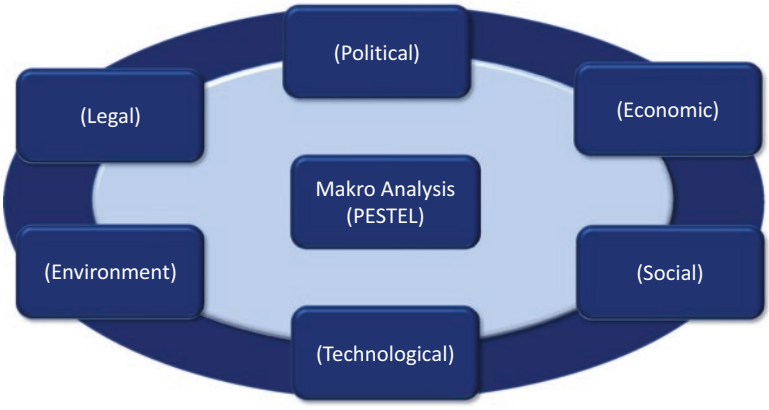



**Fig. 6.2** PESTEL analysis

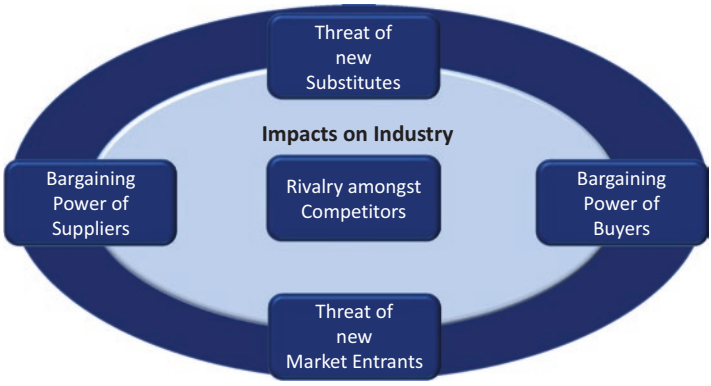
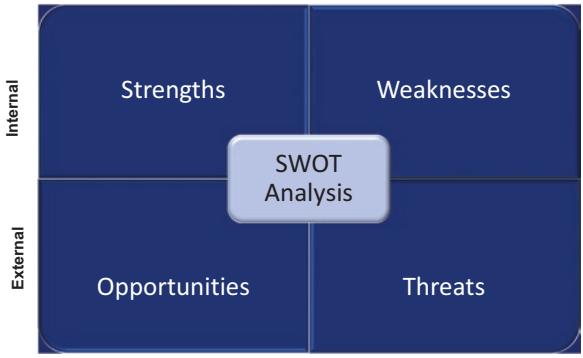



**Fig. 6.3** Porter's 5 forces analysis

**Fig. 6.4** SWOT analysis




made. Although there are techniques for evaluating specific options, the selection is often subjective and likely to be influenced by the values of managers and other groups with interest in the organization (Helmold et al., 2020; Fig. 6.5).

## 6.2.4 Strategic Implementation

### 6.2.4.1 Assessment of Suitability, Acceptability and Feasibility

Strategic implementation is concerned with the translation of the selected strategy into action (Johnson & Scholes, 1997). The ways in which strategies are implemented are described as the strategic architecture or framework of the organization (Johnson & Scholes, 1997). Successful implementation of the chosen strategy will be dependent on several factors such as stakeholder's expectations, the employees, the company culture, the will to change and the cooperation within the organization. These elements and how the management and employees work together to adopt the new plan will decide how successful the strategy implementation is. The available skills and/or the ability to develop new skills when required for the planned change and issues like the structural re-organization and resulting cultural disturbance would also affect success. Resource availability and planning for the utilization of

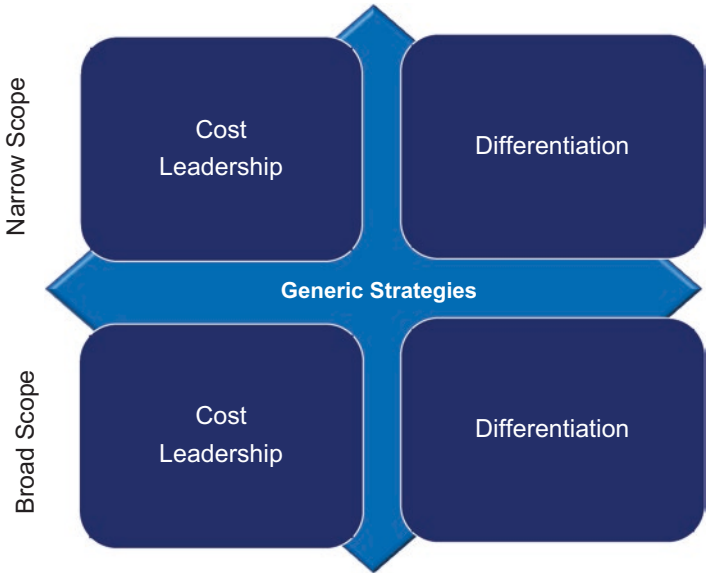



**Fig. 6.5** Generic strategies. (Source: Author's own figure, adopted from Porter (1985))

such resources need to be addressed as part of the implementation plan. The entire process necessitates the management of strategic change and will concern handling both hard and soft factors of the organization, i.e. structure and systems and culture and motivation etc. Implementing a strategy has three elements:

- Organizational structure and layout: Where and how should the organization is split into European, US and Asian divisions? How autonomous should divisions be? What parenting style should be applied?
- Resources: Enabling an organization's resources should support the chosen strategy: What are the appropriate human and non-human resources? What assets need to be acquired?
- Change management: Most strategic planning and implementation will involve change, so managing change, in particular employees' fears and resistance, is crucial.

Johnson and Scholes argue that for a strategy to be successful it must satisfy three criteria (Johnson & Scholes, 1997). These criteria can be applied to any strategy decision such as the competitive strategies, growth strategies or development strategies:

1. Suitability – whether the options are adequate responses to the firm's assessment of its strategic position.
2. Acceptability – considers whether the options meet and are consistent with the firm's objectives and are acceptable to the stakeholders.
3. Feasibility – assesses whether the organization has the resources it needs to carry out the strategy.

#### 6.2.4.2 Suitability

Suitability is a useful criterion for screening strategies, asking the following questions about strategic options:

- Does the strategy exploit the company's strengths, such as providing work for skilled craftsmen or environmental opportunities, e.g. helping to establish the organization in new growth sectors of the market?
- How far does the strategy overcome the difficulties identified in the analysis? For example, is the strategy likely to improve the organization's competitive position, solve the company's liquidity problems or decrease dependence on a particular supplier?
- Does the option fit in with the organization's purposes? For example, would the strategy achieve profit targets or growth expectations, or would it retain control for an owner-manager?

#### 6.2.4.3 Acceptability

Acceptability is essentially about assessing risk and return and is strongly related to the expectations of stakeholders. The issue of "acceptable to whom?" thus requires the analysis to be thought through carefully. Some of the questions that will help identify the likely consequences of any strategy are as follows:

- How will the strategy impact shareholder wealth? Assessing this could involve calculations relating to profitability, e.g. net present value (NPV).
- How will the organization perform in profitability terms? The parallel in the public sector would be cost/benefit assessment.
- How will the financial risk (e.g. liquidity) change?
- What effect will it have on capital structure (gearing or share ownership)?
- Will the function of any department, group or individual change significantly?
- Will the organization's relationship with outside stakeholders, e.g. suppliers, government, unions and customers, need to change?
- Will the strategy be acceptable in the organization's environment, e.g. higher levels of noise?

#### 6.2.4.4 Feasibility

Assesses whether the organization has the resources it needs to carry out the strategy. Factors that should be considered can be summarized under the M-word model.

- Machinery. What demands will the strategy make on production? Do we have sufficient spare capacity? Do we need new production systems to give lower cost/better quality/more flexibility/etc.?
- Management. Is existing management sufficiently skilled to carry out the strategy?
- Money. How much finance is needed and when? Can we raise this? Is the cash flow feasible?
- Manpower. What demands will the strategy make on human resources? How many employees are needed, what skills will they need and when do we need them? Do we already have the right people or is there a gap? Can the gap be filled by recruitment, retraining, etc.?

- Markets. Is our existing brand name strong enough for the strategy to work? Will new brand names have to be established? What market share is needed for success – how quickly can this be achieved?
- Materials. What demands will the strategy make on our relationships with suppliers? Are changes in quality needed?
- Make-up. Is the existing organizational structure adequate or will it have to be changed?

## 6.3 Need for Change of Organizational Culture

Successful organizations do not prosper by devoting a ruthless approach to chip away at costs, relentlessly reducing all decision-making to a reduction in headcount. The purpose of lean culture change is to secure the future of the entity by uniting its people to deliver to the voice of the customer. In the not-for-profit sector, lean culture change drives organizational success by adding value to existing consumers and winning loyalty. It is about developing resilient service provision, developing core staff competencies and attracting and retaining the best people. The lean culture reverses the polarity of the organization shifting from a fire-fighting mode to a planning mode, where prevention of problems rather than reacting after the event of failure becomes the norm. Healthy, positive, organizational cultures are characterized by a long-term continuity perspective, with a focus on tactics to resolve immediate short-term problems. The dominant culture should support and reward cross-organizational working. Implementing lean thinking is a cultural change that requires leadership because in the end it's all about people. Here are 10 guidelines your leader can do right now to change the culture:

**Challenge People to Think**
If you are not thinking, you're not learning new things. If you're not learning, you're not growing – and over time becoming irrelevant in your work. The most successful leaders understand their colleagues' mindsets, capabilities and areas for improvement. They use this knowledge/insight to challenge their teams to think and stretch them to reach for more.

**Lead by Example**
Leading by example sounds easy, but few leaders are consistent with this one. Successful leaders practice what they preach and are mindful of their actions. They know everyone is watching them and therefore are incredibly intuitive about detecting those who are observing their every move, waiting to detect a performance shortfall.

**Take Lots of Leaps of Faith**
Making a change requires a leap of faith. Taking that leap of faith is risky, and people will only take active steps toward the unknown if they genuinely believe – and perhaps more importantly, feel – that the risks of standing still are greater than those of moving forward in a new direction. Making a change takes lots of leaps of faith.

**Create an Environment Where It Is Ok to Fail**
Failure should be encouraged! That's right. If you don't try, you can't grow; and if growth is what you seek, failing is inevitable. There must be encouragement to try and it's ok if you try and it doesn't work. An environment where you can't fail creates fear.

**Eliminate Concrete Heads**
"Concrete heads" is the Japanese term for someone who does not accept that the organization must be focused on the elimination of waste. People feel threatened by the changes brought about by lean. As waste and bureaucracy are eliminated, some will find that little of what they have been doing is adding value. The anxiety they feel is normal and expected. To counteract this, it is critical that people are shown how the concept of work needs to change.

**Be a Great Teacher**
Successful leaders take the time to mentor their colleagues and make the investment to sponsor those who have proven they are able and eager to advance. They never stop teaching because they are so self-motivated to learn themselves.

**Show Respect to Everyone**
Everyone desires respect. Everyone. Regardless of your position or power, ensure you show everyone respect. Everyone wants to be treated fairly.

**Motivate Your Followers**
Transformational leaders provide inspirational motivation to encourage their followers to get into action. Of course, being inspirational isn't always easy. Some ideas for leadership inspiration include being genuinely passionate about ideas or goals, helping followers feel included in the process and offering recognition, praise and rewards for people's accomplishments.

**Develop a True Team Environment**
Create an environment where working as a team is valued and encouraged, where individuals work together to solve problems and help move the organization forward. Individuals who will challenge each other and support each other make teams more successful.

**Encourage People to Make Contributions**
Let the members of your team know that you welcome their ideas. Leaders who encourage involvement from group members have shown to lead to greater commitment, more creative problem-solving and improved productivity.

Constant change is a business reality, and organizations must continually adapt to their environments to stay competitive or risk losing relevance and becoming obsolete. For each change, leaders must define it, create a vision of the post-change world and mobilize their teams to make it. Fundamentally, a change of culture occurs when people start behaving differently as a result of a change in the climate

of the organization. There are many different models of how an organizational culture is shaped by the prevailing climate and how it can be assessed. Leaders who protect the status quo through control must surrender to change in order to secure the future for their organization. Don't be the leader who rewards herd mentality, and me-too thinking. Don't be the leader who encourages people not to fail or not to take risks. Be the leader who both models and gives permission to do the exact opposite of the aforementioned – be a leader who leads. The culture of an organization is learnt over time. It can be taught to new employees through formal training programs but is more generally absorbed through stories, myths, rituals and shared behaviours within teams. Organizational culture will impact positively or negatively on everything you try to do whether you want it to or not.

## 6.4 Case Study: Toyota's Policy Towards Lean Excellence

Toyota Motor Corporation's organizational culture defines the responses of employees to challenges the company faces in the market. As a global leader in the automobile industry, Toyota uses its organizational culture to maximize human resource capabilities in innovation. The company also benefits from its organizational culture in terms of support for problem-solving. The different features or characteristics of Toyota's organizational culture indicate a careful approach in facilitating organizational learning. The firm undergoes considerable change once in a while, as reflected in the change in its organizational structure in 2013. Toyota's organizational culture highlights the importance of developing an appropriate culture to support global business success. Toyota's organizational culture effectively supports the company's endeavours in innovation and continuous improvement. An understanding of this corporate culture is beneficial for identifying beliefs and principles that contribute to the strength of the firm's business and brands. Following its reorganization implemented in 2013, Toyota's organizational culture underwent corresponding change. Prior to 2013, its organizational culture emphasized a sense of hierarchy and secrecy, which translated to employees' perception that all decisions must come from the headquarters in Japan. However, after 2013, the characteristics of Toyota's organizational culture are as follows, arranged according to significance:

- Teamwork.
- Continuous improvement through learning.
- Quality.
- Secrecy.

Teamwork. Toyota uses teams in most of its business areas. One of the company's principles is that the synergy of teamwork leads to greater capabilities and success (Cortiglioni et al., 2010). This part of the organizational culture emphasizes the involvement of employees in their respective teams. To ensure that teamwork is properly integrated in the organizational culture, every Toyota employee goes through a teambuilding training program. Toyota's organizational culture facilitates the development of the firm as a learning organization. A learning organization utilizes information gained through the activities of individual workers to develop

**Fig. 6.6** Lean management workshop with Dr. Helmold in China. (Source: Author)

policies and programs for better results. Toyota's organizational culture highlights learning as a way of developing solutions to problems. In this way, the company is able to continuously improve processes and output with the support of its organizational culture. Quality is at the heart of Toyota's organizational culture. The success of the company is typically attributed to its ability to provide high-quality automobiles. To effectively integrate quality in its organizational culture, the firm uses Principle #5 of The Toyota Way, which says, "build a culture of stopping to fix problems, to get quality right the first time". The Toyota Way is a set of principles that defines the business approaches used in Toyota's organizational culture and has a considerable degree of secrecy. However, the level of secrecy has declined in recent years following the reorganization of the company in 2013. Before 2013, information about problems encountered in the workplace must go through the firm's headquarters in Toyota City, Japan. However, following the reorganization, the company's organizational culture now does not emphasize secrecy as much. For example, problems encountered in US plants are now disseminated, analysed and solved within the North American business unit of Toyota. The characteristics of Toyota's organizational culture enable the company to continue growing. Innovation is based on continuous improvement through learning. Quality improvement and problem-solving are achieved through the activities of work teams. However, the secrecy feature of Toyota's organizational culture presents possible drawbacks because it reduces organizational flexibility in rapid problem-solving. Figure 6.6 shows a lean workshop conducted by the general manager and his lean team experts, Dr. Marc Helmold, in China.

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# Toyota Production System (トヨタ生産方式)

7

*Quality needs to be constantly improved, but it is just as necessary to make sure that quality never deteriorates.*

Shigeru Mizuno

## 7.1 Toyota Production System (トヨタ生産方式) – Toyota Seisan Hoshiki

### 7.1.1 Introduction to the Toyota Production System (TPS)

The Toyota Production System (TPS), the Just-in-Time Production System or Lean Production System can be described as the ideal combination of four principles (Imai, 1986). These principles are the zero-defect principle, the pull principle, the tact principle and the flow principle, as displayed in Fig. 7.1 (Helmold & Samara, 2019).

### 7.1.2 Pull Principle

The pull system is one of the lean manufacturing principles and is used to reduce waste in the production process. In this type of system, components used in the manufacturing process are only replaced once they have been consumed, so companies only make enough products to meet customer demand (Pascual, 2013). The opposite principle is the push system, in which as many products as possible are generated to be sold via marketing activities. The principles aim to avoid overproduction and stockpiling, thereby saving working capital, by letting demand dictates the rate at which goods or services are delivered. In this way, the customer, or the next step in the chain, "pulls" value through the process.


M. Helmold et al., *Lean Management, Kaizen, Kata and Keiretsu*, Management for Professionals, https://doi.org/10.1007/978-3-031-10104-5_7

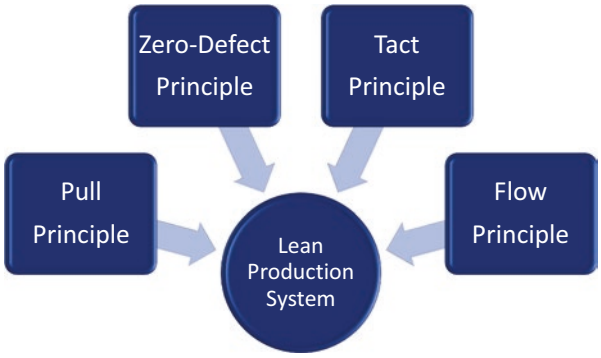


**Fig. 7.1** Four lean production principles

### 7.1.3 Zero-Defect Principle

The starting point in Toyota's success story, zero defects are all about identifying errors or defects as closely as possible to where they occur. By so doing, and by neither accepting nor passing on defects, issues are resolved quickly and efficiently, avoiding subsequent re-work and quality issues. The zero-defect principle is a concept of the Toyota Production System and is aimed at the reduction of defects through error prevention (Ohno, 1990). It is directed at motivating people to prevent mistakes by developing a constant, conscious desire to do their job right the first time. In reality, zero defects are not possible; however, the concept ensures that there is no waste existing in a project (Helmold & Terry, 2016). Waste refers to all unproductive processes, tools, employees and so on. Anything that is unproductive and does not add value to a project should be eliminated, called the process of elimination of waste. Eliminating waste creates a process of improvement and correspondingly lowers costs. Common with the zero-defects theory is the concept of "doing it right the first time" to avoid costly and time-consuming fixes later in the project management process (Belekoukias et al., 2014). The concept of zero defects is grounded on four major elements for implementation in real projects:

- Quality is a state of assurance to requirements. Therefore, zero defects in a project mean fulfilling requirements at that point in time.
- Right the first time. Quality should be integrated into the process from the beginning, rather than solving problems at a later stage.
- Quality is measured in financial terms. One needs to judge waste, production and revenue in terms of budgetary impact.
- Performance should be judged by the accepted standards, as close to perfection as possible.

### 7.1.4 Tact Principle

The German word for timing, tact refers to the rhythm at which goods or services are produced to meet customer demand. With a consistent, continuous rhythm providing a heartbeat for your production processes, it is far easier to regulate, responding flexibly and effortlessly as demand rises or falls. Tact time is defined as the average time available (time available minus breaks, maintenance or setup) divided by the customer requested quantity, as shown in Fig. 7.2.

The average time between the start of production of one unit and the start of production of the next unit when these production starts is set to match the rate of customer demand. For example, if a customer wants 15 units with the available time of 9 min and the steady flow through the production line, the average time between production starts should be 36 s for one part or unit (9 min multiplied by 60 s = 540 s; 540 s divided by 15 units requested by the customer = 36 s per part). In fact, the tact time simply reflects the rate of production needed to match the demand. In the previous example, whether it takes 4 min or 4 years to produce the product, the tact time is based on customer demand. If a process or a production line is unable to produce at tact time, demand levelling, additional resources, or process re-engineering is needed to correct the issue (Helmold & Terry, 2016).

- Directly tie production efficiencies to fiscal reporting.
- Reduce investigation time for root cause analysis.

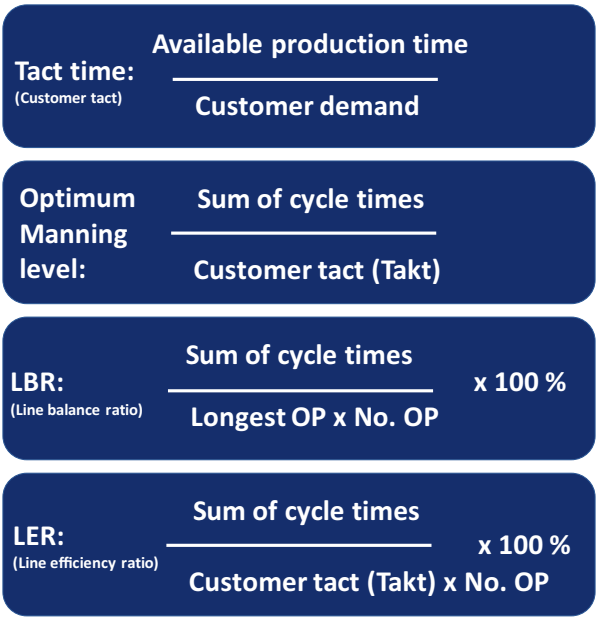


**Fig. 7.2** Tact time and other ratios

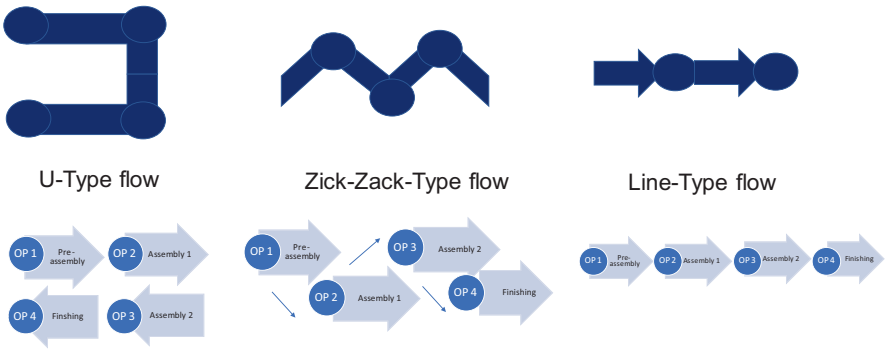


**Fig. 7.3** Types of flows in operations. (Source: Marc Helmold)

- Shorten equipment ROI through increased utilization.
- Decrease costs through waste elimination.
- Increase customer satisfaction through quality improvement.

### 7.1.5 Flow Principle

Value should be added in a smooth, uninterrupted flow, from the start to the end of the production process. The ultimate effect of this principle is that all process steps are focussed and aligned to adding value, one piece at a time, removing all wasteful and unnecessary activities from the process. The advantage of a continuous flow in operations is that it features stability, continuity and balance and doesn't waste time (the non-renewable resource). No time wasted on waiting between steps means time is being maximized for its capabilities. Operations are not able to introduce a wasteless process without the continuous flow, as it is the truly ideal process state. However, the troubles with continuous flow are that it's very hard to achieve, process steps aren't generally balanced, and all process contains inherent waste activities. When one starts out to achieve continuous flow, many process problems will appear and come to the surface. Most individuals think this is bad – it's actually a good thing. The optimal process features continuous flow, and any problems that stand in your way from achieving continuous flow are problems that are now visible and can be rectified. The ideal flow is the one-piece flow, as shown in Fig. 7.3.

## 7.2 Andon (アンドン)

Andon (Jap.: アンドン or あんどん or 行灯) is a lean manufacturing tool referring to a system to notify management, maintenance and other workers of a quality or process problem. The centrepiece is a device incorporating signal lights to indicate which workstation has the problem. The alert can be activated manually by a worker

using a pull cord or button or may be activated automatically by the production equipment itself. The system may include a means to stop production so the issue can be corrected. Some modern alert systems incorporate audio alarms, text or other displays. An Andon system is one of the principal elements of the Jidoka method pioneered by Toyota as part of the TPS and therefore now part of the lean concept. It gives the worker the ability, and moreover the empowerment, to stop production when a defect is found, and immediately calls for assistance. Common reasons for manual activation of the Andon are part shortage, defect created or found, tool malfunction, or the existence of a safety problem. Work is stopped until a solution has been found. The alerts may be logged to a database so that they can be studied as part of a continuous-improvement program. The system typically indicates where the alert was generated and may also provide a description of the trouble. Modern Andon systems can include text, graphics or audio elements. Audio alerts may be done with coded tones, music with different tunes corresponding to the various alerts, or pre-recorded verbal messages. Usage of the word originated within Japanese manufacturing companies, and in English is a loan word from a Japanese word for a paper lantern (Imai, 1986). Figure 7.4 shows an Andon example at Alstom in China. The red light means the disruption of production in the respective production operation.

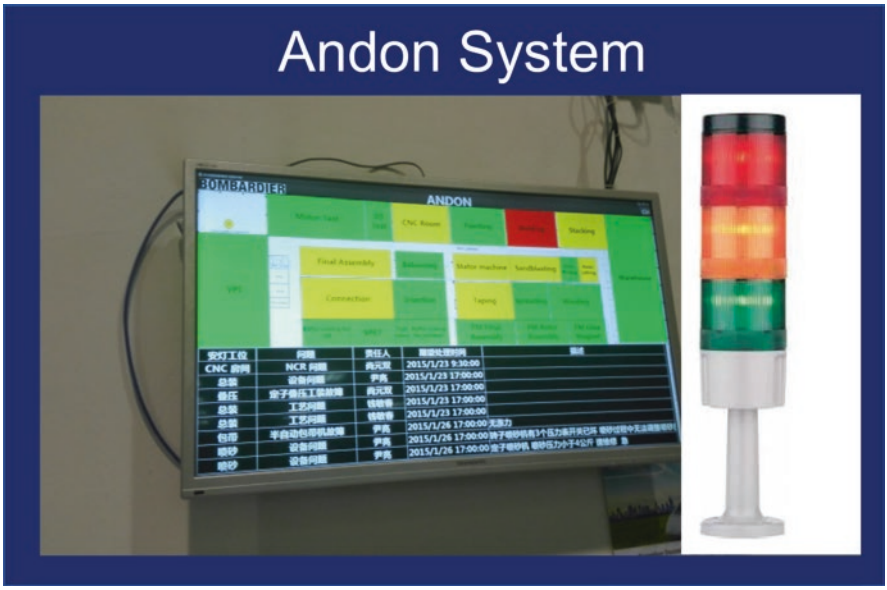


**Fig. 7.4** Andon. (Source: Author)

## 7.3 Poka-yoke (ポカヨケ)

Poka-yoke (ポカヨケ) is a Japanese term that means "mistake-proofing". A poka-yoke is any mechanism in a lean concept, a process that helps an equipment operator avoids (*yokeru*) mistakes (*poka*). Its purpose is to eliminate product defects by preventing, correcting or drawing attention to human or other errors as they occur. The concept was formalized, and the term adopted, by Shigeo Shingo as part of the TPS. It was originally described as baka-*yoke*, but as this means "fool-proofing" (or "idiot proofing"), the name was changed to the milder *poka-yoke*.

## 7.4 Gemba and Shopfloor (現場)

**Gemba** (現場) is also a Japanese term meaning the real or right place. A production environment considers the shop floor as the most important place and the employees in the operation and support functions as the most important human capital for adding value (Pascual, 2021).

## 7.5 Shadow Boards

Shadow boards are specific boards for parts, tools, equipment in operations, manufacturing or service areas to reduce waste and waiting time. The aim of the shadow board is to achieve an organized workplace where tools, supplies and equipment are stored in appropriate locations close to the work area or workstations. It provides the basis for standardization in the work place. They are a simple and inexpensive tool that provides tangible efficiencies and cost savings as well as intangible benefits. Figure 7.5 shows a shadow board for screws in Mitsubishi Japan. The appropriate storage, allocation and preparation of screws avoid waiting time and the possibility of errors. The advantages of using shadow boards include avoiding waste, such as time looking for the appropriate tool or even having to buy a new one, wasted time in looking for supplies and interchanging tools between tasks. Shadow boards also provide the ability to quickly gauge the location of tools and equipment or if they are missing. Shadow boards are used in the sort and set in order stages of the implementation and operation of a 5S system in a workplace and kaizen initiatives. Shadow boards can be different sizes and located in many different areas of a process or plant. The key is that they are appropriately located and hold all the necessary tools for the area or workstation.

## 7.6 Health, Safety and Environment (HSE)

Health, safety and environment (HSE) is the concept and paradigm that implements and secures practical aspects of environmental protection and safety at work. From a health and safety standpoint, it involves creating organized efforts and procedures


**Fig. 7.5** Shadow board. (Source: Helmold, shadow board, Mitsubishi Shinkanzen Production in Osaka)

for identifying workplace hazards and reducing accidents and exposure to harmful situations and substances. It also includes training of personnel in accident prevention, accident response, emergency preparedness, and use of protective clothing and equipment. From an environmental standpoint, it involves creating a systematic approach to complying with environmental regulations, such as managing waste or air emissions all the way to helping operations' departments reduce the company's carbon footprint. Successful HSE programs also include measures to address ergonomics, air quality and other aspects of workplace safety that could affect the health and well-being of employees and the overall community. Figure 7.6 displays HSE requirements in a Chinese operations environment.

## 7.7 Overall Equipment Effectiveness (OEE)

Manufacturing a product is a complex process. Without metrics and guidelines, it is very easy to lose control and have your business managed by your production. OEE is a tool that combines multiple manufacturing issues and data points to provide information about the process. By analysing and calculating data, it also functions as a framework for root cause analysis. Through a documented process of combining the underlying data, OEE provides specific process information. All members of the manufacturing team, from assembly technicians to financial personnel, can use the


**Fig. 7.6** Health, safety and environment. (Source: Author)

data to understand the current state of the manufacturing process. By having a predetermined framework of the impact of machine availability, performance and quality, OEE provides a framework to track underlying issues and root causes. OEE also provides a framework for improvements in the manufacturing process. By using key OEE concepts such as The Six Big Losses, waste exposed by tracking OEE can be understood and efficiencies can be improved. The components of this framework are

- Availability.
- Performance.
- Quality.

OEE is a very simple metric to immediately indicate the current status of a manufacturing process and also a complex tool allowing you to understand the effect of the various issues in the manufacturing process and how they affect the entire process (OEE = Availability × Performance × Quality). Availability refers to the machine or cell being available for production when scheduled. At the most basic level, when a process is running, it is creating value for the end user. When a process is stopped, it's creating a cost with no associated value. Whether it's due to mechanical failure, raw materials or operator issues, the cell or machine is either producing or not producing. By comparing scheduled run time to actual run time, the availability component of OEE allows for a determination of lost production due to down time. Performance is determined by how much waste is created through running at less than optimal speed. By comparing the actual cycle times against ideal cycle times, OEE allows for a determination of how much production was lost by cycles that did not meet the ideal cycle time. Quality focuses on identifying time that was wasted by producing a product that does not meet quality standards. By comparing the quantity of goods to reject parts, the percent of time actually adding value by producing good


**Fig. 7.7** OEE calculation. (Source: Author)

product is exposed. By itself, OEE only provides data about your manufacturing process. Companies that use OEE as a metric have found success when combining it with general lean manufacturing programs and also as part of TPM systems. When using OEE with these systems, the benefits become significant. Figure 7.7 shows an example of the OEE. High-performing companies can achieve an OEE higher than 85% (Helmold & Samara, 2019). In the calculation, the OEE has the elements availability (83.3%), performance (90.0%) and quality (98%). Based on the actual figures, it is now possible to optimize each at the inefficient categories. The availability ratio is below 90% and needs special actions for improvements.

## 7.8 Kanban (看板)

Kanban (看板) is a visual system for managing work as it moves through a process. It is a concept related to lean and just-in-time (JIT) production, where it is used as a scheduling system that tells you what to produce, when to produce it and how much to produce. Initially, it arose as a scheduling system for lean manufacturing, originating from the Toyota Production System (TPS).

## 7.9 Supermarkets

Supermarkets ordinarily are located near the supplying process to help that process see customer usage and requirements. Each item in a supermarket has a specific location from which a material handler withdraws products in the precise amounts needed by a downstream process. As an item is removed, a signal to make more (such as a kanban card or an empty bin) is taken by the material handler to the supplying process. Toyota installed its first supermarket in 1953 in the machine shop of its main plant in Toyota City (Ohno, 1990). Toyota executive Taiichi Ohno took the idea for the supermarket from photos of American supermarkets showing goods arrayed on shelves by specific location for withdrawal by customers.

## 7.10 Shisa Kanko (指差喚呼)

Pointing and calling is a method in occupational safety for avoiding mistakes by pointing at important indicators and verbally calling out their status. It is particularly common on Japanese railways or transportation, where it is referred to as shisa kanko (指差喚呼), shisa kakunin kanko (指差確認喚呼) or yubisashi koshō (指差呼称). Gesturing at and verbalizing these indicators help with focus on work safety and concentration. The method was first used by train drivers and is now commonly used in the Japanese industry as part of the lean management philosophy. Figure 7.8 depicts a train driver who is pointing at the direction going before starting the train.

**Fig. 7.8** Shisa kanko

## 7.11 Case Study: Porsche Production System

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 (Freitag, 2004). Porsche was also hampered by antiquated production methods. Some 20% of its parts were delivered three or more days too late, for example. In addition, supply disruptions led to severe problems in the value chain and caused recalls (Greiml, 2010). 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 (Kalkowsky, 2004). 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 synchronizing 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,
- to be customer oriented,
- to have flat hierarchies,
- 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.

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# 5S Concept: Muda (無駄), Muri (無理) and Mura (斑)

8

*Most business processes are 90% waste and 10% value-added work.*

Jeffrey Liker

## 8.1 Value-Adding Activities and Waste

Added value can be defined as products, services, processes and activities, which generate a certain value to the organization and enterprise. Value-added must be regarded from the customer viewpoint and is everything for which the customer is willing to pay for. It is important that value-added is recognized and perceived as value by the client (Bertagnolli, 2020). Many studies have shown that we only add value to a product for less than 5–15% of the time, and the rest of the time is wasted (Helmold & Terry, 2021). The opposite is non-adding value or waste. Waste (Japanese: Muda, 無駄) is anything that adds cost or time without adding any value, or any activity that does not satisfy any of the above conditions of value-added is a waste or a non-value-adding activity in a process. The focus in operations management must therefore be on eliminating such activities like waiting time or rework (Liker, 2004). Enterprise must target value-added processes and eliminate or reduce waste, whereby waste can be visible (obvious) or invisible (hidden), as shown in Fig. 8.1 (Lehmann, 2021). The main idea of lean management is about highlighting the things that add value by reducing or eliminating everything else (waste) (Sahoo, 2019). As a proven consequence, when you eliminate waste, the quality of products improves, while production time and costs are reduced. Figure 8.2 illustrate that waste must be ideally eliminated or reduced.

## 8.2 Muda (無駄), Muri (無理) and Mura (斑)

The Toyota Production System, and later on the concept of lean, was developed around eliminating the three types of deviations that show inefficient allocation of resources. The three types are Muda (無駄) (waste), Muri (無理) (overburden) and



M. Helmold et al., *Lean Management, Kaizen, Kata and Keiretsu*, Management for Professionals, https://doi.org/10.1007/978-3-031-10104-5_8

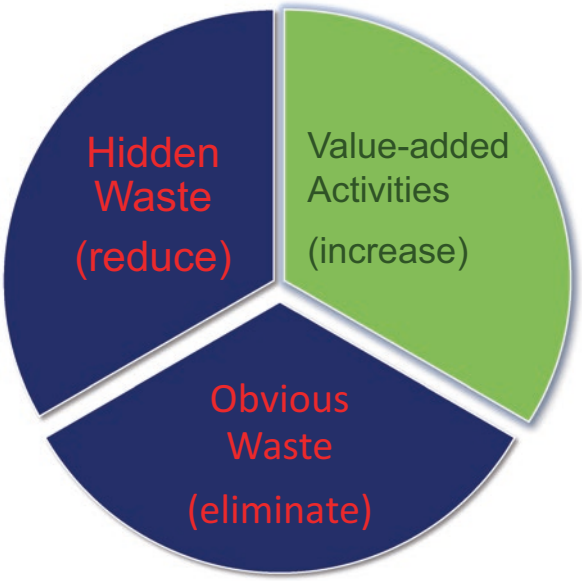


**Fig. 8.1** Value-added and waste. (Source: Author)

| Category | Impact | Principle |
|---|---|---|
| Value add  | • Added value for product<br>• Customer pays for it<br>• Customer recognizes this a value add | Increase |
| Hidden waste  | • No added value for product or service<br>• Task is necessary for production | Minimize |
| Obvious waste  | • No added value for product or service<br>• Task not necessary for production | Eliminate |

**Fig. 8.2** Actions for value-added and waste. (Source: Author)

Mura (斑) (unevenness). Muda means wastefulness, uselessness and futility, which contradicts value-addition. Value-added work and activities are a process that adds value to the product or service that the customer is willing to pay for. There are seven categories of waste under Muda Type 2 that follow the abbreviation TIMWOOD. The seven wastes are (1) transport, i.e. excess movement of product, (2) inventory, i.e. stocks of goods and raw materials, (3) motion, i.e. excess movement of machines or people, (4) waiting, (5) overproduction, (6) overprocessing, and (7) defects. Muri means overburden, beyond one's power, excessiveness, impossible or unreasonableness. Muri can result from Mura and in some cases be caused by excessive removal of Muda (waste) from the process. Muri also exists when machines or operators are utilized for more than 100% capability to complete a task or in an unsustainable way. Muri over a period of time can result in employee absenteeism, illness and breakdowns of machines. Standardizing work can help avoid Muri by designing the work processes to evenly distribute the workload and not overburden any particular employee or equipment. Mura means unevenness, nonuniformity and irregularity. Mura is the reason for the existence of any of the seven wastes. In other words, Mura drives and leads to Muda. For example, in a manufacturing line, products need to pass through several workstations during the assembly process. When the capacity of one station is greater than the other stations, you will see an accumulation of waste in the form of overproduction, waiting, etc. The goal of a lean production system is to level out the workload so that there is no unevenness or waste accumulation. Figure 8.3 shows the elements Muda, Muri and Mura.

## 8.3 Ishikawa Diagrams to Identify Waste

Ishikawa diagrams (also called fishbone diagrams, herringbone diagrams, cause-and-effect diagrams or Fishikawa) are causal diagrams created by Kaoru Ishikawa (Japanese: 石川 馨 Ishikawa Kaoru, 1915–1989) that show the cause–effect situation of a specific event. Common uses of the Ishikawa diagram are areas of design, supply, production and quality defect prevention to identify potential factors causing an overall effect. Each cause or reason for imperfection is a source of variation. Causes are usually grouped into major categories to identify and classify these sources of variation. The target of value-add and quality is shown as the fish's head, facing to the right, with the causes extending to the left as fishbones; the ribs branch off the backbone for major causes, with sub-branches for root-causes, to as many levels as required. Figures 8.4 and 8.5 show two examples of the Ishikawa diagram. Advantages of using this method are the application of a highly visual brainstorming tool, which can spark further examples of root causes. It serves to quickly identify if the root cause is found multiple times in the same or different causal tree. The Ishikawa diagram is also a good visualization tool for presenting issues to stakeholders.

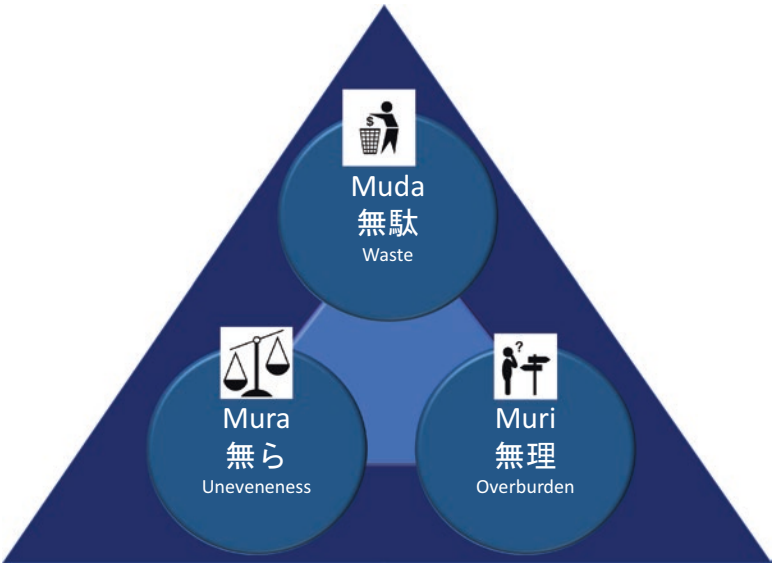


**Fig. 8.3** Muda (無駄), Muri (無理) and Mura (斑). (Source: Author)

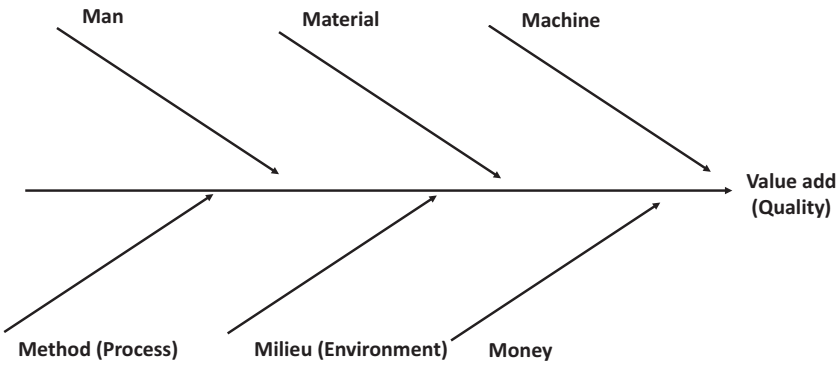


**Fig. 8.4** Ishikawa diagram. (Source: Author)

## 8.4 5S Concept

The 5S concept is the name of a workplace organization method that uses a list of five Japanese words: seiri, seiton, seiso, seiketsu and shitsuke. Transliterated into Roman Script, they all start with the letter "S". 5S is used to stabilize, maintain and improve the safest, best working environment, thus supporting sustainable QCD-plus alpha. 5S is a systematic and structured workplace optimization, originally developed and used by Toyota. The objective is the identification and elimination of waste. In simple terms, the five S methodology helps a workplace remove items that are no longer needed (sort), organize the items to optimize efficiency and flow

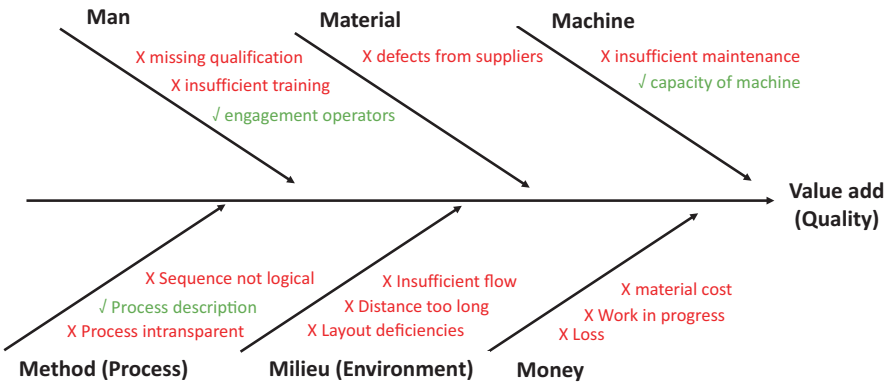


**Fig. 8.5** Ishikawa diagram with waste and value-added. (Source: Author)

(straighten), clean the area in order to more easily identify problems (shine), implement colour coding and labels to stay consistent with other areas (standardize) and develop behaviours that keep the workplace organized over the long term (sustain) (Pinto et al., 2018). 5S is a workplace organization method that uses a list of five Japanese words:

1. Seiri (整理).
2. Seiton (整頓).
3. Seisō (清掃).
4. Seiketsu (清潔).
5. Shitsuke (躾).

These five words can be translated as "sort", "set in order", "shine", "standardize" and "sustain". The 5S methodology describes how to organize a workspace for efficiency and effectiveness by identifying and storing the items used, maintaining the area and items and sustaining the new order (Niemann et al., 2021). The decision-making process usually comes from a dialogue about standardization, which builds understanding among employees of how they should do the work. In some quarters, 5S has become 6S, the sixth element being safety or self-discipline (Fig. 8.6).

**The Advantages of the 5S System Are the Following:**

- Creation of transparent layout.
- Visualization of processes.
- Transparency of hidden and obvious waste.
- Eliminates unnecessary activities.
- Improvement of efficiency.
- Focus on safety measures.
- Increases employee motivation through simplification of the work environment.
- Ensuring that all materials are instantly available.


**Fig. 8.6** 5S system. (Source: Author)

- Ensuring that necessary tools are available (screwdriver, devices).
- Ensuring that required (work procedures, work sequence etc.) information is instantly available.
- Reduction of waste.

The first element in the 5S concept is sorting (seiri). In this step, it is important to distinguish between necessary and unnecessary things. Things in this context are materials, components, tools, gauges, information, things and people. Unnecessary things must disappear. Removing these items that are not used in the working area may take a reasonable amount of time. Classification of all equipment and materials by frequency will help to decide if these items can be removed or not. The second step is the setting in order (seiton). This includes the practice of orderly storage, so the right item can be picked efficiently at the right time, easy to access for the operators. Identification and allocation of materials, information, tools and necessary things at fixed and visualized locations is important in this step. In the next and third step (seiso), it is mandatory to create a clean worksite without garbage, dirt and dust, so problems can be more easily identified (leaks, spills, excess, damage, etc). In the fourth step (seiketsu), standards for a neat, clean workplace and operations will be set up through visual management. In the fifth and last stage (shitsuke), it is

important to create the environment, patterns, management style and behaviours that established standards are executed over the long term, making the workplace organization the key to managing the process for success (Helmold & Terry, 2017).

## 8.5 7 Types of Waste (TIMWOOD)

Excess transportation is a significant waste because the time, manpower, energy, efforts and resources required to move items are something the customer does not care and does not want to pay (Ohno, 1990). Examples of wastes of transport are the transport of products from one functional area such as pressing to another area such as welding or the use of material handling devices to move batches of material from one machine to another within a work cell. It wastes time because operators are dedicating the available time of the work day to moving items from one place to another. It wastes energy and resources in that employee time could be better utilized and because some tools used for transportation (forklifts, trucks, pallet jacks) consume energy like electricity or propane. Also, by dedicating machines and operators' time to waste activities, they are no longer free and available to take on value-added activities. Figure 8.7 shows transportation waste. Reasons can be insufficient layouts and long distances between individual operations. The consequences of this waste are the increased time requirements and the decreased productivity. Decreased productivity will result in higher operating costs and can harm the profitability of the enterprise (Liker, 2004).

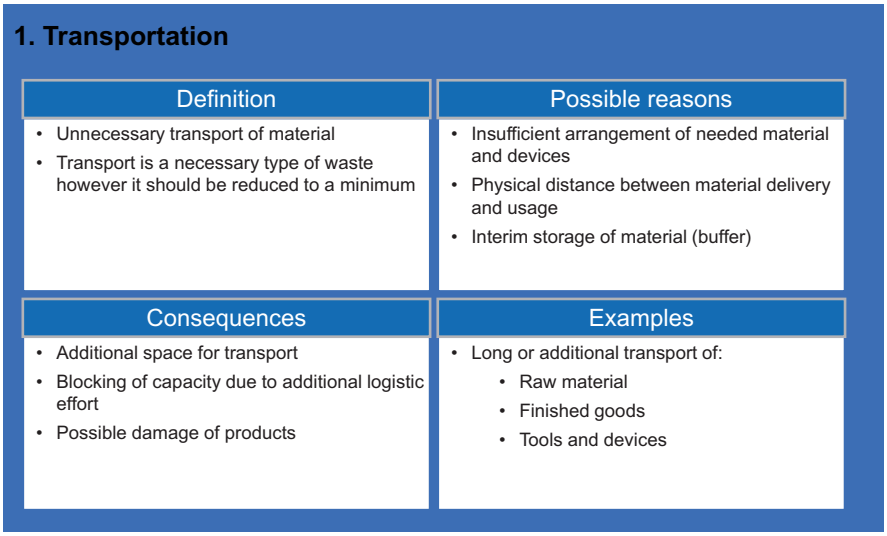


**Fig. 8.7** Transportation

### 8.5.1 Inventory

Inventory consists of excessive material of finished goods, semi-finished goods or raw material. Finished goods inventory is generally the most expensive inventory as it has labour and other overhead attached to it along with the cost of material consumed during production. In order to reduce this inventory, process improvements as well as a higher accuracy in forecasting customer requirements are required. Inventory waste refers to the waste produced by unprocessed inventory. This includes the waste of storage, the waste of capital tied up in unprocessed inventory, the waste of transporting the inventory, the containers used to hold inventory, the lighting of the storage space, etc. Moreover, having excess inventory can hide the original wastes of producing said inventory. The environmental impacts of inventory waste are packaging, deterioration or damage to work-in-process, additional materials to replace damaged or obsolete inventory, and the energy to light, as well as either heat or cool, inventory space. Figure 8.8 displays the definition, reasons, consequences and examples for inventory. Inventory will have a negative impact on working capital and on cash flow so that sophisticated production planning must focus on the optimum levels of inventory throughout the value chain and operations (Helmold & Terry, 2017).

### 8.5.2 Motion

Motion waste is the excessive movement of man, material or machines within the workspace. Motion waste will lead to higher cost as productivity decreases. Another

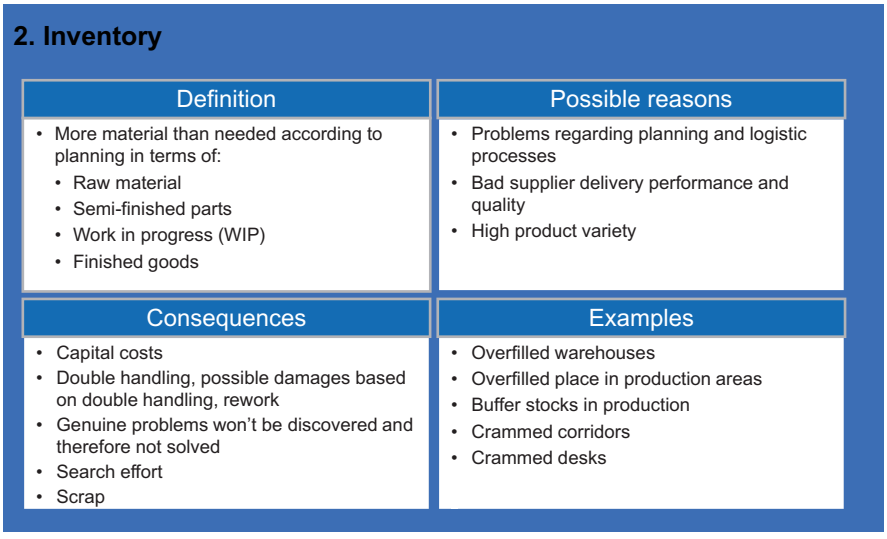


**Fig. 8.8** Inventory

problem of motion is the necessity for more time and capacity in operations than actually required. A proper workflow analysis and value stream mapping help minimize this waste. Figure 8.9 outlines the definition, possible reasons, consequences and examples of this waste.

### 8.5.3 Waiting

Idle time of operators or other employees in operations and waiting for work to arrive or to be told what-to-do are a significant waste. Waiting or standstill times must be avoided as waiting results in reduced efficiency and productivity. Other outcomes are longer lead times and decreasing engagement and motivation of employees, as illustrated in Fig. 8.10.

### 8.5.4 Overproduction

Overproduction waste is defined as producing too many products too early and in advance. That means that parts in a big quantity exist inside operations management, even though these parts are not needed. Figure 8.11 displays possible reasons such as demand non-transparency or inadequate batch sizes. A consequence of this waste is that inventory increases drastically and that work-in-progress costs rise significantly.

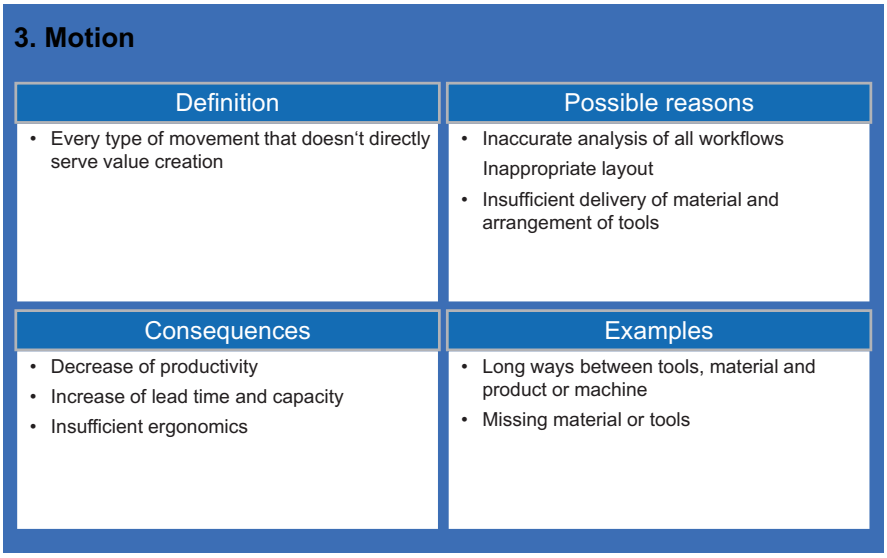


**Fig. 8.9** Motion

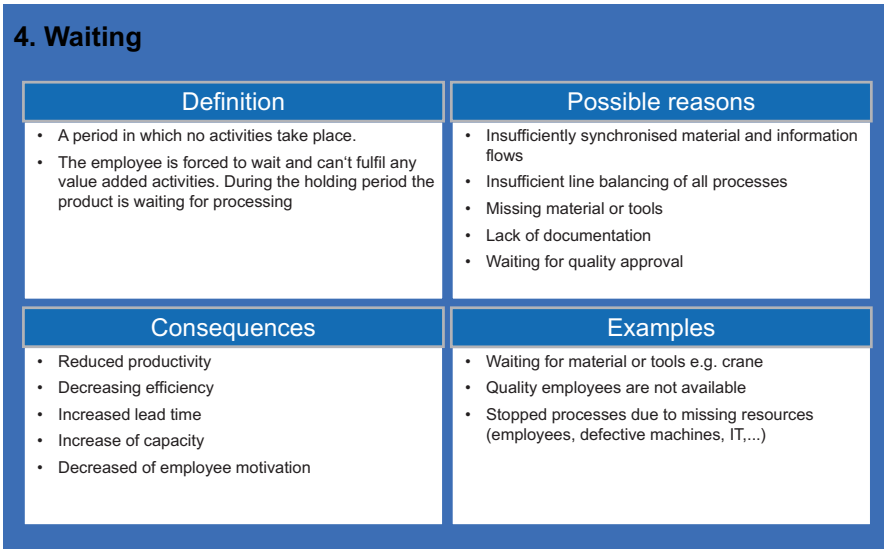


**Fig. 8.10** Waiting

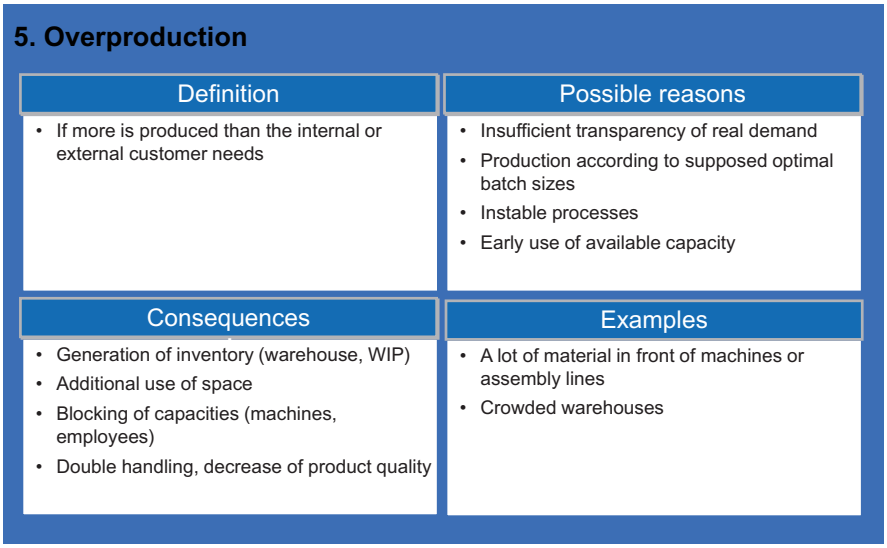


**Fig. 8.11** Overproduction

### 8.5.5 Overprocessing

Overprocessing is related to all activities and processes in operations, which are more than the customer really needs. Figures 8.12 highlights possible reasons such as insufficient technology, bad design, inefficiencies or unawareness of

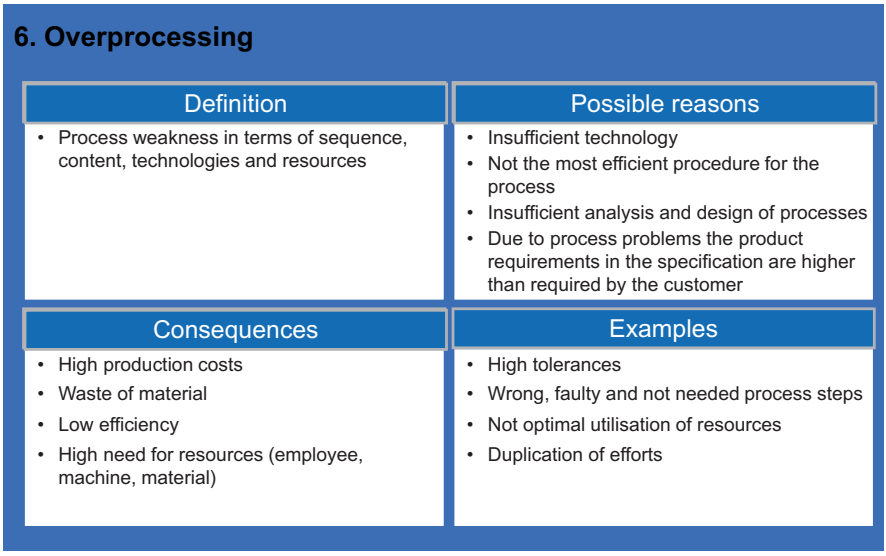


**Fig. 8.12** Overprocessing

customer-specific requirements. Overprocessing refers to any component of the process of manufacture that is unnecessary. Painting an area that will never be seen or adding features that will not be used are examples of overprocessing. Essentially, it refers to adding more value than the customer requires. The environmental impact involves the excess of parts, labour and raw materials consumed in production. Time, energy and emissions are wasted when they are used to produce something that is unnecessary in a product; simplification and efficiency reduce these wastes and benefit the company and the environment.

### 8.5.6 Defects

Defects, as shown in Fig. 8.13, refer to a product deviating from the standards of its design or from the customer's expectation. Defective products must be replaced; they require paperwork and human labour to process it; they might potentially lose customers; the resources put into the defective product are wasted because the product is not used. Moreover, a defective product implies waste at other levels that may have led to the defect to begin with; making a more efficient production system reduces defects and increases the resources needed to address them in the first place. Environmental costs of defects are the raw materials consumed, the defective parts of the product requiring disposal or recycling (which wastes other resources involved in repurposing it), and the extra space required and increased energy use involved in dealing with the defects.

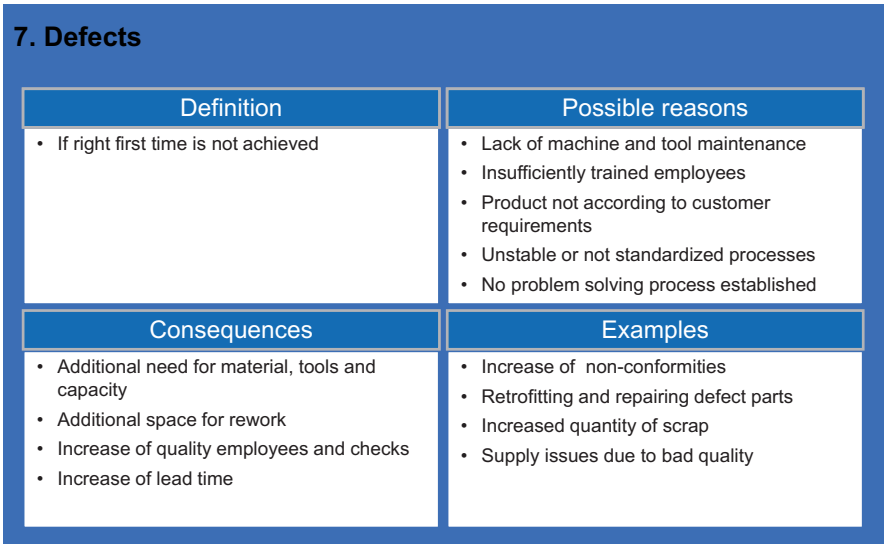


**Fig. 8.13** Defects

| | | | |
|---|---|---|---|
| T | Transport | How many times? Which routes? Empty containers? | |
| i | Inventory | How much material is in front of a line/machine? What is the material range? | |
| m | Motion | Motions of employee within the workstation: Destination? How many times? Routes? Duration? ? | |
| W | Waiting | Waiting for material, devices or supervisor? All information available? Missing documents? | |
| o | Overproduction | Compliance with quality? Batch size? | |
| o | Overprocessing | Proper tools? Proper settings? Proper instructions? Proper tolerances? | |
| d | Defects | Which mistakes? How often does it happen? Problem solving system? | |

**Fig. 8.14** TIMWOOD checklist

The checklist in Fig. 8.14 is the ideal tool to assess operations in terms of the seven wastes. It is a proven method for identifying waste in processes and activities (Helmold & Terry, 2021).

## 8.6 Case Study: Tesla's Transformation to Lean Management

### 8.6.1 Transformation Starts with Management and Employees

Tesla aims at mass producing electric cars and making them as ubiquitous as gasoline-powered cars. To do that, they have to produce affordable cars and meet the huge demand the promise of pollution-free transportation is generating in the market. The launch of the mass market Tesla Model 3 has been dogged by production problems, with the number of unfulfilled orders exceeding the ability of the company to deliver. Tesla's CEO Elon Musk has talked about being in a "production hell" – working tirelessly to get production moving at the right pace. In the past 1 year or so, Elon Musk has transformed his idea of what is required to meet production targets. He has gone from thinking that excessive automation is the answer to his productivity challenges to recently admitting that there are areas that are best left to manual human labour. In this interview, Elon even showed more admiration for low-tech "dumb robots" that use simple sensors and magnetic strips to move material to various workstations within the factory.

This transformation has taken some time to come, and – as a member of the lean community – it is gratifying to witness it. There are many interviews and talks that Elon Musk has given over the years that give a glimpse of his manufacturing philosophy. Even from the quarterly Tesla shareholder reports, one is able to decipher some aspects of his manufacturing principles and managerial style. When looked at in total, all these materials in the public domain point to an evolving mindset at the company in terms of its production system. Elon Musk's recent interview and factory tour with web video producer Marques Brownlee sheds a lot of light on what I call his transformation into a lean manufacturer. It is instructive to note that the Tesla Model 3 in Fremont California was the site of the NUMMI factory where Toyota collaborated with GM in an effort to teach Americans the Japanese production techniques. The productivity of this factory was much higher than what Tesla is currently doing – this despite the fact that it was less automated. NUMMI factory was able to produce so many cars using less manpower and automation mostly because of employing lean manufacturing principles. So what is it that Elon Musk said in his recent interviews to make me say that he is transforming into a lean manufacturer? There are a number of things.

### 8.6.2 Using Smart Robots as Part of a Lean Layout

While there are sections of the Tesla factory that are highly automated (80–90%), like the paint shop, other areas such as the final assembly are more suited for manual labour. This situation is much different from what Musk meant when he said that Tesla was building the machine that builds the machine. The idea here was to have a factory designed for tight production where everything is moving at a very fast pace. But the Tesla CEO seems to have come to the realization that such a tight layout is too complicated. During the tour, he gave the analogy of trying to automate

the grabbing of a wiggling hose – while a human does it almost thoughtlessly, programming a robot to catch the hose is almost impossible. Humans are good at tasks that require adaptation and rapid evolution such as those found in the general assembly area. Figure 8.16 shows the assembly of car bodies in Tesla.

### 8.6.3 Hybrids of Robots and Human Labour in Final Assembly

The biggest mistake we made was trying to automate general assembly, where everything is put together. Manual labour is better than robots, especially when they are complicated as they will require specialized and expensive engineering expertise. In a factory operation that runs continuously for 24 hours, this means that these technicians will have to be available all the time in the case of breakdowns. This extra layer of highly paid support labour will increase the operating costs and eat into the company's profits. The fact that the robots are specialized for specific tasks within the factory means that there is a lot of downtimes when they break down.

### 8.6.4 Enabling Flow Through Conveyors

The removal of conveyors – which Musk said ended up complicating things even more – is another indication that lean manufacturing principles are taking root at Tesla. Conveyors added a level of complexity that led to lower productivity. The conveyors – which were later removed – needed constant attention from engineers so that they do not break down. Removing things that do not add value is a major activity when doing lean manufacturing. Another thing is that conveyors tend to move material very fast. This may sound like a good thing, but it may actually be the cause of a significant drop in productivity. Why is this? Conveyors that transport material faster than the speed of the line end up creating bottlenecks because of the

**Fig. 8.15** Tesla's lean factory. (Source: Author)


**Fig. 8.16** Tesla's automatic assembly line. (Source: Author)

build-up of work in process. Resources are required to handle this material build-up, and this leads to more manpower being deployed – hence the low productivity.

### 8.6.5 Concentration on Valued-Added Processes

In Fig. 8.15, Musk explains what the robots (partially visible) at the top right side do. In order to create access to the other parts of the factory, Tesla basically uses two robots to pass cars over the gangway. The first robot picks the car body and places it on a turntable that rotates and then another robot takes it to the other parts of the assembly line. The CEO noted in the interview that he thinks the process should be redesigned to scrap the step of one robot putting the car body down on the platform and another picking it up. The robots should just pass the car to each other without the added process step. This principle of doing away with unnecessary steps that do not add value is key in achieving a lean factory, and Tesla is starting to show a better appreciation of it.

### 8.6.6 Establishing U-Shaped Layout

The Tesla factory processes are arranged in a U-shape. This type of layout is very efficient in the utilization of space and also gives visibility to what is happening on the line. The logic is simple – a straight line layout will require more space lengthwise. Bending the line in a U-shape can save up to 50% of the space required by the assembly line. Another advantage a U-shape line has over a line layout is that the input and output sections are next to each other. This makes designing of receiving


**Fig. 8.17** 8S example in China. (Source: Author)

and shipping bay much easier. Set-up times for machines and processes are lower in U-shaped lines. Another advantage is that sharing of equipment for different product lines becomes much easier – thereby saving capital costs on duplicate machines.

Figure 8.17 shows the aluminium extrusion company Zhongwang, which extended the 5S System to an 8S system.

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# Change (Henkou Kanri 変更管理) as an Integral Part of Lean Management

9

*The Kaizen Philosophy assumes that our way of life – be it our working life, our social life, or our home life – deserves to be constantly improved.*

Masaaki Imai

## 9.1 Change Management (変更管理) in Japan

The Japanese meaning of change management is Henkou Kanri (変更管理) and can be translated from Japanese to mean "change, modification or alteration" in English. In the 1980s and 1990s, Japanese management principles were successfully implemented into enterprises around the globe. Japanese enterprises like Toyota, Sony or Panasonic had productivity and efficiency advantages against Western-style managed companies by more than 40–60% (Saegusa & Itami, 2008). The Japanese-style system predominant in the 1980s and 1990s has not been discussed in such an overwhelming and positive context as Japanese companies have been suffering from slumping revenues due to the prolonged economic depression. It is widely known that Japanese companies, on the contrary, are being asked to learn the management systems of newly industrialized Asian countries, including China and India (Sato & Parry, 2013).

## 9.2 Definition of Change Management

The permanent change and transformation of organizations is an important element in order to adapt to the environment. Change management can be defined as the sum of tasks, measures and activities that are intended to bring about a comprehensive, cross-departmental and far-reaching change in an enterprise or organization. Change management includes the implementation of a new mission, vision, strategies, structures, systems, processes and behaviours in an organization. The ultimate goal of change is to obtain a long-term favourable position in the market and to gain a sustainable competitive advantage (Helmold, 2020).



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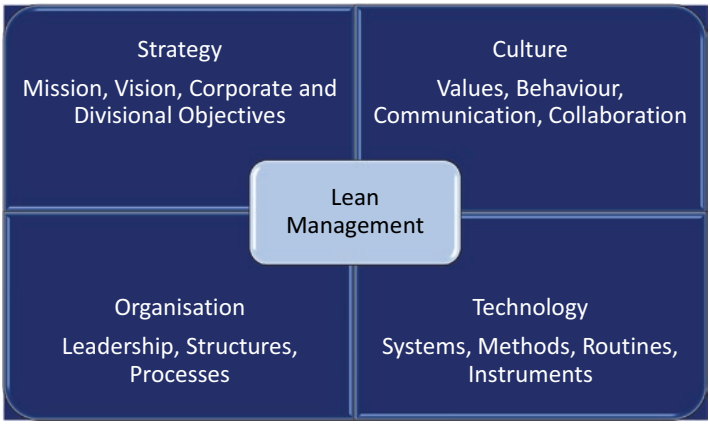


**Fig. 9.1** Elements of change management. (Source: Author)

Synonyms for change management found in the literature are business process reengineering, turnaround management, transformation management, lean management, innovation management or total quality management (Vahs, 2019). Change is increasingly determining the everyday businesses and activities of companies. In order to manage change in the most optimal way, special change management techniques are required, which can be summarized under the term change management (Lauer, 2019, 2020). The human factor is at the forefront of all considerations because the implementation of change depends on the active support of employees. Since everyone has their own needs, ideas and experiences, some of which do not conform to the official company organization, there can be no simple recipe for how to successfully manage change. Rather, it is a complex process that has to start at three points: the organization and individuals concerned, the corporate structures and the corporate culture (Lauer, 2019). Another important element in the context is the technological factor including systems, routines, methods and instruments. Figure 9.1 summarizes the elements of change management (Helmold & Terry, 2021).

## 9.3 External and Internal Reasons for Change

The need for corporate change can be caused both externally and internally. Externally, companies face an increasingly dynamic environment that requires constant adjustment of their own structures if they want to be successful in sales and also in the preceding procurement markets. The external change is caused by the market environment, politics, technology, ecology, the overall economy or institutions, as well as in the markets themselves, for example, by increasing competition (Helmold et al., 2020). To explain internal change, the metaphor of human

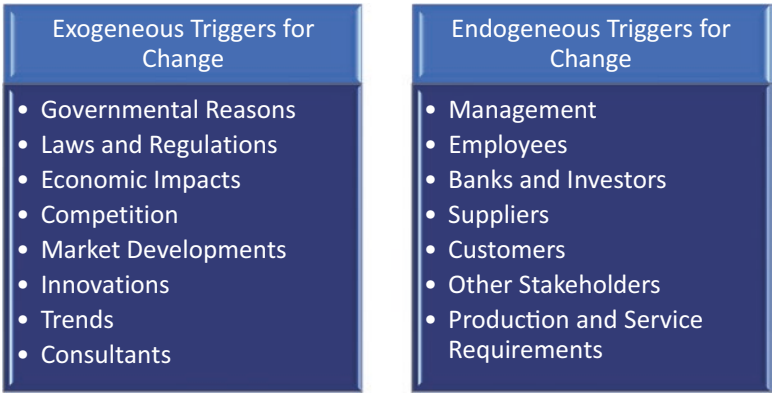


**Fig. 9.2** Triggers for change. (Source: Author)

development is used, which – like corporate development – is characterized by a succession of growth, crisis and higher maturity. There are so-called life cycle models for entrepreneurial change that exemplify the typical development phases. Change is often necessary, however, because companies are successful in exaggerating the offensive spirit of their efforts. Here too, the connection to the human psyche is established, and this phenomenon is analogously referred to as "burnout". Figure 9.2 outlines triggers for change from outside (exogeneous triggers) and inside of the organization (endogenous triggers). Exogeneous triggers can be described as governmental requirements, new laws, regulations, economic impacts, competitive reasons, market developments, innovations or the advice from consultants. Endogenous triggers are caused by internal stakeholders, such as managers, employees, shareholders, banks, investors or customers.

## 9.4 Nemawashi (根回し) as Feedback Trigger for Change

Nemawashi in Japanese means an informal process of quietly laying the foundation for some proposed change or project by talking to the people concerned, gathering support and feedback and so forth. It is considered an important element in any major change before any formal steps are taken, and successful nemawashi enables changes to be carried out with the consent of all sides.

Nemawashi literally translates as "going around the roots", from ne (root) and mawasu (to go around something). Its original meaning was literal: digging around the roots of a tree to prepare it for a transplant. This process involves bringing the dirt from the new location, and introducing it to the tree, before the transplant, so the tree can grow accustomed to the new environment before it gets there.

The Nemawashi process is

- To meet with key stakeholders and affected parties beforehand.
- In order to firstly set the context.
- To be prepared with a set of strategically crafted questions and information.
- To gain feedback (as well as buy-in pre-launch).
- To truly listen (as in to apply active listening).
- To possibly go back to the drawing board and change your proposal based on feedback.

Nemawashi is often cited as an example of a Japanese word that is difficult to translate effectively because it is tied so closely to Japanese culture itself, although it is often translated as "laying the groundwork".

In Japan, high-ranking people expect to be let in on new proposals prior to an official meeting. If they find out about something for the first time during the meeting, they will feel that they have been ignored, and they may reject it for that reason alone. Thus, it's important to approach these people individually before the meeting. This provides an opportunity to introduce the proposal to them and gauge their reaction. This is also a good chance to hear their input.

## 9.5 Change Management Phase Model of Kotter

Kotter analysed that 70% of all change projects fail, most of them in the initial phase. This is the research result of John P. Kotter, an expert in the field of change management. Two factors are responsible for the low success rate: Not the technology, but the human being is the greatest obstacle to change. Based on this knowledge, Kotter developed the eight-step model in 1996. The theory shows eight phases of change management and gives managers tips on how to successfully drive change. The focus of the model is communication – from person to person. The eight-step model by John P. Kotter is a further development of the popular three-phase model by Kurt Lewin. According to the theory, changes in companies can only be successful if they go through all eight stages of change and are intensively accompanied by managers (Kotter, 2012). The eight steps are outlined in Fig. 9.3.

1. **Show Urgency.**
   The first step in Kotter's eight-phase model is to raise awareness of the urgency of change by Top Management among both managers and employees. For example, change managers can develop scenarios that could occur if there is no change. It is recommended to convince managers and employees to implement the change with strong arguments. Stage one aims at getting the majority of managers and employees on the side of the proposed change.
2. **Build Leadership Coalition.**


**Fig. 9.3** Change management model by Kotter. (Source: Author)

Step two is necessary to build a good leadership and change management team by getting innovative and trend-setting people for the idea and bringing them together under the flag of change. The top management has to make sure that they have a good mix of people from different departments and with different skills. In this phase, it is recommended to define change teams for certain projects, consisting of employees of all departments.

3. **Develop Mission, Vision and Strategy.**
   In stage three, the top management has to wrap up a strong vision and concrete strategies with which the enterprise can achieve the final goals. Top managers must communicate this in a well-prepared and strong speech. An overarching goal for the company helps implement the change.
4. **Communication of the Mission, Vision and Strategies.**
   Top management must have a clear mission, vision and strategies for the change. This creates trust and increases motivation.
5. **Clearing Obstacles.**
   Are there structures in your company that slow down change? Top management has to take a close look at the status quo and get rid of unfavourable organizational structures, work processes and routines.
6. **Making Short-Term Successes Visible.**
   Top management should not set goals that are too time-consuming and costly to begin with, but also define intermediate goals that can be reached quickly. Employees who achieve these goals should be rewarded.
7. **Continuation of Driving Change.**

After each goal is achieved, top management has to analyse what went well and what could have gone better together with the change teams. It is mandatory to always develop new ideas and goals and bring new employees to the management and change team.

8. **Anchoring Changes in the Corporate Culture.**

   Finally, it is very important to anchor the achieved goals firmly in the corporate culture. Only after this has been achieved, one can speak of a successful change management process.

Since Kotter's eight-phase model gives specific instructions for successful change management, it can serve you well in practice. Critics complain that Kotter's model does not explain how to act in the event of setbacks and that initiatives by employees or so-called "bottom-up" perspectives are ignored. However, like no other change management model, it shows the importance of good communication for sustainable change (Kotter, 2012).

## 9.6 Case Study: Change Management at Nissan

The three stages of change management of Kurt Lewin can be aptly explained through the aid of an example of Nissan Motor Company that was on the stage of bankruptcy due to the issues of high debts and dipping market share. During that period, Carlos Ghosn took charge as the head of the Japanese automaker who was faced with the challenge of implementing a radical change and turning around the operations of Nissan, yet by keeping the resistance to change under control, which was inevitable under such circumstances, by forming cross-functional teams to recommend a robust plan of change in different functional areas. For facing the business challenges, he developed a change management strategy and involved the employees in the process of change management through effective communication and reinforcement of desired behaviours. For refreezing the behavioural change of the employees, he introduced performance-based pay and implemented an open system of feedback for guiding and facilitating the employees in accepting the new behaviour patterns at work.

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# Industry 4.0 and Artificial Intelligence (AI) in Lean Management

# 10

*Coming together is a beginning; keeping together is progress; working together is success.*

Henry Ford

## 10.1 Industry 4.0 in Lean Management

Operations systems are not like they used to be in the past. The twenty-first century will confront enterprises and manufacturing companies with completely novel generations of technologies, services and products based on intelligent and smart technologies (Daim & Faili, 2019). In order to meet competition on global markets and to ensure long-term success, the companies need to adapt to shorter delivery times, increasing product variability and high market volatility, by which enterprises are able to sensitively and timely react to continuous and unexpected changes. One of the major cornerstones to meet these challenges is the implementation of digital information and communication technologies into production systems, processes and technologies, which allow novel developments by combining the physical world and fast data access and data processing via the Internet (Industry 4.0) (see Fig. 10.1). Industry 4.0 is a name given to the current trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the Internet of things, cloud computing and cognitive computing. Industry 4.0 is commonly referred to as the fourth industrial revolution (Gilchrist, 2016). Industry 4.0 fosters what has been called the smart factory and smart supply chains. Within modular structured smart factories, cyber-physical systems monitor physical processes, create a virtual copy of the physical world and make decentralized decisions. Over the Internet of things, cyber-physical systems communicate and cooperate with each other and with humans in real-time both internally and across organizational services offered and used by participants of the value chain. There are four design principles in Industry 4.0. These principles support companies in identifying and implementing Industry 4.0 scenarios (Helmold & Terry, 2021):



M. Helmold et al., *Lean Management, Kaizen, Kata and Keiretsu*, Management for Professionals, https://doi.org/10.1007/978-3-031-10104-5_10

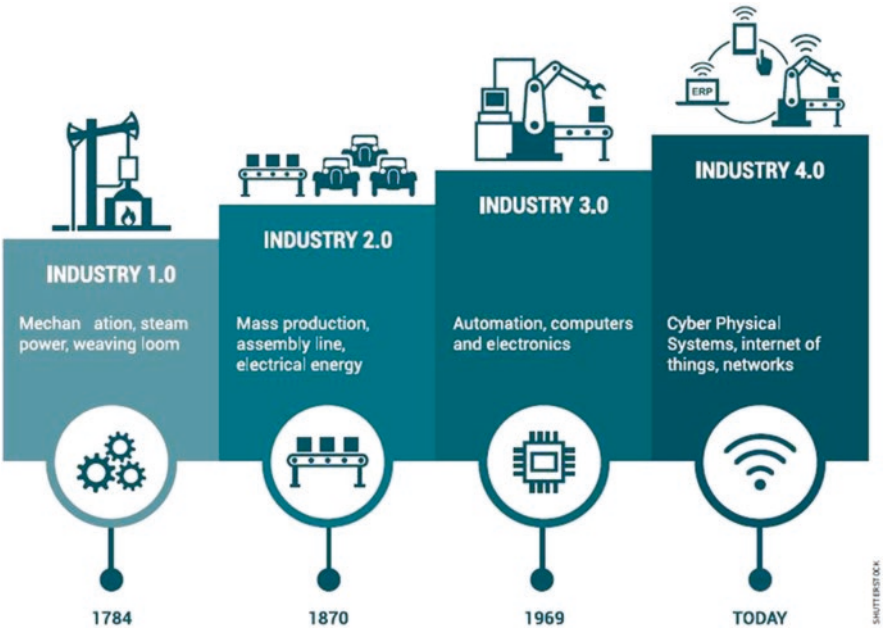


**Fig. 10.1** Industry 4.0

- Interconnection: The ability of machines, devices, sensors and people to connect and communicate with each other via the Internet of things (IoT) or the Internet of people (IoP).
- Information transparency: The transparency afforded by Industry 4.0 technology provides operators with vast amounts of useful information needed to make appropriate decisions. Interconnectivity allows operators to collect immense amounts of data and information from all points in the manufacturing process, thus aiding functionality and identifying key areas that can benefit from innovation and improvement.
- Technical assistance: First, the ability of assistance systems to support humans by aggregating and visualizing information comprehensively for making informed decisions and solving urgent problems on short notice. Second, the ability of cyber-physical systems to physically support humans by conducting a range of tasks that are unpleasant, too exhausting, or unsafe for their human co-workers.
- Decentralized decisions: The ability of cyber-physical systems to make decisions on their own and to perform their tasks as autonomously as possible. Only in the case of exceptions, interferences or conflicting goals, are tasks delegated to a higher level.

## 10.2 Artificial Intelligence (AI) in Lean Management

In the field of lean management, operations and supply chain management, artificial intelligence (AI), sometimes called machine intelligence, is intelligence demonstrated by machines, in contrast to the natural intelligence displayed by humans and other animals (Helmold & Terry, 2021). AI is aimed at managers in several industries, including operations and process and product development, to stimulate innovations in companies, processes, products and research (Hopmann & Schmitz, 2020). The rapid technological growth and innovations are offering several advantages to react more flexibly to increasing customer expectations (Tortorella et al., 2021). Figure 10.2 depicts nine lean elements of artificial intelligence that can lead to a competitive advantage across the value chain. While computers and information management systems are excellent at performing computationally complex tasks, the ability to match human intelligence and intuition with computer algorithms has always been an aspirational goal. Nevertheless, significant progress has been made

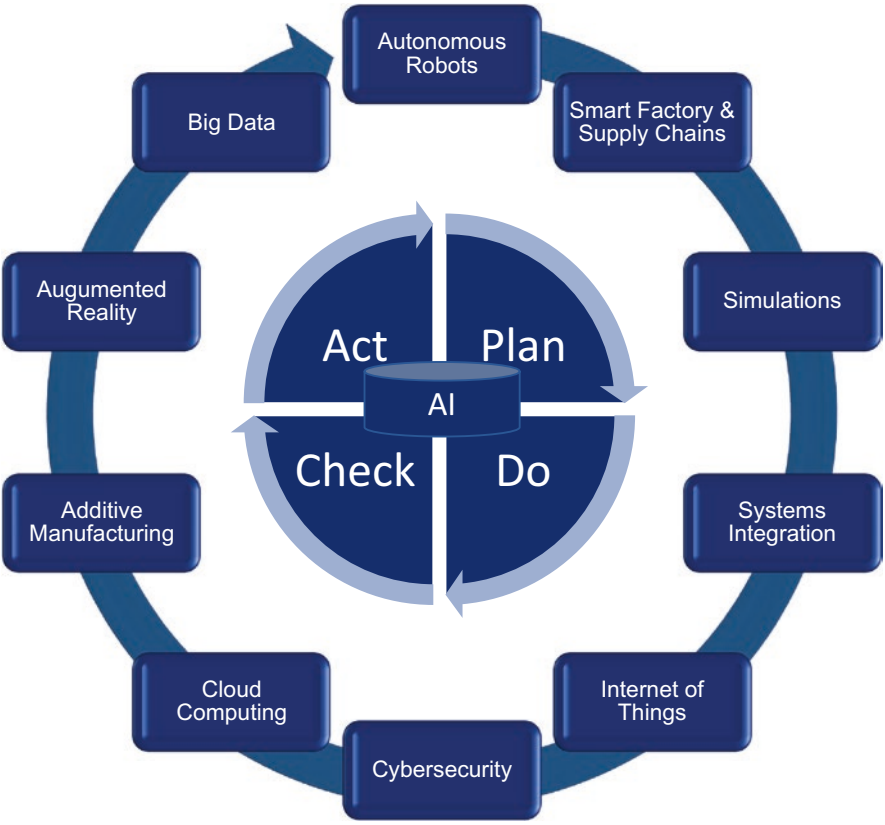


**Fig. 10.2** Artificial intelligence (AI) elements. (Source: Author)

on algorithms that can perform predictive tasks that would have been considered unimaginable a few decades back (Aggarwal, 2021).

### 10.2.1 Autonomous Robots

An autonomous robot is a robot that performs behaviours or tasks with a high degree of autonomy (without external influence). Autonomous robotics is usually considered to be a subfield of artificial intelligence, robotics and information engineering.

### 10.2.2 Smart Factory and Supply Chains

The smart factory is a core element in the future lean management concept and describes a production environment that organizes itself. The production environment includes the manufacturing facilities and the logistics systems. Additionally, enterprises include self-operating and self-functioning supply chains in their value chain operations. Virtual production and supply chains are utilized to help visualize complex scenes or scenes that simply cannot be filmed for real. In general, though, virtual production can really refer to any techniques that allow filmmakers to plan, imagine or complete some kind of filmic element, typically with the aid of digital tools.

### 10.2.3 Lean Simulation

Lean simulations include a set of hands-on experiments to teach employees about systems and process improvement in all areas of the value chain. Lean simulations can focus on design, manufacturing, capacity planning or supply chain design. The purpose of simulations is to understand the implications of input variables and alternations of the value chain elements.

### 10.2.4 Systems Integration

Lean integration is a continuous improvement methodology for bringing disparate data and software systems together. The goal is to maximize customer value. Lean integration is a management system that emphasizes eliminating waste as a sustainable data integration and system integration practice.

### 10.2.5 Internet of Things (IoT)

The Internet of things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique

identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

### 10.2.6 Cyber Technology and Security

Cyber technology and security is the protection of internet-connected systems, including hardware, software and data, from cyberattacks. In a computing context, security comprises cybersecurity and physical security – both are used by enterprises to protect against unauthorized access to data centres and other computerized systems.

### 10.2.7 Cloud Computing

Cloud computing is a type of computing that relies on shared computing resources rather than having local servers or personal devices to handle applications. In its most simple description, cloud computing is taking services ("cloud services") and moving them outside an organization's IT system and environment.

### 10.2.8 Additive Manufacturing and 3D-Printing

Additive manufacturing (AM) is the industrial production name for 3D printing, a computer-controlled process that creates three-dimensional objects by depositing materials, usually in layers. The official industry standard term is the ASTM F2792 for all applications of the 3D-technology. It is defined as the process of joining materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive **manufacturing** methodologies.

### 10.2.9 Augmented Reality

Augmented reality (AR) is an interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, auditory, haptic, somatosensory and olfactory.

### 10.2.10 Big Data

Big data is a phrase used to mean a massive volume of both structured and unstructured data that is so large and it is difficult to process using traditional database and software techniques. In most enterprise scenarios, the volume of data is too big or it moves too fast or it exceeds the current processing capacity.

## 10.3 Case Study: Google's Self-Driving Cars

Research into self-driving cars is not a new phenomenon. In the late 1950s, the first known thoughts on self-driving vehicles were described in Popular Mechanics magazine by a mechanic who argued that altering a roadster to both start itself and back itself into a driveway would be relatively straightforward. Later that year, a GM analyst revealed in Popular Science magazine that the company was already investigating embedding highways with cable and radio-control boxes as a means of developing an infrastructure to support driverless cars. Despite all of the theoretical research into the subject, self-driving cars did not become a reality until 1968. The first physical breakthrough in driverless car technology was the design of a car that used sonar and gyroscopes to drive, steer, and stop an automobile. In 1968, the Cornell Aeronautical Laboratory created the "Urbmobile", an electric car that could be driven on the road but could also glide along a subway-style track that utilized roadside guides, magnetometers, magnetic nails and internal computers. The largest breakthrough came years later, however, with the announcement from Google, Inc. of the Google Car in 2010. With the distinctive sensor and camera nub lodged on top of a Toyota Prius, the Google Car quickly became operational and present on roads across the United States. Shortly thereafter, media coverage of the Google Car became increasingly prevalent in addition to promotional commercials demonstrating the benefits of the car (Google, 2019). While the benefits demonstrated in the videos seemed to be promising, the Google Car's entrance into the market seemed a far leap away from Google's core business. Google Inc. specializes in Internet-related services and products, with the mission to organize the world's information and make it universally accessible and useful. In 1998, Larry Page and Sergey Brin, two Stanford University computer science graduate students, created a search engine that uses back links, or incoming links, to a website or web page, to determine the importance and therefore rank individual web pages during a web query. Existing competitors, like Yahoo and AOL, on the other hand, were directories of other websites, organized in a hierarchy, as opposed to a searchable index of pages. This allows the Google search process to return more relevant results rather than simply a ranked list of preferred sites. In 1999, Google secured funding from Sequoia Capital and Kleiner Perkins Caufield & Byers, Silicon Valley's two leading venture capital firms. Only one year later, Google became the world's largest search engine with over a billion pages in its index, surpassing industry giants such as Yahoo. Google's dominance of the search market continues today as Google maintains a 67% share of global searches. While Google Inc. began as a company specializing in search, it quickly expanded into other product areas. In 2004, Google launched Gmail, an email client that became the world's largest email provider by 2012 with an estimated 425 million active users. Expanding into the online video domain, Google acquired YouTube in 2006 for $1.65 billion, which reaches over 1 billion unique visitors each month. In 2008, Google launched Chrome, a web browser, and Android, an operating system for mobile devices. In both of these areas as well, Google dominates the market, with a 50% and 68% of the market share, respectively (Miller & Wald, 2013). In 2010, Google announced that the

prototype of a driverless car – the Google Car – was completed (Google, 2019). According to Google executives at the time, the goal of the Google Car was to "… help prevent traffic accidents, free up people's time and reduce carbon emissions by fundamentally changing car use". With a team assembled consisting of engineers with experience in vehicle technology from the DARPA Challenges, a series of driverless vehicle races sponsored by the U.S. Government, Google was finally able to bring the driverless car phenomenon to reality. The Google Car is a sophisticated system that integrates proprietary hardware and software, using video cameras, radar sensors, and a laser range finder to visualize traffic and detailed maps taken from Google Maps to enable navigation between destinations. Google's data centres process the incoming data relayed from the sensors and cameras mounted on the Google Car in order to provide the car with useful information about its environment that is later translated into the physical operation of the vehicle. The key to the Google Car's technological capabilities is the laser range finder mounted on the roof of the modified Toyota Prius, allowing for real-time environmental analysis. In addition, the Google Car is equipped with four radars and a velodyne 64-beam laser placed strategically around the car to accurately generate a three-dimensional map of its environment. A camera detects traffic lights while a GPS, wheel encoder and inertial measurement unit control the vehicle's location and logs car movement. The software system synthesizes laser measurements produced from the laser beam with high-resolution maps of the world, producing dynamic data models and then translating them into the physical operation of the vehicle by the car's internal software system. Altogether, the system allows for seamless operation of the vehicle that adjusts to its dynamic environment without the intervention of a driver. In addition to the generic driverless capability, the Google Car's system also adjusts for local traffic laws and environmental obstacles in real-time. For example, if the Google Car approaches a four-way intersection and senses that the driver with the right of way does not move, the Google Car inches forward slightly to indicate to other drivers the intentions of driving through the intersection (Miller & Wald, 2013). Altogether, the technology and adaptation to local conditions not only allow for driverless transportation but also increase safety on the road. Since its introduction, the Google Car has completed 200,000 miles of accident-free computer-led driving, beyond one incident that was arguably caused by another driver. The road test results for the Google Car indicate that the Google Car obeys all of the rules of the road and adjusts to its dynamic environment in real-time with no problems. Thus, with this integrated technology, the car has the capability of being safer than a human driver. The Google Car has the potential to have a profound effect on energy consumption, efficiency and traffic accidents. With subsequent productivity increases and decreases in costs, the Google Car represents a potentially revolutionizing technology. It is precisely this potential, however, that creates a threat for Google to sustain a long-term competitive advantage in the driverless car space. As the Google Car may radically shift the structure of affected industries and raise serious privacy concerns, vulnerable industries and consumer groups threaten the viability of the project. Thus, the Google Car faces challenges far greater than competing car manufacturers alone. In squaring off against politically and

economically powerful industries that are facing their demise, can the Google Car survive? Can the will to revolutionize driving outweigh the costs of potentially ruined industries and massive unemployment? Who will win the war of the road?

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# Analytical and Operations Research Methods and Techniques in Lean Management

# 11

*Excellent firms don't believe in excellence – only in constant improvement and constant change.*

Tom Peters

## 11.1 Digital Transformation Is Shaping Business Transformation

**"Companies that have embraced digital transformation are 26 percent more profitable than their average industry competitors and enjoy a 12 percent market valuation."**
**MIT Center for Digital Business**

If a few decades ago, companies faced the problem of not having enough data from which to analyse and extract valuable information that would help them make better decisions, today, they are facing a new challenge. Today's companies have access to a tremendous amount of data, referred to as "big data", which is growing at a remarkable pace each day. A variety of sources can be used to gather the data, including but not limited to company databases, surveys, social media, the Internet, transactions, sensors etc. The data can appear in a structured format as reports, or mainly unstructured (more than 80%) as images, videos and audio. The big data contains hidden information, and only by knowing how to extract the information will the companies be able to improve their performance, gain a competitive advantage and survive in the market in the long term. Digital transformation imposes the need for business transformation, i.e. investing in advanced information technologies and systems and, above all, in finding staff who have the necessary competencies to discover the hidden potential in data and to invest in the existing intellectual capital in gaining analytics and operations research skills. Analytics provides the answer to the question of how to extract information from raw data that will create values such as higher profit, increased customer and employee satisfaction, increased efficiency, productivity, quality, etc. for the companies. Operations research is the application of analytical methods, techniques and tools that are used to solve real complex problems and help the decision-makers in making faster and fact-based



M. Helmold et al., *Lean Management, Kaizen, Kata and Keiretsu*, Management for Professionals, https://doi.org/10.1007/978-3-031-10104-5_11

decisions. According to the Institute for Operations Research and the Management Sciences (INFORMS), *"Operations Research and Analytics enable organizations to turn complex challenges into substantial opportunities. They transform data into information, and information into insights for making better decisions and improving results*" (INFORMS, n.d.). As the amount of data that companies faced yesterday is smaller than the one they will face tomorrow, operations research and analytics have become the most important ingredient for companies to operate successfully.

## 11.2 The Four Pillars of Analytics

**"Information is the oil of the 21st century, and analytics is the combustion engine."**
**Peter Sondergaard, Gartner Research**

Analytics is the application of analytical methods, techniques and tools that enables the extraction of information from raw data based on which managers will make faster and better decisions. The analytics is based on four pillars: descriptive, diagnostic, predictive and prescriptive analytics (Fig. 11.1).

**Descriptive analytics** uses historical data to answer the question: What happened? It derives insight based on the past – for example, total revenue, total costs, net margin, total orders, the ten most profitable consumers, etc. This type of analytics uses data aggregation, descriptive statistics, data mining and data visualization (dataviz). It allows the management to get a clear picture of the key performance indicators and whether and how much the results obtained differ from the set targets. Descriptive analytics does not go into the reasons for the results obtained; that is the objective of the next pillar of analytics, diagnostic analytics.

**Diagnostic analytics** provides an answer to the question of why something happened. For example, if a comparison of total revenues for the current and previous years shows that revenues are lower in the current year, diagnostic analysis will allow us to determine the reasons for this result. For this type of analytics, we use

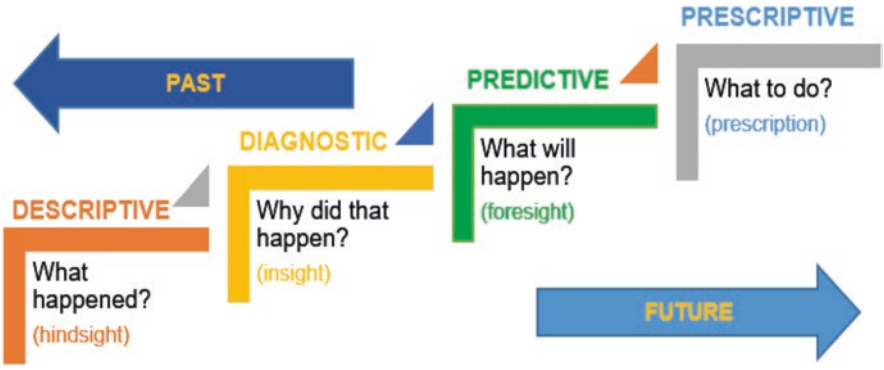


**Fig. 11.1** Analytics pillars. (Source: Author)

correlation analysis, identification of outliers, drill-down, conjoint analysis and data visualization. Let's consider the case of a multinational watch and jewellery company with locations in the United States, Europe and Asia. The company has data for the three regions by country, city, customer and seller. Descriptive analysis showed that the European region recorded the largest decrease in revenue in comparison with the other regions. A drill-down can be used to find out why this happened. For example, we will first analyse revenues by country, then by cities, then the focus will be on customers (the number of customers may have decreased, or some of those who were most profitable may not be loyal anymore, or their income has decreased, so they are not able to afford such goods), and finally, the sellers, where it can be determined that some of them require training. This type of analytics makes the reasons for the achieved results very clear, which allows managers to take appropriate actions in order to improve the results.

Once the reasons for the results are identified, the focus is on the future and what might happen. Predictive **analytics** provides the answer. Predictive analytics uses forecasting techniques, regression analysis, data mining, machine learning (which is the field of artificial intelligence (AI)) and data visualization. For example, by using a machine learning classification algorithm, retailers can discover whether the customer will buy the product or not. Furthermore, by applying the forecasting methods, the sales for the future period can be predicted, which in turn has a key impact on master budgeting because other components in the budget depend on it. Predictive analytics provides foresight for the future, but what needs to be done to achieve the set goals is the objective of the next pillar of analytics – prescriptive analytics.

**Prescriptive analytics** provides an answer to the question of what should be done. In this pillar of analytics, we use decision analysis, optimization methods, multi-criteria decision-making and data visualization. Decision analysis offers a range of decision criteria in conditions of uncertainty and risk. It enables you to choose the best location for factories, warehouses, etc. Linear optimization enables maximizing or minimizing the objective function under given constraints and is extremely useful in production, marketing and finance. An example is determining how much of each product should be produced in order to maximize the profit, subject to constraints regarding the production capacity of machines (in hours), resources, etc. Data envelopment analysis (DEA), which is the leading non-parametric methodology for measuring organizational performance and relative efficiency, is a very useful methodology in prescriptive analytics. It distinguishes between efficient and inefficient organizations and provides targets for performance improvement. Furthermore, multi-criteria decision-making (MCDM) allows the selection of the best alternative through their evaluation according to several criteria that may conflict with each other. It can be applied to selecting the best supplier, equipment, etc. One of the most frequently used MCDM methods is the analytic hierarchy process (AHP).

Data visualization is used in all pillars of analytics, and visualization skills go hand in hand with the skills of telling a good story from data (presentation and communication skills).

Analytics transforms raw data into hindsight, insight, foresight and prescription by using analytical methods, techniques and tools that help managers make faster and better data-driven decisions that will create values such as increased market share, profit, efficiency, productivity, quality, customer satisfaction, employee satisfaction, reduced costs, consumer complaints, etc. for the companies (Fig. 11.2).

Davenport et al. (2010) explain how companies can use the DELTA model to implement and succeed in analytics. The acronym DELTA stands for Data, Enterprise, Leadership, Targets, and Analysts. For data quality and integration, it is important for the company to have data that its competitors have not collected. *Enterprise* refers to the approach of managing data, people and technology at an enterprise level. Analytical leaders create a culture in the organization to make decisions by using analytics, and others in the company need to understand why this is important and to support it. Companies need to set targets to start with using analytics (such as in marketing) and expand their use over time. Analytics implementation necessitates the employment of analysts, which requires the hiring, training and management of those individuals.

The five elements of the DELTA model are internal challenges to the implementation of analytics in a company. In addition, Isson and Harriott (2013) state that the analytics priorities need to be aligned with the corporate priorities, and that there is a need for effective communication between the company's departments in order to decrease the probability of duplicating efforts and duelling data, as well as using the collective knowledge of the analytical talents in the company in different departments in the most effective way.

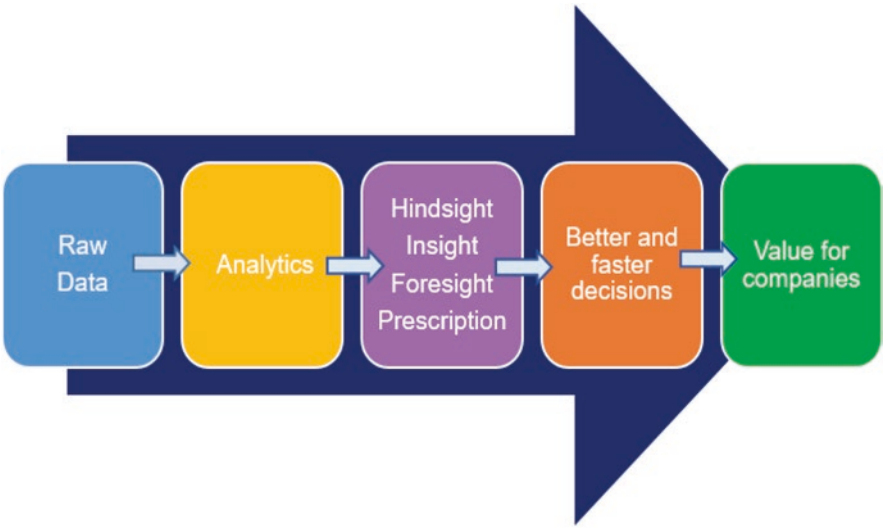


**Fig. 11.2** Creating value from raw data with analytics. (Source: Author)

## 11.3 Analytical Methods and Techniques in Lean Management

### 11.3.1 Data Mining

Does more data mean more knowledge and does it lead to informed decisions? The answer to this question is positive only if patterns are discovered in massive data sets. Data mining, also known as knowledge discovery in data (KDD), searches massive data sets to discover hidden patterns and correlations among data and to predict what is most likely to happen in the future by using statistical techniques, artificial intelligence and machine learning algorithms. Some of the data mining techniques are clustering, discriminant analysis, association rule, logistic regression, computational advertising, recommendation systems, social-network graphs, etc. The importance of data mining is increasing because most of the digital data is unstructured.

### 11.3.2 Logistic Regression

Logistic regression is adequate to use when the dependent variable is categorical – more precisely, expressing a "yes"/"no" action: the person will buy the product (the dependent variable implies a "yes" action) or the person will not buy the product (the dependent variable implies a "no" action). The "yes" action will have a binary value of 1, while the "no" action will have a binary value of 0. With logistic regression, we determine the class (1 or 0) to which the new observation will belong. In that direction, we should follow these two steps: (1) estimate the probability ($p$) that the observation falls into class 1, and (p-1) is the probability that the observation falls into class 0; (2) set a value for probability that will be used to compare the obtained probability of the observation belonging to class 1. As the probability is a value between 0 and 1, it is usually set to 0.5. This shows a symmetry, but having experience with a particular problem can help in setting a different value. Let's assume it is 0.5. If the estimated probability $p$ of the observation is higher than 0.5 ($p > 0.5$), the observation will take a "yes" action, i.e. a binary value of 1 (it will fall into class 1). If the estimated probability $p$ is lower than 0.5 ($p < 0.5$), the observation will take a "no" action, i.e. a binary value of 0 (it will fall into class 0).

### 11.3.3 Conjoint Analysis

Conjoint analysis is a market-research technique that examines consumer behaviour and preferences regarding a product or service. It is a survey-based analysis where respondents are asked to choose from the given products/services, and it helps discover the reasons behind their choice. The product or service is broken down to attributes that are further arranged in a minimum of two levels. Respondents are asked to rate the attributes on a given scale based on which we will determine which

features are important for them. That will help a company add these features to a product/service that it plans to launch at the market or present a new version of the existing products/services. Based on conjoint analysis, the company can segment its customers, allocate resources and achieve a competitive edge. Kim et al. (2016) start from the idea that the standard conjoint model does not take into account the benefits from attributes by which the customers derive utility, and they develop the benefit-based model for conjoint analysis (BBC).

## 11.4 Operations Research Methods and Techniques in Lean Management

### 11.4.1 Simulation

Simulation leans on the cause and effect of the certain problem in order to estimate future results. The problem is modelled by using the expertise and knowledge of people for the causation, and it is integrated with the data sets that could also be small. It is very powerful for the verification and validation of the created models (e.g. the probabilistic models). The most used simulation methods are Monte Carlo simulation, agent-based simulation and discrete-event simulation. When the time flow is part of the model, discrete-event simulation has a key role. One of the most powerful uses of simulation is for gaining insight to predict what will happen based on the decisions that companies are making on all levels. It is a low-cost and low-risk approach to be applied before making a decision because it imitates the real situation. The Franz Edelman Finalists in 2017, Bouffard et al. (2018) propose a discrete-event simulation (Detailed Integrated Capacity Estimate (DICE)) model for the BHP Jansen Potash Project. The model includes the production and logistics chain and provides an increase in the production capacity.

### 11.4.2 Linear Optimization

Mathematical programming, also known as mathematical planning, is the use of mathematical models to solve different problems (linear, integer, nonlinear, combinatorial, multi-objective, multi-criteria) where the relationship between variables is known exactly. Businesses usually cope with limited resources and they need optimal allocation of resources. For this purpose, they may use linear programming where the objective function needs to be minimized or maximized and it is subject to several constraints (financial, organizational, technological). Linear programming is widely used in finance, economics, transportation, production planning, etc. Taşkın et al. (2015) develop an optimization model for sales and operations planning (S&OP) for the Vestel Electronics Company located in Turkey. Their model is an integral part of the decision support system (DSS), which was implemented in the company in 2011.

### 11.4.3 Data Envelopment Analysis (DEA)

Measuring the organizations' performance and comparing how they operate with their competition in the same industry will provide them with valuable information (e.g. whether they are the best performers or not) so that the organization(s) that perform better can serve as a model (a benchmark). The Data Envelopment Analysis (DEA) is the most well-known frontier methodology for measuring organizational performance. DEA measures the relative efficiency of decision-making units (DMUs) that use the same inputs to produce the same outputs. It provides information on the efficiency score of each DMU in the analysis, but also on the sources of inefficiency and targets for improvement for DMUs that are not relatively efficient. The targets for improvement show how much the inefficient DMU needs to decrease the inputs and/or increase the outputs in order to improve the efficiency in the next period. In comparison with the parametric method (for example, regression analysis), it has an advantage because in this model we can include multiple outputs (not only one (the dependent variable) as in the regression model). Emrouznejad and Yang (2018) provide a literature survey on DEA scholarly literature, taking into account a period of 40 years (1978–2016), and they have analysed 10,300 articles published in journals. The articles published in the DEA journal were most frequently used in the following fields during the last 2 years of the observed period (2015 and 2016): agriculture, banking, supply chain, transportation, and public policy (Emrouznejad & Yang, 2018: 7). Badiezadeh et al. (2018) use the network DEA to assess the sustainability of supply chains.

### 11.4.4 Analytic Hierarchy Process (AHP)

One of the most popular multi-criteria decision-making methods is the analytic hierarchy process (AHP). The original founder of AHP is the distinguished professor Thomas L. Saaty, who introduced this methodology in 1980. AHP allows making straightforward, effective and safe decisions (Mu & Pereyra-Rojas, 2017). Mu and Pereyra-Rojas explain that decisions are straightforward because the AHP methodology can be understood and used very easily, can effectively correspond to the consistent decisions regarding our criteria and can be used safely because this methodology is an acclaimed one (it is used in more than 50 countries worldwide by companies and academia). AHP is an MCDM method that allows the decision problem to be broken down into its components (goal, criteria (sub-criteria, if any) and alternatives) and solved by using a mathematical model that will lead to the best decision. AHP allows the model to include tangible and intangible factors, i.e. criteria. It has a fundamental scale developed by Saaty that is used in the pairwise comparisons of the elements at each level, providing a measure for consistency of the judgments. It can be used for group decision-making, and there are very intuitive and easy-to-use software tools and platforms. Tavana et al. (2021) propose an integrated AHP-based approach for supply-chain risk–benefit assessment and select the best supplier.

## 11.5 Case Study: Disney

Pete Buczkowski, the manager of the Advanced Analytics team inside the Disney Industrial Engineering Department, and Hai Chu, the director of Decision Science and Support within the Revenue Management & Analytics Department, describe how Walt Disney World uses analytics to maximize the experience for its guests (Buczkowski & Chu, n.d.). The Walt Disney World Resort was opened in 1971 and offers an amazing, life-time experience for all guests who are visiting the four theme parks and hotels. Apart from the theme parks, there are also many enjoyable activities, more than 300 places to dine at, and the guests are guided by more than 60,000 cast members. Pete and Chu give a rich overview of what is happening "behind the scenes" to perform the operations without difficulties. Forecasting attendance in each park is used to plan resort activities. The forecasting models are used to satisfy the garment needs of the cast members as well as the waiting times for each attraction. They have a virtual queuing system called FASTPASS that is used by the most popular attractions, which enables guests to receive a ticket with a one-hour window, and when they return, they can skip the regular line. The smart phone app, Disney's Mobile Magic, shows the projected wait times for the parks. Furthermore, to discover which vacation packages are attractive for different types of visitors, they use data mining, and this analysis is supplemented with optimization models that allow their website and agents from the call centre to present offers that will satisfy the needs of their guests. Optimization is used for the operation of the table-service restaurant, while computer simulation is used for the attractions, restaurants, hotel front desks, etc. In order for the guests to be entertained while they are waiting in a queue, they have presented interactive queues and used agent-based simulation to model the behaviour of their guests. Also, on an annual basis, the Disney Analytics & Optimization Summit brings together cast members that have analytical roles, as well as external professionals in Operations Research. The authors state the following: "*With more data becoming available in an ever-changing landscape, Disney's need for analytics will continue to grow in the future*".

## 11.6 Case Study: General Motors

The Director of Operations Research at General Motors (GM) R&D, Jonathan H. Owen, the Director of Analytics in GM Global Product Development, David J. Vander Veen, and Lerinda L. Frost who leads executive communications and business support at GM R&D explain how GM is using OR to meet the challenges in the automotive industry and to create value for both the customers and the company (Owen et al., n.d.). Globalization is present in the business world, but in addition, the competition is more aggressive, and climate change and energy security are serious concerns. Therefore, the need for a science-based approach in the process of problem-solving and decision-making is more necessary than ever before. Operations Research is the driver of General Motors' (GM) success because the company is huge and its problems are complex. GM provides a various range of

vehicles (mini-cars, electric cars, trucks, monocabs and convertibles) in more than 120 countries worldwide. Furthermore, there are more than 200,000 employees who speak more than 50 languages, are present in 23 time zones, and are located in approximately 4 facilities in 6 continents. The employees are the most valuable asset responsible for developing new vehicles, organizing and managing the supply chain and logistics systems globally, enlarging the market, and creating new opportunities for the business. Owen et al. (n.d.) state, "… *the goal is straightforward: offer products and services that establish and maintain a deep connection with customers around the world while simultaneously generating revenue and profit for the company*". Analytical methods are used in every area in GM. GM employs OR for more than 60 years, starting from the early 1960 and 1970 when they used analytical techniques for transportation studies and traffic flow analyses, then in 1980 when they created analytical principles and applied mathematical methods for optimization in order to improve assembly line job sequencing. In 2005, they were the winners of the Franz Edelman Award for production throughput analysis and optimization, based on which they have increased productivity and reduced costs. The software they have developed is used in the plants at a global level, and the estimated savings for plant throughput alone amount more than $2 billion over the past two decades. The R&D operations research team in GM is composed of high-level experts, and the projects are in alignment with the top priorities of the company in order to improve the operational effectiveness by enhancing processes such as manufacturing productivity, capital, or supply chain management, and delivering inventory management. In addition, they are focused on improving vehicle efficiency, quality, and diagnostics and understanding their customers deeply in order to provide value by introducing new automotive products and services. Recently, the R&D operations research team in GM received two awards (internal awards) for the development of tools that use analytics and big data based on which the decision-making is improved. The research opportunities with operations research and advanced analytics are open for GM, and they may use them to improve their automotive products and services, obtain competitive advantage and create new values for their customers.

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# Lean Management in Aviation

# 12

*The secret of getting ahead is getting started. The secret of getting started is breaking your complex overwhelming tasks into small manageable tasks, and starting on the first one.*

Mark Twain

## 12.1 The "Lean Thinking" Concept

Aviation is one of the pivotal transportation modes that has a transformative impact on both social and economic production factors – mobility. Clearly, the aviation industry with its elements creates interaction between sustainability of both nations and organizations – economic, social and environmental ones. Moreover, the aviation industry supports the improvement of production mobility. In essence, the aviation industry may give more effective and efficient sustainable support to the business environment and sustainable development if it is lean in both operations and management.

Aviation is a vital engine of the global economy. The industry flies a third of world trade by value. It transports over half of international tourists. Aviation is also a connector of nations, families and businesses (ICAO, 2019).

In the civil aviation industry, which has a service production sector, one of the main objectives is to provide services in a timely and complete manner, safely and securely. Clearly, lean management practices support this goal. Lean management eliminates the use of wrong and unnecessary resources in the organizational structure and operational processes and thus provides resource usage optimization. Therefore, with this management system, costs are reduced and production may be realized on time. Thus, by increasing the quality, stakeholder satisfaction can also increase and stakeholder relations can be strengthened. Lean management, which is a value-based approach, is in line with the risk management philosophy in this respect.

Sustainability in four areas in business management, namely economic, social, environmental and operational, is a strategic risk management issue for organizations in the civil aviation industry. In this context, lean thinking with lean management is considered a corporate strategy. Namely, lean is the business strategy for



M. Helmold et al., *Lean Management, Kaizen, Kata and Keiretsu*, Management for Professionals, https://doi.org/10.1007/978-3-031-10104-5_12

continuous improvement. Therefore, lean must become part of the company culture to deliver value to the customer. The senior leadership (including the CEO) should be actively involved in the lean process. The more that is known about the value-added activities by employees as one of the vital stakeholders, the more waste that can be eliminated and the better the customer value. When employees see senior leadership actively involved in the lean process, they are more inclined to support the lean efforts (adapted from McDowell, 2015). The enterprise risk management system, implemented by managers, transforms each and every one of the employees into responsible representatives of lean management and related risks.

The aviation industry is set to face significant challenges in the future with continuously increasing competition, cost reduction pressures and skills shortages. In addition, given growing air traffic volumes, there is a relentless drive to make an already safe industry even safer. Furthermore, the drive to make aviation more environmentally friendly is rapidly gathering momentum. Therefore, the industry is under pressure to improve productivity, enhance safety and ensure sustainability. This holds true for all sectors of the industry, including aerospace manufacturing, air transport and maintenance, repair and overhaul (MRO). Lean management supports both productivity and sustainability, besides improving awareness about resource use and process design.

Capacity utilization rate and use of raw and processed materials in the aviation industry stand out as risks having the potential to directly affect the performance and productivity of enterprises. The operating and production costs in the aviation industry are very high. Therefore, the relative profit margin is low. In this respect, lean management can provide process optimization in a way that will reduce service and product production costs by eliminating unnecessary processes and resource usage, and it can also improve corporate culture in terms of correct resource use. Lean management based on risk management can be applied both in production processes and business processes in the aviation industry.

In essence, lean thinking supports a culture change in businesses. When processes that waste time and do not add value to customers are eliminated, it is possible for people to avoid complexity, so there is an opportunity to think about the next step (Öztürk, & Hancioglu, 2019). The history of lean production, on the other hand, dates back to the 1950s. Its basic principles were laid in the Japanese Toyota company, under the leadership of engineer Eiji Toyoda, a member of the Toyota family, and his partner, engineer Taiichi Ohno. The aim of the system of lean production is "to improve the quality, cost and delivery performance together by increasing the speed and shortening the flow time" (Obeya Academia, 2020). It became apparent that once lean manufacturing is applied, it can also be used to optimize industrial production processes. This has resulted in a broad lean management discipline. The concrete goal is to increase customer focus while reducing efficiency. While the difference between lean management and production can be seen as a corporate philosophy for all levels to be experienced in management, lean production is its application especially in production units (BIBUS, 2019). In lean management, the delegation of authority is increased, everyone is held responsible for their work, zero hierarchy is aimed, namely, subordinates as well as superiors

have the right to have a say in all decisions regarding the company, and it is a management style established for the realization of lean production (Atsan, 1998).

In the lexicon of lean, "waste" (or muda, Japanese for futility) is anything that doesn't add value – as airline/airports end customers would define it. In simple terms, waste is work that doesn't benefit them. Genuinely lean organizations press hard to refine their processes by removing waste and making what remains of it transparent, thus launching the next cycle of innovation and improvement. Executives with experience in true lean transformations know that direct, personal observation can show whether organizations are really lean. If a quick walk through a facility reveals several sources of obvious waste in long-standing processes, your airline has more work to do (Dichter et al., 2018).

## 12.2 Lean Approach to Enterprise Risk Management in Aviation Industry

### 12.2.1 Integration of LM with ERM

Aviation industry like other process industries is aware of the need of a robust risk management approach since they experience and interact with risk on a daily basis. Due to the continual nature of a process-focused enterprise, these companies ostensibly subject themselves to the highest level of risk as they are operating incessantly. Corporate risks are both multifaceted and interrelated, and in many ways, proper risk management deployment may positively impact and maximize lean processes (USC Consulting Group, 2015). Companies in the service industry, such as the aviation industry, are under constant pressure to offer excellent customer service, faster response times and quality support for their customers. Lean management can also help optimize all service delivery processes as part of a continuous improvement journey by targeting and eliminating waste (Helmold, 2020).

The aviation industry often poses an extremely high risk to companies. Indeed, risk management becomes a critical skill in these situations. Many large aviation companies also implement some form of program risk identification and management in their major development programs. Specific procedures vary from company to company, but the basic concepts are similar (Bresnahan, 2006). The aim of aviation organizations is to create profit by delivering the products requested by the customers at the right time and at the right price. Therefore, product development includes the elements of value, "performance, cost, schedule and risk" (Chase, 2001). It also has the potential to increase flight safety by minimizing the possibility of human error that occurs, for example, in the 5S technique, thanks to lean tools. Implementing 5S in an aircraft maintenance organization can ensure that the appropriate tools, equipment and documentation are available at the workstation at all times. Also, the probability of error is reduced by removing unnecessary items. It can also improve communication and shift or duty cycles. In this way, employees can easily see where all the items should be and quickly identify if there is anything missing (Ward & de Brito, 2007).

Indeed, enterprise risk management (ERM) supports leanness and the philosophy of leanness and enterprise risk management philosophy are compatible. Likewise, the lean approach supports risk management performance by improving the clearer identification and evaluation of risks and risk sources and making the best decisions in implementing risk management practices. Risk is the combination of the probability of occurrence of an event that has the potential to affect the achievement of organizational objectives and the severity of the impact of that event when it occurs. According to another definition, risk is "an event capable of influencing (obstructing, enhancing or causing suspicion) the fulfilment of mission, strategy, projects, routine operations, objectives, core processes, key dependencies and/or stakeholder expectations" (Hopkin, 2010). The influence can be in the form of positive or negative deviation. Plusmilkings include opportunities, minus deviations cover threats. While enterprise risk management is concerned with both capturing and utilizing these opportunities, it is also a set of efforts aimed at either minimizing or eliminating the effects of threats.

Lean risk management clearly articulates the underlying value proposition to the internal customers of engaging in risk management activities. It clearly identifies who the internal customers of the risk management activities are and articulates their key planning and decision-making situations and the corresponding need for support in appropriately addressing uncertainties (Willumsen et al., 2017).

Enterprise risk management, with its revised scope in accordance with the current VUCA conditions, provides reasonable assurance in the design and realization of the corporate strategy, is holistically integrated into the organization in all its managerial and operational areas, transforms the corporate culture on a risk-based basis, enables the organization to create value and preserves the value created and in the corporate age as well. It is an essential part of the management and strategy developed to optimally manage all risks and to derive optimum benefits. In this concept, "risk" is defined as the combination of the probability of occurrence of an event that causes deviation from the target (positive or negative, that is, a source of opportunity or threat) and the severity of the impact if it occurs. Therefore, risk includes both opportunities and threats.

Enterprise risk management, on the other hand, is a systematic approach to capture and evaluate these potential opportunities/gains, as well as effectively mitigate the severity of the losses/threats with optimum resource use, and reduce or prevent the result of a potential damage. Enterprise risk management is a structured, stable, consistent, uninterrupted and systematic process applied throughout the enterprise to identify, evaluate, decide the responses to and report the opportunities and threats that affect the achievement of the organization's objectives. On the other hand, by applying lean risk management, general lean best practices and tools to risk Management, it will be possible to reduce the complexity and waste in the risk management process and to implement the process with better performance. Implementation performance of enterprise risk management will increase by systematizing lean comprehensive process design and application approaches in enterprise risk management and integrating them into corporate culture. In addition, with enterprise risk management with a lean approach, reasonable assurance that can be

obtained from risk management towards achieving corporate objectives will be approached.

With the enterprise adoption of risk management, risk management practices with the desired performance can be implemented and the targeted results from risk management can be approached. For the organization-specific design of the risk management system, the installation and implementation of the system, resources are needed in terms of both infrastructure and implementation. Enterprise risk management must be comprehended, owned and implemented across the enterprise.

Trying to implement a certain practice or another company's model is a big risk to success. Enterprise risk management emphasizes that prescription applications are risky, especially in terms of threat. Accordingly, the design and application of administrative systems with organizational shaping is considered a vital necessity. There are lean thinking approaches and different techniques and management practices in different industries. ERM should be designed and selected in accordance with corporate strategies and considering organizational goals and resources. Lean management, which is people-oriented, is integrated into the corporate culture to be applied throughout the enterprise with a holistic approach to receive the contributions of individual uniqueness, much like risk management. Lean and risk management practices built on values are focused on added value. As soon as cultural change is achieved, risk management and lean management will increase corporate value with full performance and support the achievement of corporate goals.

When considered in terms of project management, ERM can be defined as "the systematic method of identifying, evaluating, mitigating, monitoring or controlling unplanned events that may affect a project" (Seddigh & Alimohamadi, 2009). For successful risk management, not only the process itself, but also the corporate culture and corporate context are important. Similar to other efforts aimed at continuous improvement of processes and products, risk management depends on the following factors (Oehmen & Rebentisch, 2010):

(a) A clear and shared understanding of the relevance and objectives of risk management.
(b) Matching expectations, responsibilities and impact.
(c) Identifying cross-border and cross-hierarchical process teams.
(d) Adequate resource allocation.

Lean is a risk strategy that deals with the optimization of corporate efficiency, productivity and culture to sustainability that they are in line with RM's improvement needs (Pelle et al., 2017). Lean risk management is a combination of tight forecasts, optimal buffers and compression of more than can be obtained from project current and historical information and integration of risk management with project planning and regular project activities (Bollinger, 2010).

Clearly, lean management is a strategy that leads to continuous improvement in an organization. To optimize results, organizations must eliminate all waste and non-value-added processes in the business. Lean thinking is not only a cost-cutting method; it is also a company culture.

In essence, lean thinking includes change in organizations starting from top management. Senior managers need to know both the managerial and operational details of the organization in order to identify waste, set goals that encourage all employees throughout the organization to contribute to the implementation and achieve these goals (Leffler, 2015). It will encourage employees to change in terms of lean-based evolution of organizational culture. Therefore, much like in enterprise risk management, lean starts from the top and becomes the culture of the organization.

Risk management involves systematic planning, direction and control over company resources that the company has to maintain. The lean risk management program includes efforts by individuals to evaluate and control risk efficiently and effectively to minimize the negative effects of losses or missed opportunities (Leffler, 2015). Enterprise risk management adds value to both organizations and their stakeholders and reduces missed opportunities to achieve their goals.

### 12.2.2 Risk Management-Based Lean Concept

A lean methodology or process is a philosophy that considers the expenditure of non-value-added resources to the customers in any aspect as wasteful. The process then aims to eliminate such wastages from the system, which would improve the efficiency of the organization as a whole. The main goals of a lean system can be briefly stated as eliminating waste, improving quality and reducing time and total costs (Kumar, 2014).

The concept of lean management expresses a systematic, flexible and sustainable approach to optimally manage both the organizational structure and all managerial processes of an organization. It represents a business strategy focused on creating value for both employees and customers, while eliminating misuse of resources and inadequacies in both allocation and use of resources in organizational structure, operating systems and managerial and functional processes. Any activity that does not add value to an organization's processes or threatens the sustainability of the organization is waste. Lean management is not limited to the continuous improvement of all managerial processes in the organization along with their scope. In simple dreams, it is about socially sensitive and also about respecting people. An organization will only be able to achieve sustainable change and business excellence by combining purpose, process and people (Thun, 2014).

Enterprise risk management is similar to and supports lean management both within the scope of its philosophy and organizational effects and processes. Therefore, the integration of enterprise risk management and lean management is possible. A lean risk management program adds value and helps ensure that losses or missed opportunities do not prevent a company from meeting its goals (McDowell, 2015). The lean concepts are synonymous with those of the risk management strategic process. The mandate and commitment of the framework are synonymous with management commitment, strategy, leadership and alignment within the organization (Pearce & Pons, 2013).

In effect, the lean approach (lean thinking and management) is a risk management strategy. Thus, a lean enterprise risk management strategy aims not to eliminate roles and processes in the organization but to eliminate or minimize the number of roles and process steps that do not create added value for both organizations and their stakeholders.

The true lean mindset shouldn't hinge myopically on the problem but the factor or process that yields the problem. This is where risk management comes in. In one way or another, everyone working at a processing plant assesses and manages risk. For example, when an employee applies his occupational knowledge by safely operating heavy machinery, he's leveraging the risk of injury with his expertise. That said, risk management doesn't exclusively pertain to preventing injuries in the workplace. That same employee prevents value loss by processing material properly (USC Consulting Group, 2015).

Enterprise risk management is a continuous systematic process in organizations during their whole life cycle. Integrating lean management with risk management makes it possible to use the available resources in the optimum way possible, thus achieving organizational aims with a minimum of time and resources. Risk management process steps may become more effective. Valueless complexity obscures important sources of risk. Leaner and integrated risk management identifies value streams that reveal the real sources of risk and allows the organization to realign its controls, so they are more targeted and effective (Thun, 2014).

Lean-based managerial approaches, combined with all functions of management processes within the scope of SMART goal development and decision-making, are also critical for the achievement of corporate strategies. Lean approaches and practices increase efficiency in terms of creating a common language throughout the organization and developing the desired corporate risk culture.

Hence, lean implementation involves selecting appropriate tools from the lean arsenal to achieve process excellence. However, there is a danger of focusing overly on the tool benefit and striving for process excellence but neglecting the sustainability of the lean tool within that specific work culture. Every time a new method is implemented, there is risk introduced to the organization: both an opportunity and a threat. On the one side is the benefit of the technique and on the other side are the detriments (Pearce & Pons, 2013).

In this context, managers and supervisors seeking to flesh out their risk management simultaneously enhance their lean capabilities. BASF explained risk matrices as a very simple math problem. Risk equals probability times severity. This means the equal weight is given to small issues that occur frequently and huge ones that only happen once in a while. Lean process oversight follows similar guidelines: Waste production can be glaring or ingrained in the system, but either way, it's unwanted at a business seeking efficiency (USC Consulting Group, 2015).

Indeed, the most important principle of lean production is to eliminate everything that causes excessive consumption of resources and does not add value to the product. Lean manufacturing is the set of techniques to take the necessary measures to eliminate all these non-value-added processes (Gergin et al., 2017).

According to Yangınlarve Bal, lean management is a form of management that removes non-value-added items from the system and aims to have high-tech equipment and qualified manpower in the system. It is an approach that focuses on innovation with the least use of resources as well as reducing errors.

In essence, the goal of lean management is not to eliminate tasks, but to eliminate or minimize non-value-added process steps. Lean management is not a concept that only concerns manufacturing companies or a cost reduction program; it is a management strategy that can be applied in all types of organizations as it focuses on improving processes via managing corporate risks (Aytaç, 2009).

Companies in the service industry are under constant pressure to offer excellent customer service, faster response times and quality support for their customers. By targeting and eliminating waste, lean management can also help optimize all service delivery processes as part of a continuous improvement journey (Helmold, 2020).

In this context, enterprise risk management may present reasonable assurance to achieving objectives in organizations while lean all process as management functions, organizational structure and operations. It is a structured, stable, consistent, uninterrupted and systematic process applied throughout the enterprise to identify, identify, evaluate, decide the responses to and report the opportunities and threats that affect the achievement of the organization's objectives. The most important principle of lean production is to eliminate everything that causes excessive consumption of resources and does not add value to the product. Lean manufacturing is the set of techniques to take the necessary measures to eliminate all these non-value-added processes (Gergin et al., 2017).

Risk analysis and management are critical to all serious decision-making processes. In some ways, it is not surprising that the risk management approach is similar to lean management since both are inherent to the quality and continuous improvement systems. Both lean and risk management focus on "value". The risk approach protects value and lean supports this by focusing on providing customer value. Both are systematic and data driven. Both implementations are tailored to the organization, take into account human and cultural factors, aim to be inclusive of the entire system (not compartmentalized or locally focused) and include all stakeholders in the processes. Both are dynamic and responsive to change and facilitate continual improvement of the organization (Pearce & Pons, 2013).

Hence, leaned enterprise risk management processes in organizations may support to improve enterprise risk management implementation performance. It occurs in line with the reduction or elimination of non-value-adding activities in enterprise risk management processes (Seddigh & Alimohamadi, 2009). The vital point to consider here is the understanding that lean success in supply chain risk management will only be possible if the entire supply chain becomes lean. Therefore, everyone's participation in the transformation process is a key success factor in lean practice (Womack & Jones, 1998). It can use lean thinking to overcome different barriers to the value stream in enterprise risk management processes. Because, when the risk management process is viewed as a pure thinker, it is understood that the aim is to create value for the stakeholders.

Once businesses have acquired the appropriate knowledge and ability to distinguish between value and waste, they are ready to map out the value stream to eliminate non-value-added activities outside the category of activities known as essential waste (Seddigh & Alimohamadi, 2009). The value stream mapping technique also has the potential to be adapted to not only identify non-value-added activities and waste but also highlight opportunities where both value-added and safety can be improved simultaneously. It can also indicate activities prone to human error and raise awareness of where waste removal activities can have a negative impact on safety (Ward & de Brito, Lean-Safe Operations for the Aviation Industry, 2007).

Being lean refers to a common goal in the idea of opposing all kinds of waste in the business and related processes. The challenge in implementing lean guidelines is, for the most part, not compromising safety and security. With a low level of safety, situations arise that are more vulnerable to wastage in human health, time and energy and financial waste. Therefore, safety-related activities cannot be considered as non-value-added activities, as opposed to lean goals such as being faster, cheaper and better (Seddigh & Alimohamadi, 2009). Given that safety is a key component of customer value, it can be argued that the use of value stream mapping applies to both airline and aviation maintenance operations (Ward & de Brito, Lean-Safe Operations for the Aviation Industry, 2007).

Since the aviation industry is a service industry, it can be generalized with other service industry processes or results. So much so that there are two lines of conclusion in lean service processes. The first is that applying lean to service processes should include optimal alignment of workstations to eliminate waste and balance workstations. Thus, the highest efficiency, the best cost and time limits drawn by lean principles are reached. A second factor is the natural variability in service processes. Analytical steps need to be taken regarding the service line process to predict and evaluate the resulting impacts, and on this basis, compensatory measures can be taken to accommodate variations (Arbos, 2002). Having this perspective should be applicable in the risk management process. Because, especially in aviation, the target is to serve customers at the best level. In this direction, the goal of increasing the probability and results of desired events can be pursued while simultaneously reducing the probability and consequences of undesirable events (Seddigh & Alimohamadi, 2009).

When both lean thinking and lean approach are integrated with enterprise risk management, a better environment will be created in terms of efficiency, safety and security for organizations or companies that do this. If all the people working in the companies accept these two conditions, the business can reach a constantly improving position (Seddigh & Alimohamadi, 2009). Better integration of these can be done using lean tools, resulting in a lean enterprise risk management process. For instance, the concept of kaizen refers to many activities that will help continuous improvement and belong to risk reduction operations. That is, they reduce the possibility of interruption of the flow of goods or information, losses due to unnecessary transactions without added value and quality problems. Similar functions can be achieved with the following tools: Kanban or “pull” system, 5s (sort, set, shine, standardize and sustain), single-piece flow, synchronization between machines and

workshops: total job control, U-lines, job rotation and job descriptions, poka-yoke or autonomy, die change in single minutes, quality circles, total productive maintenance, judoka, andon, 7w and Ishikawa diagram (Konecka, 2010). Thanks to these lean tools, uncertainties can be removed, thereby revealing elements of value for the company. Indirectly, it is in the direction of reducing the risks.

To define it differently, lean management is the simplification of the organizational structure in order to provide faster and more adequate feedback to the quality and standards demanded by the customers, the elimination of processes or positions that do not create added value for the business and bringing the person who does the work and the decision-maker as close as possible (Atsan, 1998). Certain factors lead businesses to lean management. The first is to minimize personnel costs, and the other is to keep lean management companies increasingly competitive. In this way, companies can get faster results by constantly reviewing themselves. Its products and services are always customer-oriented (Wynne & Marovac, 1993).

Nevertheless, exceptional results should not be expected in the short term. Lean management and risk management, implemented with an approach designed specifically for the institution, will create a solid and effective Institutional change and transformation. The transition and transformation of organizational culture to lean management are not possible by changing only one part. All actors in the organization need to change. For example, top managers need to change. For this, they need to develop a vision and develop a point that will inspire the organization. In addition, they need to motivate employees, the main purpose of which is to ensure that employees do not feel empty. Finally, organizational culture should be made open to development and learning (Wynne & Marovac, 1993). A lean management system also makes it possible to focus people on strategically important and value-added activities, reducing the waste of valuable intellectual and managerial resources across the entire enterprise. Therefore, improving management systems will enable businesses to be more successful in challenging and competitive markets. With lean management, it is aimed to establish a structure that is free from unnecessary details, does not get caught in bureaucratic obstacles and can react immediately. By providing simplicity in this way, organizational levels that delay communication and decision-making in enterprises are reduced, and the processes and instructions related to decision-making are leaned. In addition, a structure that is free from bureaucratic structure and can respond immediately to the demands of customers and the market is formed. In this way, flexible, shrunken and entrepreneurial organizations have emerged (Atsan, 1998).

We are entering an era when past experiences and memorization will not be enough. We are going through a period where the speed and scope of change cannot be determined, we have difficulty in understanding the events, and we cannot make predictions. We are in the VUCA period due to many factors, such as political uncertainties, fluctuations in the economy, changes in production processes created by digital transformation, increasing employee demands and customer expectations and social and environmental factors. The concept of VUCA, which was described as volatile, uncertain, complex and ambiguous, and developments that emerged in the 2000s became frequently spoken in the business world. Variability is the

increasing speed and size of change; uncertainty indicates that unpredictability is the most decisive rule, complexity indicates that it is difficult to establish relationships between parts, and ambiguity indicates that we have difficulty in making sense of the phenomena around us (Stratejico, 2021).

### 12.2.3 Everyone Has Responsibility to Leanness as Risk Manager

A lean methodology or process is a philosophy that considers the expenditure of non-value-added resources to the customers in any aspect as wasteful. The process then aims to eliminate such wastages from the system, which would improve the efficiency of the organization as a whole. The main goals of a lean system can be briefly stated as eliminating waste, improving quality and reducing time and total costs (Kumar, 2014).

The concept of lean management expresses a systematic, flexible and sustainable approach to optimally manage both the organizational structure and all managerial processes of an organization. It represents a business strategy focused on creating value for both employees and customers, while eliminating misuse of resources and inadequacies in both allocation and use of resources in organizational structure, operating systems and managerial and functional processes. Any activity that does not add value to an organization's processes or threatens the sustainability of the organization is waste. Lean management is not limited to the continuous improvement of all managerial processes in the organization along with their scope. In simple dreams, it is about socially sensitive and also about respecting people. An organization will only be able to achieve sustainable change and business excellence by combining purpose, process and people (Thun, 2014).

Enterprise risk management is similar to and supports each other with lean management both within the scope of its philosophy and organizational effects and processes. Therefore, the integration of enterprise risk management and lean management is possible. A lean risk management program adds value and helps ensure that losses or missed opportunities do not prevent a company from meeting its goals (McDowell, 2015). The lean concepts are synonymous with those of the risk management strategic process. The mandate and commitment of the framework are synonymous with management commitment, strategy, leadership and alignment within the organization (Pearce & Pons, 2013).

### 12.2.4 Lean Thinking in Risk Management

The lean approach (lean thinking and management) is a risk management strategy. Lean enterprise risk management strategy aims not to eliminate roles and processes in the organization but to eliminate or minimize the number of roles and process steps that do not create added value for both organizations and their stakeholders. The true lean mindset shouldn't hinge myopically on the problem, but the factor or process that yields the problem. This is where risk management comes in. In one

way or another, everyone working at a processing plant assesses and manages risk. For example, when an employee applies his occupational knowledge by safely operating heavy machinery, he's leveraging the risk of injury with his expertise. That said, risk management doesn't exclusively pertain to preventing injuries in the workplace. That same employee prevents value loss by properly processing material (USC Consulting Group, 2015). Enterprise risk management is a continuous systematic process in organizations during their whole life cycle. Integrating lean management with risk management makes it possible to use the available resources in the optimum way possible, thus achieving organizational aims with a minimum of time and resources. Risk management process steps may become more effective. Valueless complexity obscures important sources of risk. Leaner and integrated risk management identifies value streams that reveal the real sources of risk and allows the organization to realign its controls, so they are more targeted and effective (Thun, 2014). Lean-based managerial approaches, together with all functions of management processes within the scope of SMART goal development and decision-making, are also critical for the achievement of corporate strategies. Lean approaches and practices increase efficiency in terms of creating a common language throughout the organization and developing the desired corporate risk culture.

Lean implementation involves selecting appropriate tools from the lean arsenal to achieve process excellence. However, there is a danger of focusing overly on the tool benefit and striving for process excellence but neglecting the sustainability of the lean tool within that specific work culture. Every time a new method is implemented, there is risk introduced to the organization: both an opportunity and a threat. On the one side is the benefit of the technique and on the other side are the detriments (Pearce & Pons, 2013).

Managers and supervisors seeking to flesh out their risk management simultaneously enhance their lean capabilities. BASF explained risk matrices as a very simple math problem: Risk equals probability times severity. This means the equal weight is given to small issues that occur frequently and huge ones that only happen once in a while. Lean process oversight follows similar guidelines: Waste production can be glaring or ingrained in the system, but either way, it's unwanted at a business seeking efficiency (USC Consulting Group, 2015). The most important principle of lean production is to eliminate everything that causes excessive consumption of resources and does not add value to the product. Lean manufacturing is the set of techniques to take the necessary measures to eliminate all these non-value-added processes (Gergin et al., 2017). Lean management is a form of management that removes non-value-added items from the system and aims to have high-tech equipment and qualified manpower in the system. It is an approach that focuses on innovation with the least use of resources as well as reducing errors. The goal of lean management is not to eliminate tasks but to eliminate or minimize non-value-added process steps. Lean management is not a concept that only concerns manufacturing companies or a cost reduction program; it is a management strategy that can be applied in all types of organizations as it focuses on improving processes (Aytaç, 2009) via managing corporate risks. Companies in the service industry are under constant pressure to offer excellent customer service, faster response times and

quality support for their customers. By targeting and eliminating waste, lean management can also help optimize all service delivery processes as part of a continuous improvement journey (Helmold, 2020). Enterprise risk management may present reasonable assurance to achieving objectives in organizations while lean all process as management functions, organizational structure and operations. It is a structured, stable, consistent, uninterrupted and systematic process applied throughout the enterprise to identify, identify, evaluate, decide the responses to and report the opportunities and threats that affect the achievement of the organization's objectives. The most important principle of lean production is to eliminate everything that causes excessive consumption of resources and does not add value to the product. Lean manufacturing is the set of techniques to take the necessary measures to eliminate all these non-value-added processes (Gergin et al., 2017). Risk analysis and management are critical to all serious decision-making processes. In some ways, it is not surprising that the risk management approach matches with lean management since both had roots in the quality and continuous improvement systems. Both lean and risk management focus on "value". The risk approach protects value and lean supports this by focusing on providing customer value. Both are systematic and data driven. Both implementations are tailored to the organization, take into account human and cultural factors, aim to be inclusive of the entire system (not compartmentalized or locally focused) and include all stakeholders in the processes. Both are dynamic and responsive to change and facilitate continual improvement of the organization (Pearce & Pons, 2013). Leaned enterprise risk management processes in organizations may support improving enterprise risk management implementation performance. It occurs in line with the reduction or elimination of non-value-adding activities in enterprise risk management processes (Seddigh & Alimohamadi, 2009). The vital point to consider here is the understanding that lean success in supply chain risk management will only be possible if the entire supply chain becomes lean. Therefore, everyone's participation in the transformation process is a key success factor in lean practice (Womack & Jones, 1998). It can use lean thinking to overcome different barriers to the value stream in enterprise risk management processes. Because, when the risk management process is viewed as a pure thinker, it is understood that the aim is to create value for the stakeholders. Once businesses have acquired the appropriate knowledge and ability to distinguish between value and waste, they are ready to map out the value stream to eliminate non-value-added activities outside the category of activities known as essential waste (Seddigh & Alimohamadi, 2009). The value stream mapping technique also has the potential to be adapted to not only identify non-value-added activities and waste but also highlight opportunities where both value-added and safety can be improved simultaneously. It can also indicate activities prone to human error and raise awareness of where waste removal activities can have a negative impact on safety (Ward & de Brito, Lean-Safe Operations for the Aviation Industry, 2007). Being lean refers to a common goal in the idea of opposing all kinds of waste in the business and related processes. The challenge in implementing lean guidelines is, in most cases, not compromising safety and security. With a low level of safety, situations arise that are more vulnerable to wastage in human health, time and energy and financial

waste. Therefore, safety-related activities cannot be considered non-value-added activities, as opposed to lean goals such as being faster, cheaper and better (Seddigh & Alimohamadi, 2009). Given that safety is a key component of customer value, it can be argued that the use of value stream mapping applies to both airline and aviation maintenance operations (Ward & de Brito, Lean-Safe Operations for the Aviation Industry, 2007). Since the aviation industry is a service industry, it can be generalized with other service industry processes or results. So much so that there are two lines of conclusion in lean service processes. The first is that applying lean to service processes should include optimal alignment of workstations to eliminate waste and balance workstations. Thus, the highest efficiency, the best cost and time limits drawn by lean principles are reached. A second factor is a natural variability in service processes. Analytical steps need to be taken regarding the service line process to predict and evaluate the resulting impacts, and on this basis, compensatory measures can be taken to accommodate variations (Arbos, 2002). Having this perspective should be applicable in the risk management process. Because, especially in aviation, the target is to serve customers at the best level. In this direction, the goal of increasing the probability and results of desired events can be pursued while simultaneously reducing the probability and consequences of undesirable events (Seddigh & Alimohamadi, 2009). When both lean thinking and lean approach are integrated with enterprise risk management, it will create a better environment in terms of efficiency, safety and security for organizations or companies that do this. If all the people working in the companies accept these two conditions, the business can reach a constantly improving position (Seddigh & Alimohamadi, 2009). Better integration of these can be done using lean tools, resulting in a lean enterprise risk management process. For example, the concept of kaizen refers to many activities that will help continuous improvement and belong to risk reduction operations. That is, they reduce the possibility of interruption of the flow of goods or information, losses due to unnecessary transactions, without added value and quality problems. Similar functions can be achieved with the following tools: Kanban or "pull" system, 5s (classify, sort, delete, standardize, resume), single-piece flow, synchronization between machines/workshops: total job control, U-lines, job rotation and job descriptions, poka-yoke or autonomy, die change in single minutes, quality circles, total productive maintenance, judoka, andon, 7w and Ishikawa diagram (Konecka, 2010). Thanks to these lean tools, uncertainties can be removed, thereby revealing elements of value for the company. Indirectly, it is in the direction of reducing the risks. To define it in another way, lean management is the simplification of the organizational structure in order to provide faster and more adequate feedback to the quality and standards demanded by the customers, the elimination of processes or positions that do not create added value for the business and bringing the person who does the work and the decision-maker as close as possible (Atsan, 1998). There are some factors that lead businesses to lean management. The first is to minimize personnel costs, and the other is to keep lean management companies increasingly competitive. In this way, companies can get faster results by constantly reviewing themselves. Its products and services are always customer-oriented (Wynne & Marovac, 1993). Great results should not be expected in the

short term. Lean management and risk management, implemented with an approach designed specifically for the institution, will create a solid and effective Institutional change and transformation. The transition and transformation of organizational culture to lean management are not possible by changing only one part. All actors in the organization need to change. For example, top managers need to change. For this, they need to develop a vision and develop a point that will inspire the organization. In addition, they need to motivate employees, the main purpose of which is to ensure that employees do not feel empty. Finally, organizational culture should be made open to development and learning (Wynne & Marovac, 1993). A lean management system also makes it possible to focus people on strategically important and value-added activities, reducing the waste of valuable intellectual and managerial resources across the entire enterprise. Therefore, improving management systems will enable businesses to be more successful in challenging and competitive markets (Shinkle, 2005). With lean management, it is aimed to establish a structure that is free from unnecessary details, does not get caught in bureaucratic obstacles and can react immediately. By providing simplicity in this way, organizational levels that delay communication and decision-making in enterprises are reduced, and the processes and instructions related to decision-making are leaned. In addition, a structure that is free from bureaucratic structure and can respond immediately to the demands of customers and the market is formed. In this way, flexible, shrunken and entrepreneurial organizations have emerged (Atsan, 1998).

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change. For example, top managers need to change. For this, they need to develop a vision and develop a point that will inspire the organization. In addition, they need to motivate employees, the main purpose of which is to ensure that employees do not feel empty. Finally, the organizational culture should be made open to development and learning (Wynne & Marovac, 1993). A lean management system also makes it possible to focus people on strategically important and value-added activities, reducing the waste of valuable intellectual and managerial resources across the entire enterprise. Therefore, improving management systems will enable businesses to be more successful in challenging and competitive markets (Shinkle, 2005). With lean management, it is aimed to establish a structure that is free from unnecessary details, does not get caught in bureaucratic obstacles and can react immediately. By providing simplicity in this way, organizational levels that delay communication and decision-making in enterprises are reduced, and the processes and instructions related to decision-making are leaned. In addition, a structure that is free from bureaucratic structure and can respond immediately to the demands of customers and the market is formed. In this way, flexible, shrunken and entrepreneurial organizations have emerged (Atsan, 1998).

## 12.3 Lean-Based Risk Management Philosophy Is Vital in VUCA Conditions

Lean management is a management approach that is absolutely necessary in VUCA conditions applied in many sectors, including aviation, and its implementation is critical in terms of resource management. In order for lean management to be implemented both in production and in the desired performance throughout the organization, it is important that both its perspective and philosophy are understood by both employees, managers and all stakeholders, and the relevant awareness is increased.

In today's VUCA conditions, production organizations are faced with some problems. One of the problems faced by organizations can be defined as the obsolescence of traditional methods with the emergence of new production philosophies. Another problem is that the way of thinking of consumers has changed and they are now demanding innovative products and services in a shorter time and at a lower price (Tersine & Wacker, 2000). According to Jasti and Kodali, it has become imperative for businesses to change and stand out from their competitors by keeping up with changing conditions in order to meet changing demands today. Here, lean management may be accepted as a production philosophy that will be applied for the long-term solution of such problems that arise in organizations (Bhasin & Burcher, 2006). Lean management provides development in organizations with its own methods in line with certain principles in order to meet the needs that traditional methods cannot meet. With simplicity, it is possible to increase quality and delivery levels and reduce costs. In addition, lean management by creating a culture of continuous improvement has produced significant improvement results. These improvements can be implemented throughout the supply chain (Plenert, 2007). Lean management is a philosophy that eliminates waste, enables both cost and time

savings and aims to ensure sustainability while doing these. Lean management is an approach that maximizes customer satisfaction and facilitates responding to globally changing demands. The benefits of the lean philosophy can be divided into three broad categories: operational, administrative and strategic benefits. Although it is still used only within the field of activity with the perception that only operational benefits are provided today, research shows that the administrative and strategic benefits of lean are equally effective (Kilpatrick, 2003). Lean management is an innovative approach that provides benefits to the organization in multiple areas when applied to the entire flow in line with the principles determined by methods suitable for the organization. In order to stay ahead of their competitors in the developing world, organizations should understand new philosophies and apply them by handling them with the most appropriate method. Lean management is a form of management that removes non-value-added items from the system and aims to have high-tech equipment and qualified manpower in the system. It is an approach that focuses on innovation with the least use of resources as well as reducing errors. The core point of view of the lean management approach is that the management adds value to all the elements that are managed philosophically, ensures their development and uses the resources as much as possible for the needs of those under management. Lean thinking, which brings to the fore a transparent management approach accepted by everyone, is a management approach in which multidimensional and out-of-purpose calculations are ignored and thus activities are acted directly towards the target. Lean management thought has a strong potential to influence and direct the entire organization since it covers all units and individuals within the organizational structure (Şirin & Eyel, 2021). Lean management is an approach that sees the non-value-added expenses of the product reaching the customer as waste in organizations (Sobek & Lang, 2010). Wastes that are seen as waste in lean management and that are tried to be eliminated in principle; shipping, inventory, movement, waiting, over-processing, overproduction and product defects. There are multiple methods applied to eliminate these wastes with lean management. By incorporating lean thinking into the processes in the business, a lean organization can be achieved. These processes are processes such as lean thinking on a product basis, lean thinking on product flow, lean thinking on delivering the product to the customer and lean thinking on improvement. These processes will reveal lean production, lean management and lean organizations managed with lean management (Aksoy et al., 2006). Lean thinking is fundamentally based on eliminating waste, empowering frontline workers, responding promptly to customer requests and optimizing across the value chain. Lean thinking takes its name from the best-selling book "The Machine that Changed the World", which describes the movement of automobile production from handcraft production to mass production and lean production. The aim of the lean philosophy developed at Toyota Motor Company after the Second World War was to reduce costs by eliminating waste. Here, waste or waste can be defined as things that the customer does not want to pay for and therefore must be eliminated (Åhlström & Karlsson, 1996).

One element of lean management is the reduction of variability, including demand variability, production variability and supplier variability. Production variability includes not only variation in product quality characteristics but also variation in duty cycles. Lean management seeks to reduce tenure variation by establishing standardized business procedures. Supplier variability also means uncertainties in quality and delivery times. Reduction in supplier variability is often achieved through partnerships and other forms of supplier–manufacturer collaboration (Arnheiter & Maleyeff, 2005). Lean management actually emerged from the subject of lean production. The brief history of lean production dates back to the 1950s. Its basic principles were laid in the Japanese Toyota company, under the leadership of engineer Eiji Toyoda, a member of the Toyota family, and Taiichi Ohno, an engineer he worked with. The aim of the system of lean production is "to improve quality, cost and delivery performance together by increasing the speed and shortening the flow time" (Obeya Academy, 2020). It became clear that once lean manufacturing is done, it can also be used to optimize processes that are directly linked to industrial production. This has resulted in a broad lean management discipline. The concrete goal is to increase customer focus while reducing efficiency. While the difference between lean management and production can be seen as a corporate philosophy for all levels of management, lean production is its application, especially in production units (BIBUS, 2019). In lean management, the delegation of authority is increased, everyone is held responsible for their work, zero hierarchy is aimed, that is, subordinates as well as superiors have the right to have a say in all decisions regarding the company, and it is a management style established for the realization of lean production (Atsan, 1998).

Lean thinking and six sigma philosophies originating from leading companies such as Toyota and General Electric (GE) are successfully applied in ground operations, maintenance and flight operations in the aviation industry. Six sigma, which focuses on effectiveness by finding root causes and improving the project by using daily applied lean techniques such as standing postures, improvement boards and Kaizen events focused on process efficiency improvement, or using the Define–Measure–Analyze–Improve–Control cycle, both techniques are constantly better. It is the complement of taking small steps for the better (Aviation Decision Science, 2021).

## 12.4 Lean Learning, Training and Education: Twenty-First-Century Skills-Based Approach in Aviation

Lean training may be designed in two ways. The first one is to increase the training performance by simplifying the in-organization training. The aim here is to simplify both the content and the way of delivery of the pieces of training and the resources used in the training. This means that the training is given more clearly and the gains of the participant from the training are increased.

Another value area is to improve the awareness levels of both managers and all personnel about lean management. Resource use risks can be optimally managed by

providing training on how to increase efficiency and performance, and how to reduce waste, to all human resources throughout the organization and, if possible, to stakeholders. The capacity utilization rate will also increase with the increase of awareness of lean management and the formation of lean consciousness. This will be reflected in sustainability as added value (see Fig. 12.1).

Safety and security are first in the aviation management concept. The competencies and non-tech skills of the human resources in the aviation industry are the vital drivers that have an impact on both safety and security. Aviation requires licensed human resources for operations. Lean aviation training systems support the competencies of technicians, traffic controllers, pilots, cabin attendants, dispatchers, supervisors and all other licensed personnel in the aviation industry. Lean training helps improve situational awareness more clearly. Training environment with a clear training process and materials of lean training and learning systems creates optimum learning environments. The lean approach integrated with enterprise risk management is a driver to sustainable improvement in organizations. In this point, leaned training process may improve an organization's training performance and also optimize resource use in these processes. Therefore, lean thinking-based training systems may contribute to next-generation professionals. Lean training

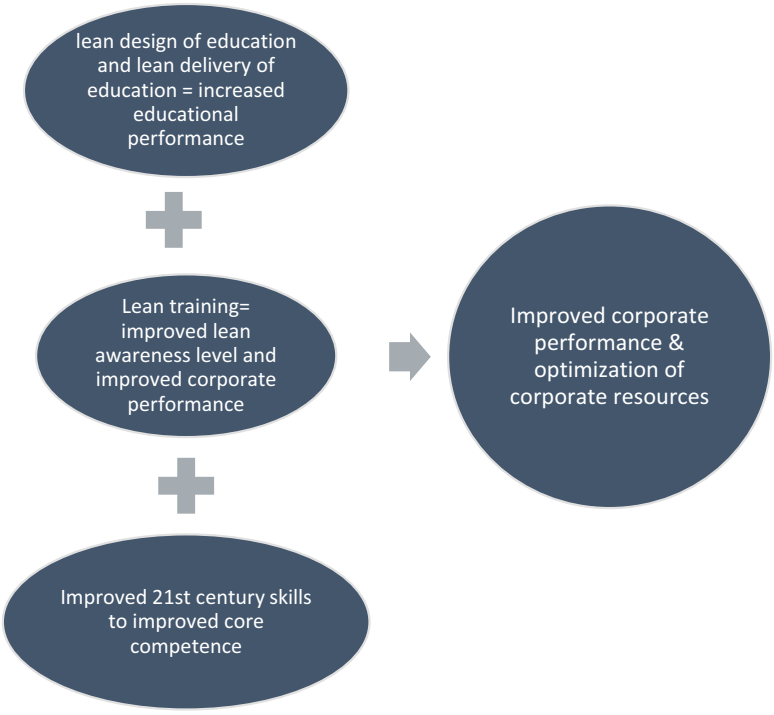


**Fig. 12.1** Lean design to training and education integrated with twenty-first-century skills
Source: Author

methodologies use data, measurements and statistics to identify process inefficiencies and then apply strategic tools to eliminate defects by decreasing process variation.

Organizations that effectively apply a lean methodology will reduce waste, increase profit and enhance shareholder value. For example, General Electric used lean techniques to increase profits by $2 billion in a one-year period (Acclino, 2021, https://www.acclino.com/benefits-of-lean-training/).

Lean training has considerable potential to support achieving corporate strategies and also improve awareness of internal stakeholders in civil aviation organizations. The benefits of lean education will be in the following subject areas:

- Allocating only as much time as necessary to education, and thus shortening the education period.
- Reduction in operating costs of education system elements – infrastructure, technology, equipment, facilities, human resources, etc.
- Developing and changing the design of the interface, taking into account human factors.
- Minimizing the risk of distraction and minimizing the elements that may put safety at risk.
- Elimination of adaptation problem in the case of employee change, thanks to the ease of use of the system.
- Being an example for other trends in the business and inspiring the spread of simplicity throughout the organization.

In order to improve educational performance and train young professionals who meet the requirements of the twenty-first century, it is important that lean thinking philosophy is established in education and that it is one of the essential parts of education culture. It is a holistic and systematic managerial approach that eliminates the elements that do not create added value in the processes and makes the processes value-based with all their elements. The lean education system supports the optimization of education in terms of quality and quantity, which supports the empowerment of both students and educators.

Twenty-first-century skills of professionals (human resources) such as situational awareness, problem-solving and event analysis, accurate, conscious and timely decision-making, understanding situational conditions, adaptability, flexibility and opportunity-based risks are vital for sustainability in global VUCA conditions, both in risk management and lean management. Twenty-first-century skills support improving the core competence of human resources in organizations. Therefore, the development of twenty-first-century skills will support the lean and risk management performance applied in an organization. Wagner (2008) states the "New World" of Work and the Seven Survival Skills as follows:

- Critical thinking and problem-solving
- Collaboration across networks and leading by influence
- Agility and adaptability

- Initiative and entrepreneurialism
- Effective oral and written communication
- Accessing and analysing information
- Curiosity and imagination

Twenty-first-century skills are required to fully understand and implement lean management, as well as to design and implement enterprise risk management as lean throughout the enterprise. In addition, the development of twenty-first-century skills as self-ability is considered an important opportunity point in order to achieve optimum performance in both education and professional working life. For example, in today's VUCA conditions, decision-making stands out as one of the most critical skills. Problem-solving involves the ability to generate and execute a solution to a problem. Problem-solving occurs when a child uses trial and error to solve a problem until a successful solution is found. This includes imitation and observational learning by observing others and using their problem-solving approaches; sorting and classifying to compare, contrast, group, sort and categorize objects; using logic and reasoning to generate solutions to problems based on rules generally accepted as true; and planning and sequencing to develop and follow a multi-step plan in order to achieve a goal. Interactive, complex activities that are difficult to understand become easily distinguishable from each other, thanks to the skills of learning and renewal, one of the twenty-first-century skills. Within the scope of learning and renewal skills, there are critical thinking and problem solving, creativity and innovation, communication and cooperation skills (Partnership for 21st Century Skills, 2019). In the past, most companies had large hierarchies and their management style was very top-down and employees were very specialized in their functions, but today the organizational hierarchy in any company is more horizontal. The way work is now organized consists of multiple networks of cross-functional teams working together on specific projects. So the job is no longer defined by people's expertise; defined by the task they and their teams are trying to solve or the ultimate goal they want to achieve. Teams are forced to find the best way to achieve that goal. Therefore, teams or individuals should have critical thinking and problem-solving skills (Wagner, 2008). In order for a company to become leaner, there should be a horizontal hierarchy instead of a vertical hierarchy, but not only that, but companies begin to become leaner as leaders or managers become leaner. With critical thinking and problem-solving skills, employees or leaders can start to become lean. Because this skill is expected from people due to the horizontal hierarchy. The aviation sector is a dynamic sector; it is likely to be affected by the environment or adverse events, so it contains high risks. Employees or managers in the aviation industry, if they have this skill, can intervene quickly by solving existing problems. Therefore, critical thinking and especially problem-solving skills are also important in other high-risk sectors such as aviation. Creativity and innovation skill is the correct and creative use of information for the subject or problem at hand. It is necessary to use a wide variety of idea generation techniques. In addition, having new and valuable ideas means that people need to elaborate, refine, analyse and evaluate their own ideas in order to develop and maximize creative efforts. It is necessary to

be able to work creatively not only personally but also with others. It is necessary to communicate new ideas to others so that they can become open and sensitive to new and different perspectives (Partnership for 21st Century Skills, 2019). The purpose of simplification is a continuous renewal, and the concept of kaizen accompanies this. Innovation can become more effective with kaizen. These become necessary in order to accompany the twenty-first-century world. Creativity and innovation can be nurtured by learning environments that encourage inquiry, patience, openness to new ideas, a high level of confidence in twenty-first-century skills, and learning from mistakes and failures. Like many other skills, they can be developed over time with practice (Trilling & Fadel, 2009). Communication and collaboration skill is the effective expression of thoughts and ideas using verbal, written and non-verbal communication skills in a variety of forms and contexts. Through cooperation, communication will also become more useful (Ibid). Effective communication is the key to everything; therefore, people need to learn to communicate effectively with each other and with outside communities (Wagner, 2008). The aviation sector is a sector where communication is used extensively and has an important position. So much so that many communication-related accidents occur in this sector. Extremely good communication ensures that these accidents are prevented. Working environments in the aviation industry are complex, messy and noisy, and most jobs use digital technology and artificial intelligence. In such a business environment, healthy communication is vital for the achievement of safety and security main objectives. If there is no uninterrupted and healthy communication, it will be inevitable that accidents and massacres will occur. Therefore, "leanness" is the basic element of communication for all businesses in the aviation industry. Simplicity is also a determining issue in terms of sustainable relations with stakeholders.

A twenty-first-century approach to risk management builds on and integrates aspects from these existing risk approaches. It leverages an intentional process that is tailored to the project by the project team. Rather than a tactical bottom-up approach, it takes a systemic view of identifying and handling risks (Griffiths & Stevens, 2013). Decision-making and risk taking, which are personal skills, are critical determiners in the risk management process. Enterprise risk management, which is shaped with twenty-first-century skills, will give a more reasonable guarantee for achieving corporate strategies with the lean approach. Another sample of twenty-first-century-based skills is information, media and technology skills, which include information literacy, media literacy, and information and communication technology (ICT) literacy (Partnership for 21st Century Skills, 2019). With the support of digitalization and smart systems, the dynamics of the business environment has changed. Thanks to this digitalized environment, employees and managers have access to all the qualified resources necessary to improve their thinking, learning, communication, cooperation and creation abilities. This power of access also results in the need to learn the appropriate skills to deal with the vast amount of information, media and technology (Trilling & Fadel, 2009). We now live in a technology- and media-driven environment marked by access to abundant information, rapid changes in technology tools, and the ability to collaborate and make individual contributions on an unprecedented scale. Everyone should have these skills in order to

keep up with this environment (Partnership for 21st Century Skills, 2019). It is necessary for all sectors to have these skills in order to keep up with technology. The use of developing technologies in the aviation industry can increase safety and security while providing convenience. For example, thanks to the new technologies used in the handling of cargo, the transportation of dangerous goods can be prevented or the process can be accelerated thanks to new technological tools in cargo loading. While the digitalized work environment reduces the workload, it also increases the amount of qualified work that can be done. This skill is again a skill that can be used in simplification. The convenience that twenty-first-century skills provide to human resources and the business environment creates an opportunity to eliminate waste and all processes that do not create value.

Investing in lean training for employees at all levels within a company can be a catalyst to increasing productivity and profitability. The foundation of a successful lean training programme is a thoroughly trained base of empowered employees. Once the number of employees with lean training reaches a critical mass in the company, productivity can begin to improve without increasing capital costs (Acclino, 2021, https://www.acclino.com/benefits-of-lean-training/).

Enterprise risk management considers the lean approach, both in the content of the training and during the training, as a managerial strategy that increases the performance of the participants and supports their motivation.

A company benefits from lean training the most when a significant number of its employees are trained in the methodology. When employees have adequate lean training, they become much better problem solvers and can continue to increase the company's productivity for the remainder of their careers. As more employees are trained in the lean process, the company gains more professionals to help alleviate issues, more minds to solve problems and more hands to help execute the solution (Acclino, 2021, https://www.acclino.com/benefits-of-lean-training/).

## 12.5 Lean Operations in Airline and Airport Practices and Implementation

Assets and fixed expenses of businesses such as aircraft manufacturers, spare parts manufacturers, airports, airlines and ground services operating in the aviation industry are very high. For this reason, simple and cost-effective solutions are sought in other areas as much as possible. It does not seem possible to operate and achieve sustainable growth in the VUCA environment with traditional manoeuvres and approaches. At this point, redesign and simplification of all management functions, operational activities and business processes, including the organizational structure, is necessary for the management of risks. In the main framework of the value-based risk management approach, it will be possible to simplify the systems by removing all processes, activities, structures and functions that do not create value.

The aviation industry includes a number of interconnected processes, each with its own unique complexities and challenges. The aim of civil aviation is to ensure safe and secure operations as well as customer satisfaction. However, there are

many areas where customer satisfaction can be affected. There are many areas where this can go wrong, from delayed flights, missed connections, long stays, lost luggage or worst of all, cancelled flights. Weather plays a role in some of these issues, and it's definitely beyond an airline's control. However, as McKinsey & Company reports, airlines have delays at gates, underutilized aircraft, and other expensive equipment and personnel sit idle long after planes have landed (Six Sigma Daily, 2018). Supply chains are a vital element of the sustainable aviation industry. Lean applications in the supply chain are a considerable topic in both aviation operations and aviation business. Digitalization and artificial intelligence are transforming business, both the business world and our lives. This intensive digital and artificial intelligence environment has made it easier to implement lean management. Many methods used in the application of lean management, such as the application of the just-in-time (JIT) method, the increase in teamwork and participation, the continuity in improvement, the reduction of inventory, and the quick arrangement, have become much more applicable with the Internet. The collaborative nature of the Internet is particularly beneficial in the production planning function. Supply chain members can adjust production plans quickly and collaboratively, with quick notification of disruptions or malfunctions throughout the entire chain. A key principle of JIT is to minimize inventories and the effort put into doing so plays a role in reducing waste and inefficiencies throughout the production process. Thanks to the Internet, it is possible for each participant to more closely coordinate the supply chain to produce only what is being used next, not what they expect to use. This results in small lot sizes and frequent deliveries; this means low inventory levels throughout the supply chain (Mefford & Bruun, 2003).

Since the emergence of the lean manufacturing concept, derived from the just-in-time system developed by Toyota from the 1960s, there have been advances in information technology, particularly with the widespread deployment of the Internet. Firms have turned to the e-lean concept. Goals such as new product development, coordination of production planning and inventory management, and taking inventory out of the system, which is the main goal of lean production, have become easier with e-leanness. As collaboration has increased thanks to the web, some disadvantages of global supply networks have also become invisible. It can be said that being e-lean in global supply chains provides great benefits (Berggren, 1993).

In terms of production concept, it is stated that lean management has a flow concept unlike traditional management; while all functions are positioned as value-added functions in traditional methods, there are also functions that do not add value in lean management. By comparison, traditional methods only focus on activity costs, whereas lean management focuses on the time, value and cost of flows. When the focus of development is considered, only new developments are followed in traditional methods, while in lean management, there is also the elimination of functions that do not add value, and the increase of functions that add value through continuous development (Koskela, 2007). In aviation, it has been observed that they generally try to reach the concept of lean management based on lean production. The main issue is always lean production. It has been discussed whether there will be lean management in aviation and the obstacles

related to this have been revealed. For example, James-Moore and Gibbons, in their study, based on a typical lean high-volume automotive manufacturer model, suggested a methodology for enabling the examination of lean manufacturing relevance to such products by comparing the drivers encountered and the practices adopted to respond. It also provides an explanation of how this approach has been applied to the civil aviation industry, with examples of the products researchers have chosen to describe as "super-valued goods". As a result, 11 out of 16 applications (i.e. 69%) likely to be found in a typical lean volume automotive company during the new product promotion process show that the civil aviation companies examined have a high level of adoption. Similarly, 13% had a moderate level of adoption, while 18% had a low level of adoption. They think it may reflect that civil aviation companies have not yet completed their lean journey and/or practices and measures are not seen as viable.

The aviation industry involves a series of interlocking processes, each with its own challenges. In addition to the issue of safety, airlines aim to improve passenger satisfaction. There are many areas where this can go wrong, from delayed flights, missed connections, long layovers, lost luggage or, worst of all, cancelled flights (Six Sigma Daily, 2018). The aviation industry is a very dynamic industry in terms of competition. For this reason, brand awareness and service quality perception are important factors for airline companies. In particular, on-time performance is an important factor for measuring performance. For example, increasing the quality of ground handling services can be an important point to satisfy passengers (Gergin et al., 2017). Considering the key drivers of "lean" in aviation, inter-sectoral transfer may not be easy. The requirements for using the advantages that exist on the basis of lean manufacturing have been accepted in the aviation industry. Good results are obtained by applying systems for lean applications in aviation. The aviation industry has seized the opportunity to eliminate large amounts of waste in value streams. The problems faced with implementing lean in aviation are no more difficult than applying lean in other high-volume industries, including automotive. Lean capabilities can be considered within the scope of self-capabilities in terms of management and strategy. As in risk management, managers are in the critical determinant position in terms of lean management implementation and performance of the system (Crute et al., 2003). The weather plays a role in some of these issues, and certainly that is beyond an airline's control. However, as McKinsey & Company reported airlines also have delays at gates after airplanes land, under-utilized aircrafts and other expensive equipment and staff that remains idle for long periods of time. Many of these issues can be reduced or even eliminated by applying the tools used in Lean Six Sigma (Six Sigma Daily, 2018).

The research was conducted to measure the current state of leanness in 31 corporate processes in the US and UK aerospace industries. MIT Lean Enterprise Self-Assessment Tool (LESAT) was used in this research. The results of the research show that the companies sampled from the aviation industry (airlines are not included) show that the managerial vision development and implementations for this are at a low level and not at a sufficient level of maturity yet. However, a clear opportunity for lean enterprise transformation has the potential to be beneficial for

these businesses to increase their maturity in understanding current value streams and identifying future value streams. It is argued that it is not easy for aviation organizations living in a dynamic environment to develop a vision for tracking internal and external factors and managing them in a lean way (Hallam & Keating, 2014).

It is possible to say that lean management was born with the aim of creating a response to changing needs and developing systems. Success in meeting changing needs also makes organizations stand out among their competitors. In addition, being able to follow changing methods and new systems and include them in the flow also plays a role in ensuring the sustainability of organizations. Customer satisfaction is an important factor for airline operations, for example, and service quality is also of great importance in this sector. The customer-oriented theme of lean philosophy to improve service quality has gained momentum in services, but lean management in the airline service sector often lags far behind production and healthcare services. When it comes to operating efficiently, few industries directly impact customers like aviation. A delayed flight causes many problems, particularly if passengers are trying to make connecting flights. Moving thousands of passengers every day through ticketing, security, lines at the gate and while boarding involves a series of interlocking tasks. One hiccup, and people end up with delayed flights or missing baggage (Six Sigma Daily, 2018).

## 12.6 Lean Maintenance, Repair, Overhaul (MRO)

Thanks to increasing global competition and the challenges faced by the travel industry in the wake of the COVID-19 pandemic, aviation MRO organizations are feeling intense pressure to streamline and improve business operations and boost profit margins. The result is that aviation MRO organizations need to speed aircraft turn-around times (TAT), reduce overall maintenance costs, streamline supply pipelines and meet higher demands in customer service and business standards (Four Principles, 2021, https://fourprinciples.com/expert-opinion/lean-aviation-mro/).

In the aviation sector, many organizations such as airline companies, maintenance and repair organizations, ground handling companies and aircraft manufacturers use and continue to develop lean management practices. Pilla Leitner, in her study on the lean management approach and history of Boeing, an aircraft manufacturer, showed that Boeing started to implement lean management approach since the 1980s and works by integrating lean management into its own production systems. When we look at the production techniques of the B-17 aircraft produced by Boeing just after the Second World War, we can see that this aircraft was produced with lean management techniques (Leitner, 2005).

Lean management, applied both in areas such as maintenance and in cabin and cockpit duties, reveals many developments in the aviation industry and ensures sustainability. Safety systems, one of the most important issues in aviation, can also be developed with these methods. Ulfvengren and Corrigan argue that by integrating quality management with existing management processes, lean management can be operationally effective and demonstrate safety performance in line with new

aviation safety regulations (Ulfvengren & Corrigan, 2014). Lean management provides development in organizations with its own methods in line with certain principles in order to meet the needs that traditional methods cannot meet. With simplicity, it is possible to increase quality and delivery levels and reduce costs. In addition, lean management by creating a culture of continuous improvement has produced significant improvement results. These improvements can be implemented throughout the supply chain (Plenert, 2007).

Servicing and repairing aircraft is a complex business that requires a fool-proof system of inspection, detection and quality control. Tasked with returning aircraft to a state at which they can perform their original function, Aviation MROs therefore may be seen as more in the business of remanufacturing than manufacturing. MROs are responsible for making modifications, repairing and restoring parts, and obtaining replacement parts, making supply and inventory primary concerns. The repair and restoration process may occur as scheduled or unscheduled maintenance, increasing unpredictability. In the aviation industry, MRO involves a series of processes (Four Principles, 2021, https://fourprinciples.com/expert-opinion/lean-aviation-mro/):

- Communication and inspection of the problem
- Disassembly of the plane or part, partial or complete
- Inspection of the components
- Repair, replacement, or modification of the parts at fault
- Reassembly
- Testing and inspection of the reassembled plane
- QA of the repair process

The transition to a lean MRO service could be for many companies the solution to market continuity and maintaining a global competitive status. Some improvements have been demonstrated. For example, improvements caused by lean introduction in MRO services have been reported by the MIT Lean Aerospace Initiative (2005) to result in the following (Sánchez & Sunmola, 2017):

- Set-up time: 17–85% improvement.
- Lead time: 16–50% improvement.
- Labour hours: 10–71% improvement.
- Costs: 11–50% improvement.
- Productivity: 27–100% improvement.
- Cycle time: 20–97% improvement.
- Factory floor space: 25–81% improvement.
- Travel distances (people or product): 42–95% improvement.
- Inventory or work in progress: 31–98% improvement.
- Scrap, rework, defects or inspection: 20–80% improvement.

In addition, in MRO organizations that apply lean application techniques, monitoring and evaluation of performance, technical competency, consultancy

participation, user appreciation and supplier management mostly took place in cloud-based systems (Sánchez & Sunmola, 2017). It is possible to observe in this example that the widespread use of the Internet supports lean management practices in aviation. According to Sanchez and Sunmola, effective lean waste reduction with the benefits of increased resource utilization and productivity is achievable in aviation MRO services. Technological advances such as cloud-based systems should in principle help leverage the gains of lean in MRO services (Sánchez & Sunmola, 2017). Lean management aims to eliminate all kinds of waste in the production process, including unnecessary elements in the maintenance process. If lean principles are applied to aircraft maintenance activities, the standard of the maintenance process can be significantly improved (Kolanjiappan, 2015). Generally, the primary goal of lean practices has been to increase outputs such as efficiency, reduce delivery times and costs and improve production quality. However, the structure of the aviation maintenance and repair industry requires that lean implementation should not only be limited to manufacturing activities but also include service-oriented activities (Ayeni et al., 2016). In order to increase efficiency and minimize costs in the aviation industry, maintenance, repair and overhaul services are increasingly adopting a lean philosophy and technological developments (Sánchez & Sunmola, 2017). Icelandair decided to implement lean management in its technical unit in 2008 and realized a successful transformation, saving time on technical tasks such as engine replacement time (Thorhallsdottir, 2016). The maintenance centre myTECHNIC, located at Sabiha Gökçen International Airport (SAW) on the Anatolian side of Istanbul, has been designed according to business lean management principles, providing a wide range of services from maintenance of wide and narrow-body aircraft to engine revisions and aircraft painting. According to what is stated on the web page, myTECHNIC, which embodies lean management principles, productivity and safety since its establishment, eliminates the loss of space, movement and time. It works to expand its corporate responsibility areas for the environment, increase the satisfaction of its partners and reduce the completion times of the works (myTECHNIC, 2021).

## 12.7 Lean Supply Chain in Aviation

### 12.7.1 Introduction to Lean Supply Chain in Aviation

At the most fundamental level, supply chain management (SCM) is the management of the flow of goods, data and finances related to a product or service, from the procurement of raw materials to the delivery of the product at its final destination. Although many people equate the supply chain with logistics, logistics is actually just one component of the supply chain. Today's digitally based SCM systems include material handling and software for all parties involved in product or service creation, order fulfilment and information tracking – such as suppliers, manufacturers, wholesalers, transportation and logistics providers, and retailers (ORACLE, 2021).

The aviation industry is a dynamic sector that constantly changes; thus, it is affected by all the situations in the world, such as the petrol crisis, epidemic, economic crisis, etc. For this reason, aviation struggles with the rise of global competition, availability of raw material and industry induration. To encounter these challenges, the aerospace sector can learn from the lean principles developed within the automotive sector (Beelaerts et al., 2010). The traditional thinking in the USA and Europe was that only mass production could reduce manufacturing costs. However, Japan's automakers have managed to achieve low-cost manufacturing with low volume and high complexity and shorter lead times by applying a lean supply chain model and their products are not only fuel-efficient but also durable (Wu & Wee, 2009). Using mass production generates wastes that lean production eliminates. The eight wastes highlighted in TPS are overproduction, waiting, conveyance, over-processing, excess inventory, movement, defects and unused employee creativity, and the biggest one being overproduction (Wu & Wee, 2009). Thus, the value stream mapping, which is a lean management tool, is used in the lean supply chain to detect what is wasteful and what adds value to the process. And lean supply chain means to detect all that to eradicate them to decrease the time that process took. In aviation, the suppliers are involved with the development of entire functions of the aircraft, such as wings, fuselage and stabilizers, which causes the value to shift from the aerospace original equipment manufacturers (OEM) towards the supply chain (Beelaerts et al., 2010). The final assembly of the Boeing B787 is going to be faster than the assembly of any other aircraft; the goal is only 3 days, according to Boeing. The global supply chain has taken over the classic production function from the focal aerospace OEM Boeing. In fact, Boeing is leveraging customer demand value on suppliers by adding own unique value, which is a mainly innovative design of the aircraft and managing the supply chain for design and integration of aircraft functions such as wings, fuselage, stabilizers, etc. (Ibid) (Beelaerts et al., 2010).

### 12.7.2 Lean Services with On-Time Performance in Aviation

The aviation industry is a very dynamic industry in terms of competition. Therefore, brand awareness and passengers' perception of service quality are important factors for airline companies (Gergin et al., 2017). Another important factor for airlines is on-time performance. In addition to these, high costs are also one of the aspects of the sector that should be emphasized. Studies mention the necessity of a lean management strategy to improve these elements.

High operational costs and hard competition environment in the aviation industry have led airline companies to seek permanent improvements in both their planning and operational practices. Classic cost-cutting methods fall short of helping this policy. Airline companies need to fully evaluate their business processes and organizations. Lean thinking philosophy focuses on improving efficiency and quality by eliminating unnecessary business processes, reducing business times of companies (Demiral, 2006).

Icelandair started to implement its lean management strategy in cabin services as well, and as a result, it achieved benefits such as a reduction in the number of cabin crew going to and from the kitchen, a reduction in unnecessary cost factors, a lighter galley trolley and a more regularity. It both reduced costs and eliminated the unnecessary workload of the cabin crew (Thorhallsdottir, 2016). In their research, Gergin et al. (2017) focused on examining opportunities to improve ground handling quality for Atlasglobal airline company with a lean management approach. In their work covering the entire ground operation, they made suggestions to simplify the process. They concluded that with the lean management approach, the duration of the ground operation was shortened, especially in the check-in and baggage delivery times (Gergin et al., 2017). Businesses operating in aviation services, such as airlines, ground handling services, and catering, apply many processes while offering their services. In these processes, sometimes there may be problems in integrating with each other and being applied simultaneously. At this point, simplifying processes within the scope of lean thinking and lean management principles helps to correct, design or improve the entire value chain by eliminating both conflicts and disruptions in processes. In order for this to happen, the organization must be considered holistically and each process must be directly or indirectly involved in services in a manner that supports each other and in simplicity. This is a requirement that is always emphasized within the scope of enterprise risk management. The aviation industry is also a service industry that includes more than one process. To give an example, the ground operations process can be given. It starts with the contact of the customers with the check-in counter, continues with the transportation of the passengers and their luggage to the plane and ends with the closing of the plane's door. In addition, the transfer of passengers and baggage to the terminal after landing and the delivery of baggage to customers are also within the scope of ground operations (Gergin et al., 2017). Thanks to the lean approach, every step in these processes should be tried to be corrected or improved. In this way, the processes will still be simpler. There are various studies on these processes. For example, in one study, they obtained a leaner process result by analysing ground operation processes from a lean management perspective (Ibid: Gergin et al., 2017). The positive aspects of these studies show that simplicity is possible in aviation. The airline industry has begun to embrace lean operations in recent years, for good reason. Airlines are process, labour, and capital intensive: small reductions in waste – the eternal enemy of lean – go straight to the bottom line, improve the customer experience and engage employees in a more productive "value-added" workplace (Dichter et al., 2018). TEI (Tusaş Motor Sanayi A.Ş.) has adopted the lean production approach since 2001 in order to reduce waste and increase efficiency, as stated on its official website. In this context, the following have been implemented: cellular manufacturing, just-in-time manufacturing (JIT), value stream analytics (VSM), Kaizen meetings and presentations, 5S (editing, discipline, standardization, sorting, cleaning) practices and controls, visual factory and full-time digital critical performance indicators (KPIs) they are working on. They conduct periodic 5S inspections to make the working environment cleaner, safer, more organized and more workable (TEI, 2021).

The aviation business company is myTECHNIC, the maintenance centre located at Sabiha Gökçen International Airport (SAW) on the Asian side of Istanbul. It is designed according to business lean management principles, providing a wide range of services from maintenance of wide and narrow-body aircraft to engine overhauls and aircraft painting. According to what is stated on the web page, myTECHNIC, which has incorporated lean Management principles, productivity and safety since its establishment, eliminates the loss of space, movement and time. It works to expand its corporate responsibility areas for the environment, increase the satisfaction of its partners and reduce the completion times of the works (myTECHNIC, 2021).

Many airlines have internalized the message: posters encouraging employees to follow lean principles are now common in terminal baggage piers, maintenance facilities and crew lounges. These companies use lean tools to reduce the time needed to turn aircraft around at gates, to compress maintenance activities and even to train pilots. But businesses that have truly embraced lean see it as more than a matter of posters, one-off productivity fixes and cost-cutting: it is a mindset, a culture, that systematically seeks and eliminates sources of waste, variability and inflexibility in operations (Dichter et al., 2018).

## 12.8 Lean Management at Airports and Ground Handling

### 12.8.1 Lean Airports

Customer demand for civil aviation is constantly increasing. Although it is one of the sectors whose resilience is tested in pandemic conditions, investments in the aviation industry are continuing.

To meet the steady growth of passenger traffic, there are two main solutions for airports: build new terminals or improve existing ones. To allow this development, an evolution of airports is required (and possible). In the case of new terminal construction, numerous obstacles are encountered, like the project duration that lasts for many decades, infrastructure costs or environmental impacts (ecological footprint, noise and visual nuisances). Some projects such as Notre Dame des Landes airport (Nantes, France) can be prospected for years before eventually being dropped (Sia Partners, 2018).

In this context, the redesign or the improvement of the existing infrastructure could be the most favourable solution. Improving is lean's main goal: it's a combination of methods and tools based on principles created in the 1950s by Toyota and used in Europe since the 1980–1990s. Its objective is to produce in the most effective way in order to meet customer demand, avoid waste, remove non-value-added activities, standardize processes and adapt production to the demand (Ibid: Sia Partners, 2018).

Lean management is a strength for airports just as much as it is for the industry. With the constant growth of air traffic and the reluctance of people and governments to build new airports, lean management is becoming an essential component of

strategic plans. Combined with the smart airport innovations, lean management's principles adapt existing processes and infrastructures to meet new passengers' expectations (Ibid: Sia Partners, 2018).

Boeing airports are complex organizations whose areas of comparative advantages and efficiency hinge on elements of the airport management. It can be concluded that lean management philosophy resulted in optimization of resources, efficiency in performance and gradual but continuous reduction of all forms of waste amongst all localities of airports. This implies that lean management philosophy, if properly followed, guarantees continuous customers' satisfaction, which in turn ensures business viability of airports (Almehareb & Graham-Jones, 2011).

Since the 2000s, lean management has been expanded in the aeronautic industry and the service sector. Numerous companies are using its methods to optimize the use of both material and human resources and increase customer and collaborator satisfaction. Operational excellence, of which lean management is a component, is even going so far as to be an integral part of corporate culture and part of the strategic plans of international hubs as follows (Sia Partners, 2018):

London Heathrow Airport, for instance, used lean principles to increase passenger traffic flow at departure and reduce the number of passengers risking tardiness, from 15.400 to 10 each month.

Frankfort airport has improved the fluidity of passenger flows by 29%, thanks to lean application. In the USA, Chicago and Atlanta airports applied lean management to their security checkpoints reducing waiting times between 20% and 30% on average.

Arrival routes can also garner significant gains, as did Parisian airport Roissy Charles de Gaulle with projects focused on border police or baggage delivery. Auckland airport also increased the percentage of arriving passengers who leave the airport within 25 min by 50% (Fig. 12.2).


**Fig. 12.2** Examples of lean management projects in international hubs (Sia Partners, 2018)

Baggage operations and processes in aviation include the handling operations performed by a service provider from the moment the baggage is unloaded from the aircraft until it is picked up by the passengers from the bands at the terminal. Streamlining the baggage flow process can contribute to better performance, improve customer service and make employees more productive by reducing work that has little added value (Barroso et al., 2019).

By examining the decisions taken at every stage of the in-flight cleaning and baggage processes and by purifying the processes within the scope of the lean management concept, it is possible to realize faster and improved cleaning and baggage processes services. With the lean management approach, the total ground handling time can be shortened due to the operational times spent, especially in the processes of making the aircraft suitable for flight, cleaning, check-in and baggage receipt and delivery. Nugroho et al. (2012) focused on shortening the time in passenger baggage processes, especially in-flight cleaning, in their research on an Indonesian airline company. In their studies, they observed these processes and suggested many simple and minor changes. They concluded that these small changes combined make processes much faster and improved (Nugroho et al., 2012). In their study, Gergin et al. (2017) focused on examining the opportunities to improve ground handling quality for Atlasglobal airline company with a lean management approach. In their work covering the entire ground operation, they made suggestions to simplify the process. They concluded that with the lean management approach, the duration of the ground operation was shortened, especially in the check-in and baggage delivery times (Gergin et al., 2017).

Lean management is a strength for airports just as much as it is for the industry. With the constant growth of air traffic and the reluctance of people and governments to build new airports, lean management is becoming an essential component of strategic plans. Combined with the smart airport innovations, lean management's principles adapt existing processes and infrastructures to meet new passengers' expectations (Sia Partners, 2018). In their research, Almehareb and Graham-Jones (2011) emphasized that continuous customer satisfaction is important as it is the determining factor of business viability in today's aviation business; they evaluated and compared the effectiveness of lean management practice in the aviation sector of European and other Asian airports. In their research, they concluded that a lean airport system can be achieved with a clearly defined goal of total commitment, good leadership and passenger priority to support the lean program, sustainable responsibility, numbers, people and teamwork, airport safety and health and safety. Lean management also has benefits for airport operations in the areas of cost reduction, passenger satisfaction and continuous improvement. In this research, it has also been determined that lean brings a more organized and efficient production order. There is also a reduction in travel distances and also a great reduction in processing time (Almehareb & Graham-Jones, 2011).

### 12.8.2 Lean Aircraft Ground Handling Process

In a study conducted on an airline company that landed at the main airport of a European city, it was aimed to simplify ground operations by focusing on local baggage flow in ground handling processes. A Waste Relationship Matrix has been developed, which allows quantifying the relationship between various types of waste identified in the baggage flow by making waste identification of operational indicators and processes (Pierobon, 2016). In this study, the handling operations carried out by a service provider from the moment the baggage is unloaded from the plane until it is picked up by the passengers from the bands at the terminal are covered. Therefore, the focus is on local baggage flow. As a result of the research, it was concluded that since the airline industry covers a process, labour and capital-intensive sector, reducing jobs with little added value will lead to better performance, improved customer service and more productive employees (Barroso et al., 2019). Almuhareb (2014) conducted a study in which he evaluated the six sigma approach of lean management in order to increase service quality and customer satisfaction at King Khalid International Airport. As a result of his study, it is seen that passenger satisfaction has increased thanks to the 35.7% reduction in passenger waiting time at the airport, and the airport has increased from E (insufficient) to C (good) according to IATA service level standards (Almuhareb, 2014).

"The crucial word for lean is 'waste,' everything that an organisation does not need. According to lean management thinking, there are three types of tasks and processes in an industrial or service setting with regard to waste: those which add value to the outcome, those that must be accomplished but do not add value 'per se' and those that are absolutely not necessary and must be eliminated" (Pierobon, 2016):

- ***Passenger handling:*** *The handling of passengers at the gate in the terminal area is a service which is normally delivered by aircraft ground handling companies. So far, the most common passenger boarding procedure is to board premium passengers, reduced mobility passengers and parents with infants first and then the rest of the passengers* (Pierobon, 2016). *Especially applicable to low-cost carriers, there are other models – which have not yet become mainstream – to make the boarding process more efficient, such as clustering and boarding passengers according to their seating area in the cabin, normally from the rear to the front* (Pierobon, 2016).
- ***Baggage handling:*** *A significant potential for inefficiency exists in the aircraft ground handling process concerning the need to offload bags in the case of a passenger's non-show at the gate (*Pierobon*,* 2016*). Whereas in the past it was more common to offload bags directly from the cargo compartment in the case of non-shows, technology in baggage recollection areas is making it increasingly possible to load bags nearly at the same time as the passenger boards the plane (*Pierobon*,* 2016*).*
- ***Cargo handling:*** *A "lean" solution for cargo operations concerns the positioning of containers in the cargo hold (*Pierobon*,* 2016*).*

- ***Cabin cleaning:*** *In the case of short-haul planes with no crew changes, a possible solution for the optimization of resources is a practice most commonly adopted by low-cost carriers whereby the cabin is cleaned by the cabin attendants during the stop (*Pierobon, 2016*). Sometimes aircraft are delayed on arrival, and in order not to cause an onward delay, the cabin cleaning service can be made shorter; this is another "lean" management technique: the hovering of the cockpit and of the crew rest area, for example, can be skipped, without compromising the quality of service for the airfare paying passengers (*Pierobon, 2016*).*
- ***Mapping and resource planning:*** *One of the things a lean management professional does with processes is mapping them: whatever s/he observes is mapped, together with who goes where and for how long (*Pierobon, 2016*).*
- ***Safety and lean management:*** *Safety is an important part of lean management, in that safety has to be part of management consideration when implementing lean management initiatives (*Pierobon, 2016*).*
- ***Harmonized effort:*** *Leaning up the aircraft ground handling process requires a harmonized effort in the awareness that the ground time of an aircraft for servicing can be shortened only up to a certain point. The aircraft ground handling process is made of several tasks that may be performed simultaneously but each has a given duration (*Pierobon, 2016*).*

The aviation industry is facing significant challenges for the future with continuously increasing competition, cost reduction pressures and skills shortages. In addition, given growing air traffic volumes, there is a relentless drive to make an already safe industry even safer. Furthermore, the drive to make aviation more environmentally friendly is rapidly gathering momentum. Therefore, the industry is under pressure to improve productivity, enhance safety and ensure sustainability. This holds true for all sectors of the industry, including aerospace manufacturing, air transport and maintenance, repair and overhaul (MRO) (Ward & de Brito, 2007). In this point, lean management creates considerable results to support corporate sustainability via using flexible and lean processes besides improving awareness about resource use and process designing.

### 12.8.3 Lean Airlines

Lean management and production approach, besides resource use optimization, has the ability of organizations to accelerate their activities with refined processes and flexibility and at the same time strengthen their resilience. Service quality is of vital importance in this sector for the economic, social and operational profitability of the aviation industry stakeholders and all its components. The aviation industry is in a chip-related difficulty in production today, and the problems in the supply chain due to the pandemic have also affected the aviation industry. Lean practices in the supply chain have started to come to the agenda of managers in the aviation industry. However, the application of lean in the aviation industry, and especially in airlines

and airports, is not as common as it is in healthcare, manufacturing and production services, but today, the concept of lean airport and lean airline is becoming more and more popular as its importance is understood.

It is based on the basic assumption of airline management: the plane incurs losses as long as it is on the ground. So airplanes only make money for airlines while flying. Therefore, the biggest challenge for airline business management is optimizing aircraft turnaround times and improving on-time take-off performance. In addition, operating in a capital-intensive industry known for low-profit margins forces aviation stakeholders to continue improving processes to achieve operational excellence (Aviation Decision Sciences, 2021). In order to overcome these challenges, the integration of enterprise risk management and lean management is considered essential. *Improving customer service*: Lean management can also be used to improve customer service. Airlines may include an entry system to increase efficiency by segmenting passengers. This technique will enable airlines to match staff and passenger arrivals, standardize best practices and monitor varying processing times. It also helps to systematically eliminate the causes of slowdowns and establish a well-rehearsed protocol for dealing with uncontrollable events such as weather cancellations. Something that is well known to all airlines these days: Low cost – low fare. The aim is simple. To reduce the operating costs of the aircraft to reduce the fee for customers. A lean practice commonly used by lean airlines to achieve this is to reduce the time the aircraft is on the ground. However, customers need to be partially involved in some activities to do this. For example, the crew can ask all passengers to collect their own magazines and trash, which not only reduces downtime but also reduces cleaning costs. Another commonly used lean logistics strategy is to shorten boarding time by calling passengers who have to sit in different parts of the plane at different times during the boarding process to increase the overall efficiency of the process (Ibid).

### 12.8.4 Waste Areas in the Aviation Industry and Services

Owing to effective lean management implementation, airlines may reduce their wastes to a reasonable level. Overproduction can also be defined as making the product sooner than necessary or faster than necessary. Overproduction is called the worst waste by some. This is because it creates most of the other waste. For example, overproduction leads to excess inventory, which leads to wasted movement and shipping. Additionally, excess inventory requires more people, equipment and plant space, all of which reduce the company's productivity and profitability. There are reasons for overproduction. The first of these is "logic just in case". It is made to fill the gap by making more products just in case. This has been termed as one of the most common non-lean employee behaviours available in companies today. Unnecessary movement is commonly found in other waste categories such as shipping, inventory, waiting and defects (Charron et al., 2015). An example of this in aviation is "overbooking". Overbooking is selling more tickets than the aircraft capacity. For example, in a plane with 158 seats, it is necessary to sell 158 tickets

while 168 tickets are sold. Overbooking is an action that makes sense to do it just in case. Another reason is poor planning and unbalanced workloads. Inappropriate scheduling and unbalanced workloads can lead to overproduction. When these conditions are met and employees continue to produce, overproduction occurs even if there is no customer demand. In forecast-driven environments, unlevelled timing often occurs. For example, in aviation, ticket prices, how much passenger demand will be and the lines to be opened (city pairs) are predictive. If the airlines that open a new pair of cities do not make good passenger demand or cannot adjust their ticket prices well, the plane will go with an empty seat. This is a situation that puts companies in harm's way. Therefore, by doing this, it will be damaged by overproduction (Charron et al., 2015). Production systems can handle small volumes of "give me now" demand as long as production intervals are planned for last-minute orders and do not exceed a certain percentage of production (Womack & Jones, 2006). Passengers traveling for business purposes make the request "give it to me now". For example, in cases where there is a sudden need for a meeting in another city or the meeting time ends early, the person does not want to return without waiting and does not want to waste time. Various market segmentations are made in the airline market. This is because the main purpose of businesses is to meet the needs of customers and in return to earn a profit. However, since it is not possible to meet the needs of all customers at the same level, the market is divided into segments, and then the market segment that will best respond to the facilities and services of the airline operator is selected, and the needs and wishes of the customers in this segment are tried to be fulfilled (Eser, 2018).

It may be said that the business travel market is the most suitable segment for the simplicity of aviation. This is because in the commercial passenger market, they are located at points that are important to passengers. For example, passengers in this market pay attention to punctuality. Passengers want to arrive at their destination on time. Already in simplicity, waiting times are seen as waste. It eliminates the waste of waiting, which is one of the wastes in terms of punctuality. Another important issue is the location and accessibility of the airport. Business travellers prefer easily accessible airports close to their destinations for short-haul flights because transportation to distant airports causes both loss of time and additional costs (Eser, 2018). Another important issue is the availability and flexibility of tickets. Flight frequency and timing are also important. "Flight frequency is important so that business travellers can reach their desired destination in a short time as a result of sudden changes in their tariffs" (Ibid). Business travellers request a check-in counter so that they can check-in just before the flight to avoid the long queues of time-sensitive passengers. In addition, they want to relax in special halls (CIP) where security and passport controls are made and to give priority to baggage services (Ibid). Unnecessary operations or excessive operations are an unnecessary repetition of an action. Examples include unnecessary recount tools, requesting the same information from a customer multiple times, and obtaining unnecessary additional information. Overproduction or overstocking is also seen as overworking. Except for exceptional cases in aviation, excessive processing does not occur in some cases due to legal requirements regarding the handling of passengers and the use of certain documents

with the process (Al-Dhaheri & Kang, 2015). Overprocessing can originate from many sources and is often present regardless of the type of activity. They are predominantly wastes found in front office areas such as order processing, information collection and dissemination and in all accounting functions. It is also dominant in service sectors where service delivery requirements are not well defined or may be difficult to reach (Charron et al., 2015). Mobility refers to any human activity that workers cannot derive directly from products, tools or information in their workplace. The lean approach emphasizes the use of standard methods to identify steps and corresponding time to eliminate waste of action (Chen, 2018). The transfer of information between employees, departments and customers often leads to wasted movement. Information management systems that are not established to provide necessary information to employees when and where they are needed often result in employees getting printouts and manual document transfers within the organization (Charron et al., 2015). Using technology or transmitting information electronically prevents waste of movement. Selling tickets on the Internet in aviation is a situation that reduces the waste of movement. Kiosk check-in and express baggage devices are examples of actions that prevent unnecessary movement.

Defects are situations where the service process is defective or does not meet the customer's requirements, and corrective action, such as rework, is required. This means that it causes a waste of manpower and time (Chen, 2018). In aviation, defects are products or services that do not meet specifications or passenger expectations. However, the issue here is not considered valid for the passenger departure process, as passengers must go through the process in a legally prescribed manner (Al-Dhaheri & Kang, 2015). In other words, whether the existing processes comply with the expectations of the passengers has been ignored. However, isn't the basic issue in simplicity determining value according to the end customer as well as the passengers? It is debatable whether this situation is contrary to simplicity. This waste, also called waiting or queuing, can often be defined as waiting for something to happen or occur. This could be human waiting time, machine waiting or materials waiting to be processed. After all, it is the customer waiting (Charron et al., 2015). Waste of waiting, at every processing station, intermediate waiting areas and check-in process, etc. takes place in places (Al-Dhaheri & Kang, 2015). Sometimes waiting times can be quite long in aviation. Among the reasons for this, the airport and aircraft traffic density may also be delayed. Generally, passengers are requested to arrive at the airports 1 h before the flight time. It is requested to arrive early for both security procedures and check-in and baggage procedures. Considering that there are also passengers who go to very busy airports 2–3 h earlier, it is seen that there is no stable situation in these waiting times. The procedures during the boarding process from the airport are as follows: Arriving at the airport, going through the security procedure at the first entrance to the airport, waiting at the check-in counter and delivering the baggage, going through the second security procedure to go to the gate, waiting to be boarded in the waiting room and boarding the plane. The activities that add value from these transactions are seen as the arrival at the airport and the departure (Womack & Jones, 2006). The reason for this is that there is waiting, unnecessary operations and movement waste in other processes. Examples of activities that reduce the waste of waiting are boarding by scanning barcodes, kiosk

check-in and express baggage devices. The requests of business passengers mentioned above include the activities that shorten the waiting time the most. The shorter the journey time, the more lean activity is likely to occur.

### 12.8.5 Manufacturing Process in Aviation Industry: Lean Practices in Aircraft Flight Tests

The potential consequences of lean management practices in flight tests of airplanes have also been investigated. Carreras (2002) investigated lean management opportunities in flight testing. He examined a total of 90 flights of 7 different aircraft types. Although the focus of flight tests is on the evaluation of the aircraft and its flight systems, only a small part of the testing process takes place in the air. Many processes take place on the ground to support flight. Lean-thinking improvements to these processes have the potential to reduce the cost of flight tests and shorten the processing time (Carreras, 2002) Boeing, one of the world's largest aircraft manufacturers, started lean management with quality circles in the mid-1980s. This was followed by world class competitiveness training, 5S and just-in-time workshops. Boeing's move to lean was driven primarily by a desire to fix manufacturing problems and meet the demands of its customers and the manufacturing industry (Agyeman, 2021). Although lean management is mostly encountered in the production, maintenance and ground handling processes in the aviation field, it is seen that there are adaptations to other units when the literature is examined. One of them is Carreras' (2002) study examining lean management opportunities in flight tests. He examined a total of 90 flights of 7 different aircraft types. Although the focus of flight tests is on the evaluation of the aircraft and its flight systems, only a small part of the testing process takes place in the air. Many processes take place on the ground to support flight. Lean-thinking improvements to these processes have the potential to reduce the cost of flight tests and shorten the processing time (Carreras, 2002).

### 12.8.6 Lean Manufacturing in Aviation: Aircraft Manufacturing and Spare Parts Manufacturing

In the aircraft industries, the enormous increase in demand has forced manufacturers to seek new concepts to stay in business amid strong competition (Ramamoorthy, 2007). Although lean manufacturing was originally developed for the automotive industry, aerospace manufacturing companies have found that these principles can also be applied in this high-precision industry to create dramatic improvements in manufacturing efficiency. The application of lean principles in the development of production processes is becoming more and more necessary to ensure the attractiveness, competitiveness and sustainability of aircraft producing businesses (Barbosa et al., 2014). The aircraft industry covers the scope of civil aircraft, military aircraft, aircraft maintenance, etc. The main aerospace manufacturing companies (Tier-1) keep the high value-added and technical-intensive activities in house, such as design, final assembly, flying tests, marketing, etc. And offload the low value-added

and labour-intensive production activities to aerospace manufacturing suppliers (Tier-2, Tier-3 …), such as detail part fabrication and aero-structure assembly, etc. The global supply chain of aerospace is then constructed and organized. The aerospace manufacturing suppliers provide the hardware (aircraft, component, spare, AOG (air on ground) parts, etc.) and software (design, service, logistics, NC program, etc.) to their customers. Due to the aerospace manufacturing suppliers provide the products to satisfy the demand of main aerospace manufacturing companies, so the customer satisfaction is the fundamental requirement of suppliers to keep long-tern relationship and obtain stable, enough business from main aerospace manufacturing companies (Ming Chang et al., 2013). The goal of enterprise can break down into four categories (Ming Chang et al., 2013):

1. Delivery: Plan the detail production schedule and control the production progress, from design, engineering, tooling and detailed parts to assembly stage and delivery products on schedule.
2. Quality: Construct the qualified and stable production system to produce the products within the required specification of customers.
3. Cost: Build the products in a competitive cost and obtain a reasonable profit for the enterprise to play an important role in the supply chain.
4. Flexibility: Due to the market and production line being dynamic and fluctuated, the aircraft manufacturing suppliers have to construct the ability to absorb the fluctuations and risk (Ming Chang et al., 2013).

Using six sigma method from lean elements in the aircraft assembly process was evaluated on Bombardier Aerospace Learjet, a business jet manufacturer. As a result of this evaluation, it is stated that the delivery time can be reduced from 26 days to 10 days and savings of nearly $6000 per aircraft can be achieved (Ramamoorthy, 2007). TEI (Tusaş Motor Sanayi A.Ş.), operating in the field of aviation production in Turkey, has adopted the lean production approach since 2001 in order to reduce waste and increase efficiency, according to the official website. In this context, the following are implemented: cellular manufacturing, just-in-time manufacturing (JIT), value stream analytics (VSM), Kaizen meetings and presentations, 5S (editing, discipline, standardization, sorting, cleaning) practices and controls, visual factory and full-time digital critical performance indicators (KPI) they are working on. They conduct periodic 5S inspections to make the working environment cleaner, safer, more organized and more workable (TEI, 2021).

### 12.8.7 Lean Management in Cabin and Catering Services in Air Freight

Lean is particularly useful in the management of catering inventory such as soft drinks. With the transition from traditional techniques to lean, you can reduce the costs of catering, make sure that the catering is as accurate as it can be and trim down the time for on-hand inventory (Marmol, 2017).

Icelandair started to implement the lean management strategy in cabin services after the success of lean management in the technical unit that carries out maintenance and repair activities, and as a result, benefits such as reduction in the number of cabin crew going to and from the kitchen, reduction in unnecessary cost factors, lighter weight of the galley trolley and more regularity. It both reduced costs and eliminated the unnecessary workload of the cabin crew (Thorhallsdottir, 2016). To achieve desired and improved levels of lean practices in airport services, stakeholders such as airlines, ground handling and airports may combine their core competencies to update and improve their approach to services such as baggage and passenger flow. The time it takes for luggage to reach passengers is a very important perfect measure for airports. Therefore, it is important to deal with the ground handling process, and continuous improvement can be implemented in the unloading and handling of aircraft baggage.

In ground handling processes, especially in waste in baggage unloading (BY) and baggage handling (BD), many operator actions were identified to be inappropriate. Equipment should be placed in specific locations, which may be eliminated due to safety regulations and for operations. For example, in the baggage carousel of the BD process, the proposed layout decreases, on average, 75% of the travelled distance (from 80 to 20 m) and 72% of the time spent (from 88 to 25 s) (Barroso et al., 2019). It is emphasized that the lean approach, which we see mostly in terms of shortening processes and reducing costs, may have another benefit in addition to these in the study conducted by Ross (2014). The research emphasizes that food waste can also be reduced by integrating lean thinking to businesses that provide catering to airlines (Ross, 2014).

The lack of resources and inadequate layouts at airports currently compromise the airport performance, which is BU and BD handling processes that influence the flow time of the baggage allowed to identify improvement opportunities, which are the basis for implementing lean management tools. For this purpose, the processes were observed in the Gemba walk and times from some activities were collected for quantifying some relevant operational indicators (Barroso et al., Towards Lean Ground Handling Processes at an Airport, 2019). IATA and US Airways have adopted this lean management technique and got good results from their implementations (Marmol, 2017). A just-in-time production model is helped them to reduce inventory on the aeroplane in improving the overall consistency of stocking. US Airways has now adopted a workflow practice in which a particular employee is responsible for stocking the same drawers repeatedly, which improves the quality of the stocking process (Marmol, 2017).

### 12.8.8 Lean Management at Airports and Ground Handling

Risk management and lean management are strategic core competencies for organizations. For sustainability in VUCA conditions, it is necessary to apply risk management based on lean philosophy at the institutional level. Core competencies in competitive strategies provide organizations with a remarkable advantage:

identification of core competencies in organizations and evaluating them as an opportunity to achieve strategies attainable with corporate risk management based on a lean management philosophy.

We make decisions every day. We face risks every day. Therefore, risk management and lean management constitute the basis of our lives. Since it is not possible for all organizations in the aviation industry to completely eliminate their sources, minimizing the risks on the basis of their effects and managing them optimally by seeing the opportunities and deciding on the best alternative form the basis of today's risk approach.

The concept of lean management expresses a systematic, flexible and sustainable approach to optimally manage both the organizational structure and all managerial processes of an organization. It represents a business strategy focused on creating value for both employees and customers, while eliminating misuse of resources and inadequacies in both allocation and use of resources in organizational structure, operating systems, and managerial and functional processes. In this respect, any activity that does not add value to an organization's processes or threatens the sustainability of the organization is waste. Moreover, lean management is not limited to the continuous improvement of all managerial processes in the organization along with their scope. In a simplified manner, it involves being socially sensitive and respecting people. An organization will only be able to achieve sustainable change and business excellence by combining purpose, process and people.

Lean as an element of corporate strategy emphasizes the significance of optimizing workflow through strategic procedures while eliminating waste and being adjustable. All these concepts have to be approved by employees who create the products and start processes that provide value (Acclino, 2021).

Clearly, the goal of lean management is not to eliminate tasks but to eliminate or minimize non-value-added process steps. Lean management is not a concept that only concerns manufacturing companies or a cost reduction program; it is a management strategy that can be applied in all types of organizations as it focuses on improving processes (Aytaç, 2009).

The lean management system was successfully built by Toyota Motors pioneers Eiji Toyoda and Taiichi Ohno in 1945 and has since been implemented to other sectors as well. In the last two decades, different industries, which operate in a quite competitive and dynamic market, are adopting lean management in their business, aiming to improve their production process in the world as well as in the aviation industry.

High operational expenses and fierce competition in the aviation industry have led airline companies to seek permanent improvements in both their planning and operational practices. Classic cost-cutting methods fall short of helping this policy. Airline companies need to fully evaluate their business processes and organizations. Lean thinking philosophy focuses on improving efficiency and quality by eliminating unnecessary business processes and reducing the work time of companies (Demiral, 2006).

The aviation industry is a service, manufacturing, and production. All the stages in the aviation sectors are interconnected with each other, and there is direct

interaction with the customers. Service is consumed by customers in real time. For all of the passengers, delayed flights cause issues, especially to connecting flights. Moreover, the process of flying, such as ticketing, check-in, security, boarding and all those interconnected stages in aviation sectors, cannot be ignored. Due to their interconnection, a small error can cause a delay in flights, long layovers, missed connections, missing baggage, cancelled flights and more. Recently, some airlines have started to adopt lean management principles to reduce redundant processes (Barroso et al., 2019).

In essence, the concept of lean management is about an embedded culture of understanding the client's needs and requirements, while continuously striving to reduce waste and optimizing the performances of process, people and infrastructure (Thun, 2014). Indeed, the most important factor that supports an organization's competitiveness is the human resource used to achieve business goals with individual uniqueness and capacity and high-level performance. In this respect, lean management approach consents to improving organizational performance. Lean management empowers soft elements of management. Lean management is a form of management that removes non-value-added items from the system and aims to have high-tech equipment and qualified manpower in the system. It is an approach that focuses on innovation with the least use of resources as well as reducing errors.

Thus, lean management philosophy, which is value-based just like corporate risk management, is considered a strategy that redesigns processes with a focus of organizational goals. Therefore, it exhibits a common basis with corporate risk management. The implementation of risk management can also be enhanced by simplifying its processes. Lean management thought has a strong potential to influence and direct the entire organization since it covers all units and individuals within the organizational structure (Şirin & Eyel, 2021).

As stated above, the goal of lean management is not to eliminate tasks but to eliminate or minimize non-value-added process steps. Lean management is not a concept that only concerns manufacturing companies or a cost reduction program; it is a management strategy that can be applied in all types of organizations as it focuses on improving processes (Aytaç, 2009). Aviation processes are extremely complex and involve multiple stakeholders. Stakeholder satisfaction is pivotal for aviation industry organizations. Structured continuous improvement methods need to be implemented to foster a positive attitude towards continuous improvement and solving difficult problems (Aviation Decision Science, 2021). In this respect, enterprise risk management and lean management integration may be key tools for managers.

The aviation sector is a sector where operational, production and managerial costs are high, the competitive environment is fierce, and market entry is difficult. Thus, stability may only be maintained through optimization. The concept of optimization, which should be integrated with lean management and enterprise risk management, should always be on the agenda of businesses and should be internalized. Optimization should be considered not only with what is available, but also with the opportunities that are evaluated. Opportunities that businesses do not take

advantage of while making managerial decisions will not be realized if optimization is to be achieved. Hence, it should be the policy of the organization to go to the simplest from the detailed (the most accurate evaluation of the opportunities) processes and should be adopted by the internal and external circles. Every business in the aviation industry should strive to contribute to the lean achievement of the industry goals.

Lean six sigma helps airlines, airports, ground handlers, MRO companies and component suppliers to optimize and improve basis processes. The aim is to reduce service lead times, drive down costs or create new business opportunities (Aviation Decision Sciences, 2021).

On balance, lean management is a management approach that focuses on creating added value throughout the organization with corporate-wide participation, aims to eliminate all processes, systems and processes that have no value, and supports growth in the fields of operational, financial, environmental and social responsibility in an optimum and sustainable manner with continuous improvement activities.

## 12.9 Case Studies: Lean Management in Aviation

### 12.9.1 Lean Airbus

Lean management and lean production are applied in many areas of the aviation industry. One of the best examples is AIRBUS. Details of lean applications of AIRBUS are as follows (Flores, 2021):

As part of Airbus Defence & Space vision of developing a corporate lean ideology, the organization has implemented the lean business improvement methodology. It aims to support the corporate projects during the life cycle under a Kaizen or continuous improvement vision. The commitment of the company to this framework has helped them to enhance control and execution, therefore enabling its continuous improvement (Flores, 2021).

Airbus Group creates cutting-edge technology and is a global pioneer in aeronautics, space and defence-related services. Combining a European past with global outreach, the diversity of the company's talent and technology drives innovation, integration and internationalization. Airbus Defence & Space was created in June 2014 as a result of the integration of Airbus Military, Cassidian and Astrium, all of which were previously part of the EADS group. This division has a presence in 18 European countries and in more than 30 countries worldwide. It is organized into four business lines, including Space Systems, Communications, Intelligence and Security, and Electronics and Military Aircraft.

At Airbus Defence & Space, all the improvement projects are managed using the LBIP (Lean Business Improvement Projects). This framework combines three dimensions: Process Improvement, Change Management and Project Management. In the LBIP, the projects' life cycle is represented through a group of sequential steps (from creation to completion) and a group of milestone gates between phases

to mark and control the execution of the project. In both, the steps and gates are inscribed into one of the DMAIC stages (Define, Measure, Analyse, Improve, Control). A further explanation for each stage is presented below (Flores, 2021):

- **Define:** Airbus DS focuses on understanding potential project's benefits, objectives, scope and business impact establishing the benefits model.
- **Measure:** The company measures the current situation or "As-Is" state to outline a performance baseline. Also, the groups that the project will impact are defined and if required, a dialogue with them is started. A project management plan is also created specifying how the project will be managed.
- **Analyse:** The performance baseline and the target performance are contrasted to identify the gap. Then, the problems that restrain the company from achieving its goals are identified. For each one of them, a root cause analysis is conducted to effectively understand what needs to be addressed to serve better the clients. During this stage, the "Voice of the Customer/Business/Process" data is also analysed to capture the customers' requirements, expectations and preferences.
- **Improve:** Based on the previous evaluation of the "As-Is" scenario, the company defines "improvement levers" and creates the future ideal process state, or "To-Be" scenario. Following this, Airbus DS sets the plan to achieve that state and execute it.
- **Control:** Finally, the company evaluates and verifies if the objectives are met. Also, they hand over the ongoing monitoring and post-implementation benefits confirmation to operational teams.

To conclude, it can be observed that Airbus Space and Defence has beneficiated from implementing the Lean Business Improvement practice. The approach supports all the levels in the project life cycle and hence allows for enhancing the control and execution and supporting the business growth.

Also, AIRBUS has considerable practices in other service areas such as baggage service, food and passenger services, in-flight service, aircraft production and maintenance area (Flores, 2021).

### 12.9.2 Lean Lufthansa Group

The Lufthansa Aviation Group is one of the world's leading air transport corporations. It comprises more than 400 subsidiaries and affiliates, active in business segments including passenger business, logistics, repair and overhaul, catering and IT services. Lufthansa underlines that lean maintenance methods may work in the MRO industry but lean management requires strong management down to the working level. Also, it requires managers to ask questions in continuous improvement cycles rather than giving instructions "do it my way" and also requires managers providing help and asking the right questions. Lufthansa emphasizes the impact of corporate culture on the implementation of lean management in desired performance. Because, according to Lufthansa, the corporate culture has a direct influence

on the duration of a change project and the requirement for training and information. A clear definition of the vision as a guide is a driver for lean management implementations. Guiding principles are understood as pictures of an achievable and desirable future state. A guiding principle is a clearly structured vision and shows the strategy of how to achieve the company's goals. Vision also comprises relevant company culture aspects. For this reason, to apply lean management effectively, organizations need guidance in their vision. Lufthansa had many efforts in the implementation of lean in maintenance. First, they performed dozens of workshops. They aimed at sustainable implementations of lean maintenance. They set Kaizen Board WR252 and Kaizen cards. In the lean management application, first the addresses to be made lean are determined. Lufthansa Group gives importance to Visualization of division targets. For this reason, their targets for the entire product division are defined and published in every department. Also, departments specify these targets for their processes and visualize them in KPIs. Lufthansa has key performance indicators (KPIs) in lean production as follows:

- KPI boards complement the Kaizen boards.
- Relevant processes (turn time, cost, M/H) are shown with actual/planned/target figures.
- An index for customer delivery performance and customer satisfaction is always included.

### 12.9.3 Lean British Airways

Lean leadership is a methodical system for the sustainable implementation and continuous improvement of the lean product system (LPS). It describes the cooperation of employees and leaders in their mutual striving for perfection. This includes the customer focus of all processes as well as the long-term development of employees and leaders (Dombrowski & Mielke, 2014).

Having continuously developing/improving culture is one of the main characteristics of lean leadership. The leader always endeavours for better and perfection. They even see errors as a step forward to improvement. Self-development is also part of continuous development. Here, the leader must have new leadership skills so that they pay attention to self-development. The others are; qualification, Gemba, Hoshin Kanri – a management process that relates its organizational functions and operations both vertical and horizontal to its strategical aims. And it's a specific plan that prepares annually. ***True north values are:***

- Challenge
- Kaizen mind
- Go and see
- Teamwork
- Respect for humanity

"The diamond model is a four-step development cycle that is focused on some true north values. At the first step, leaders have to confess themselves to their self-development and the true north values. The second step includes the development of their employees. In the third step of the approach, the actual CIP takes place. The fourth step comprises the development of a vision and the setting of targets". Lean leadership is gradually becoming a widespread term used in the management process.

The CIO of British airways explains lean application as "So why was it LEAN that worked for us? Well, it eliminates waste, saves cost and – most critically for us – motivates and involves our colleagues. It is also, of course, very challenging! It requires top management lean leadership; it needs colleagues in the customer front-line and on the shop floor to be involved and genuinely bought in to LEAN; and, perhaps most challenging of all, it relies on line management empowering the front-line." The CIO of BA explains the example of lean applications in leadership. The lifejackets in aircraft that are carried in each flight must be maintained, and the process took 57 days for lifejackets to continue through the last process. The CIO says, "There were multiple operations, including manual inflation of the life-vest! Not much flow there. One of our colleagues – a long-serving member of the South Wales Engineering Team – was so frustrated with this that he designed a new process, complete with a newly designed turntable that allowed him to work on the life-vests." As a conclusion, the turnaround time has been reduced from 58 days and 90 min to 4 days, with a vest needing 58 minutes to service. True flow, true lean, and, most importantly true leadership of the job (Paul Coby's blog (2010), https://paulcoby.wordpress.com/2010/06/16/lean-as-the-key-enabler-of-change-at-british-airways/, Retrieved at December 29, 2021).

### 12.9.4 Lean Lufthansa Technik Group Philippines

Lufthansa Technik Philippines is a global provider of maintenance, repair and overhaul services for commercial aircrafts. With the location of a 4-h flight radius to Singapore and Hong Kong, this strategic facility in the Asia Pacific rim provides strategic servicing to customers worldwide. Faced with mounting pressure from global competitors, the lean program management team needed a lean implementation and training program customized to enable the Philippine workforce to increase their productivity and secure more business.

Following the introduction of a new aircraft type, the lean management team also needed to improve efficiency and increase capacity to maintain its competitive advantage within a 2-year target. As the shop mechanics prepared for servicing a new aircraft type, the lean management team wanted to reduce cycle time for the current process by 15%. Kairos Worldwide began with an assessment of a pilot division and the establishment of QuickAdop, a Kairos Lean Six Sigma program. Included were customized training, lean project application and coaching team members to navigate through the project life cycle. To introduce QuickAdopt most effectively, multiple lean teams were created. The goal was to facilitate lean

analysis, applying tools that would build organizational capability within short time frames. After reviewing process flows and interviewing internal stakeholders, Kairos Worldwide led the lean teams in their work on the floor. Along with management, we prioritized ROI opportunities having the greatest potential for significant impact. This QuickAdopt approach improved cycle time, labour productivity and customer satisfaction within 3 months, well ahead of the client's two-year target.

Results: The Impact on the cycle time and labour productivity is as follows:

- Cycle Time
  - 26% aircraft turnaround improvement compared to 15% target, increasing customer satisfaction by releasing aircrafts to customers sooner
  - $120,000/year savings realized for purchase, delivery and use of tools
- Labour Productivity
  - 23% labour savings achieved by a reduction in labour hours
  - Reduction in the need for overtime achieved by redesign of tool set-up procedures

*This part is quoted from "*Kairos Worldwide (2021)*, Lutfhansa, Success Stories, https://kairosworldwide.com/success-stories/lufthansa/, Retrieved at Dec 28, 2021.*

### 12.9.5 Lean Southwest Airlines

Southwest is one of those airlines that has seen profits consistently despite the problems the airlines industry face. They have also been associated with delivering efficient and on-time service. Having a low amount of cost in their operations is one of the contributing factors to their success. This low-cost model is brought out by the strategy in place. Is this strategy lean? Below are the factors that suggest so (Kumar, 2014)[1]:

- ***A customer-centric approach to the operations:*** *Southwest Airlines introduced the "bags fly free" concept. While the competition charges approx. $120 round trip for baggage, they don't charge anything for the first and second bags. This has been well received by the public as it had addressed one of their biggest problems with airlines. This showed that Southwest was listening to the customer complaints. The airlines also introduced ticketless travel, which addressed another main issue the passengers faced at the airports. They anticipated that the huge lines would decrease customer satisfaction and in turn decrease the turnaround time standard set by the airline.*
- ***Eliminate waste in the value stream****: Airline industries face wastage in the form of idle time due to congested airports. Southwest minimizes idle time with a faster airplane turnaround. All employees contribute towards ensuring timely*

[1] Kumar, D. (2014), The 'Lean'Southwest Airlines, Wednesday, September 10, 2014, Retrieved at November 2, 2021, from http://cmuscm.blogspot.com/2014/09/the-lean-southwest-airlines.html

*take-offs and landing. The entire crew works together as a smooth system and ensures that there is very little rework in the form of reticketing or rescheduling. Also, they use the hub and spoke system to distribute passengers in the airport and concentrate on point-to-point routes.*

– ***Provide affordable service without compromise in the quality****: The reason for Southwest's low-cost model lies in its use of one type of aircraft – the Boeing 737. Apart from being fuel efficient, this strategy reduces the variable maintenance cost. The airline does not serve meals on board and there are no luxury seats offered. Due to all these things, they were able to offer lower tickets to the customers. Southwest Airlines conforms to the process steps required by a lean system. Furthermore, they are working to improve the processes, continuously finding ways to decrease wastage and optimize process flows.*

### 12.9.6 Lean Iceland Air

Icelandair, the largest airline in Iceland and also the largest private company in the country, decided to implement lean management in 2008. Their pilot project was to introduce lean management to the Icelandic Air Technical Services (ITS). This lean management practice was a huge success, reducing the time it takes to replace an engine on an airplane from 20 to 8 h. Building on the success of lean management implementation within the ITS division, the company began seeking opportunities to replicate this success by incorporating lean management into other parts of its operations, including the office environment and the airplane cabin, which was the first known lean (Thorhallsdottir, 2016).

### 12.9.7 Lean FedEx

Another example is the aircraft maintenance facilities at FedEx, a large American company. FedEx Express Los Angeles' lean initiative since December 2007 has aligned nicely with the company's current emphasis on finding ways to cut costs and increase revenues during the global economic downturn. To that end, the Los Angeles facility has accelerated its current aircraft upgrade programs designed to reduce maintenance costs by increasing capacity with the same equipment and personnel. "We found opportunities here where we could build capacity using lean management," says Phillip Coley, general manager of aircraft maintenance at FedEx Express, which is responsible for the Los Angeles maintenance facility in Indianapolis as well as the Los Angeles (Bartholomew, 2009).

During the recession of 2008, FedEx Express sought ways to reduce costs and maximize productivity. One of these cost-saving tactics was to implement lean principles at the FedEx Express Aircraft Maintenance facility at LAX. Before any changes were made, investigators found that employees spent an average of 1.3–2.4 h each day walking to retrieve parts and, in total, all employees made 106 trips a day to retrieve expendables and consumables. Those wasted hours and trips

meant delays in aircraft repair and service times. Following the implementation of lean manufacturing principles, FedEx Express saw a drastic cut in hours spent on parts retrieval (0.47–1.3 h), and the average number of trips across all employees dropped to 25! This increased productivity allowed FedEx Express to better weather the storms of the recession (Proponent, 2021).

Boeing introduced lean manufacturing in 1997. In 1999, he succeeded in establishing a mobile assembly line by producing 717 aircraft with 100 seats at the Long Beach Factory. The Boeing 747 final assembly line introduced moving line technology in 2001. The results delivered highly optimized production flows and processes, reducing cost and flow time from the traditional 24 to 18 days. Lockheed Martin applied lean techniques to the F-16, F-22 and C-130 J in 1999 (Lu, 2002) (Boeing Goes Lean, 2001).

Although the business models of Icelandair and FedEx are different, their maintenance teams seem to work similarly. Both teams execute C-checks and scheduled maintenance but mainly perform unpredictable and unscheduled repairs and maintenance (Bartholomew, 2009).

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# Lean Management in the Automotive Industry

# 13

*Excellence is not a destination; it is a continuous journey that never ends.*

Brian Tracy

## 13.1 Introduction to the Automotive Industry

The automotive industry represents a significant contribution to the global economies by manufacturers, suppliers, logistics companies, distributors or third parties. The Original Equipment Manufacturers (OEM) are nowadays more focused on leaner supply chains, which integrate suppliers and customers with the own operations. Enterprises will have to continue to innovate to adapt to changing consumer demand and regulatory changes. The OEMs are outsourcing non-core competencies to raw materials, component and systems supplier and must therefore create the optimal transparency of materials and information flows. In addition, it is visible that other activities, i.e. research & development, product development or logistics services, are carried out by third parties. The same trend is visible on the customer side (downstream). Customers wish to obtain their products immediately after the placement of orders, which has a significant impact on the entire value chain, too. Another trend is the competition on a global basis. Customers expect more value and functions for lower cost from the OEMs.

Overall, the global automotive industry is in a good situation, especially in the USA, where profits and sales have recovered following the recent economic crisis, and in China, where growth remains strong. This progress will likely continue. By 2025, global profits for automotive OEMs are expected to rise by almost 50% (Bothe, 2013).

The new revenue streams and profits will come mainly from growth in emerging markets and, to a lesser extent, the USA. Europe, Japan and South Korea will be stagnant in terms of profit growth. There are four key challenges that OEMs need to address to get a piece of future profitability.



M. Helmold et al., *Lean Management, Kaizen, Kata and Keiretsu*, Management for Professionals, https://doi.org/10.1007/978-3-031-10104-5_13

1. Complexity and cost pressure. There will be more platform sharing and more modular systems. At the same time, regulatory pressures will tighten, and prices in established markets are likely to be flat.
2. Diverging markets. OEMs need to adapt to changing regional and segment patterns of supply and demand with respect to their production and supply base footprints, supply chains and product portfolios; and the emerging Chinese aftersales market offers new growth opportunities.
3. Digital demands. Consumers who want more connectivity, are focused on active safety and ease of use and are increasingly using digital sources in making their purchase decisions.
4. Shifting industry landscape. Suppliers will add more value in alternative powertrain technologies and in innovative solutions for active safety and infotainment; Europe needs to restructure and adjust its capacity to better match demand; and competition is emerging from China (Figs. 13.1 and 13.2).

McKinsey. (2013). The road to 2020 and beyond: What's driving the global automotive industry? Advanced Industries. August 2013. Retrieved 30.06.2022. https://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/automotive%20and%20assembly/pdfs/mck_the_road_to_2020_and_beyond.ashx.

## 13.2 Toyota as the Leader for Lean Management in the Automotive Industry

The automobile industry is highly competitive due to the rapid expansion of industrialization, globalization, environmental commitments and high protection requirements. However, the magnanimity of a firm does not guarantee success. Success in this industry is determined by the ability of firms to innovate and to create value. Toyota's beginning was humble with its consistent and fuel-efficient manufacturing in the presence of giant companies, such as Ford and GM (CascadeTeam, 2021). On the other hand, the rise of Toyota in the automobile industry was not overnight. The company made improvements with each model and raised its manufacturing standards little by little. Toyota became the world's leading global car manufacturer by ousting its main rival, Volkswagen Group, with about 9.5 million units sold in 2020. The automobile giant enjoys market dominance in more than 170 countries all over the world. To examine the economic health of Toyota, here is a glance over the key growth indicators of Toyota:

- The net revenue of Toyota was 247 billion US dollars in March 2021.
- The operating income of Toyota is about 20 billion US dollars in the fiscal year of 2021.
- The total number of workers was about 360,000 in the fiscal year 2020.
- In terms of global sales, Toyota sold about 3.9 million units in 2020.
- Toyota generated around 87 billion US dollars of revenue from North America.


**Fig. 13.1** Impacts of COVID-19 on automotive industry. (Source: Author)

- The sales of the company were $249.4B in May 2021.
- The market capitalization of Toyota was $219.2B in May 2021.

The Japanese automobile brand is engaged in the design, production, assemblage and sale of commuter cars, minivans, commercial automobiles and associated parts and accessories, mainly in Japan, America, Europe and Asia. This incredible journey of Toyota has many lessons for the success seekers in the industry (CascadeTeam, 2021). Toyota is a Japanese auto manufacturing company headquartered in Japan. Its journey in the automobile industry started with the commencement of its operations in 1933. It all started with Kiichiro Toyoda, who came forth with the idea of Toyoda in 1894 and launched it in Shizuoka Prefecture, Japan. Kiichiro Toyoda was the son of Sakichi Toyoda, a well-known creator, and originator of Toyoda Automatic Loom Works. Kiichiro went to America for higher studies and was impressed by American cars. Upon his return, he asked his family members to fund an automotive

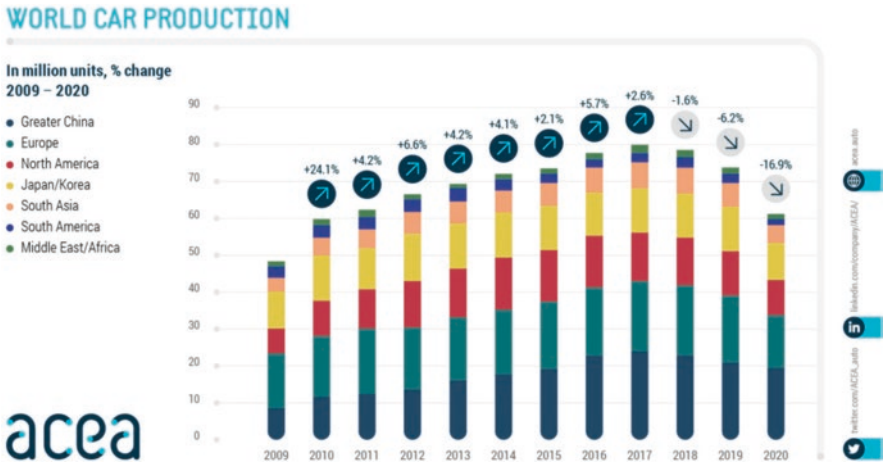


**Fig. 13.2** World car production in figures. (Source: Author)

development program, and thus, the tale started. Toyota's state-of-art production facilities are located worldwide, which collect and produce vehicles for domestic markets and international markets. JIT Production, together with lean manufacturing, is the main success factor of the company, which helps it maintain its dominant position in the automobile industry worldwide (Cortiglioni et al., 2010). To optimize its production and supply techniques for vehicles across the world, Toyota initiated its plan of Innovative International Multi-purpose Vehicle (IMV). This is to meet its ever-growing market demand in over 142 countries worldwide. The values, such as quality, robustness, dependability, environment-friendliness and expedient define Toyota's Research and Development practices (Furata, 2021). The bulk-produced hybrid gasoline-electric automobile is one of the primary vehicles produced by Toyota by using novel technology. It showed the immense sale of two million globally in 2010. Other technology-based facilities of Toyota are the Advanced Parking Guidance method, eight-speed automatic transference. The innovative methods constitute the product structure of Toyota. Heijunka scheduling is one of the main parts of the supply chain of Toyota, with the help of which it meets rapidly growing market demand without keeping surplus inventory. The Just-in-time system of Toyota has made its production system efficient and more receptive to erratic demand. Work in process and waiting in between procedures has significantly diminished due to a just-in-time system as raw materials arrive at the production space immediately when required. Consequently, the stock is removed. On hand stock is limited or eliminated because of the just-in-time system as minor lots diminish the stock required at the production units to function. As a result, the production decisions of Toyota are flexible due to reduced stock, and it enjoys low costs all over the whole supply chain.

## 13.3 COVID-19 Harming the Automotive Industry

As shown in Fig. 13.3, it is visible that China was the leading country in terms of passenger car production in 2020: around 21.4 million units were produced here. This compares to about 8.3 million units in runner-up Japan. China remained the top light-vehicle producing country in 2020. Domestic manufacturers such as SAIC, Changan, Dongfeng, Geely and BAIC – which is in a joint-venture with Daimler – are gaining market share; joint ventures with foreign partners were the key to China's success as a motor vehicle producer, both in the passenger car and the truck segment. Japan, Germany, India and South Korea completed the list of the world's largest car producers. Most of these countries are home to the major manufacturers of passenger vehicles. The leading car manufacturers worldwide include Germany's Volkswagen Group and the Japanese automaker Toyota Motor Corporation.

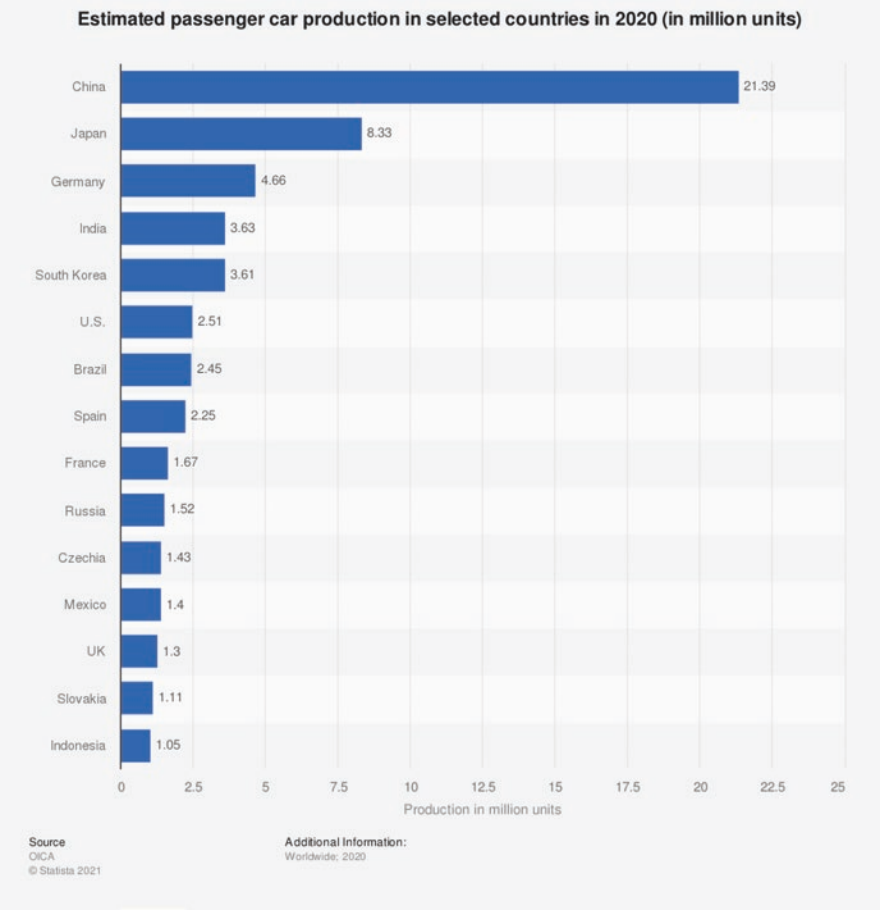


**Fig. 13.3** Worldwide car production

## 13.4 Application of Lean Tools in the Automotive Industry

Lean manufacturing is a methodology that improves processes through continuous improvement (kaizen) and elimination of waste. It is the North American equivalent of the Toyota Production System. Lean manufacturing offers a proven method to eliminate non-value-added activities and waste from your processes.

Lean manufacturing is the manufacturing philosophy and the system that was given by the Toyota, Japan, and now many of the manufacturers are using these techniques in industries.

> Lean is simply a systematic technique or approach to identify and eliminating the waste through the continuous improvement by flowing the product at the pull of the customer in pursuit of the perfections. The main aim is to eliminate the wastages in every area of the production including the customer relations and the product design and suppliers.

Lean tools and approach are very much popular in the automobile component manufacturing which is improving the growth initiatives in the automobile industry in the last two decades. In automobile these lean tools like Just-in-Time, Kanban, Continuous Improvement or 5S also help in the rapid development and growth in assembly line and overall production and growth specially in automobile sector. Nowadays almost 70% to 80% improvement in most of industrial growth is due to the approach of lean manufacturing.

## 13.5 Transformation and Disruption in the Automotive Industry

Today's economies are dramatically changing, triggered by development in emerging markets, the accelerated rise of new technologies, sustainability policies and changing consumer preferences around ownership. Digitization, increasing automation and new business models have revolutionized other industries, and automotive will be no exception. These forces are giving rise to four disruptive technology-driven trends in the automotive sector: diverse mobility, autonomous driving, electrification and connectivity. Most industry players and experts agree that the four trends will reinforce and accelerate one another, and that the automotive industry is ripe for disruption. Given the widespread understanding that game-changing disruption is already on the horizon, there is still no integrated perspective on how the industry will look in 10–15 years as a result of these trends. To that end, our eight key perspectives on the "2030 automotive revolution" are aimed at providing scenarios concerning what kind of changes are coming and how they will affect traditional vehicle manufacturers and suppliers, potential new players, regulators, consumers, markets and the automotive value chain.

## 13.6 Trends in the Automotive Industry

### 13.6.1 Digitization

The impacts of digital transformation in the world are evident and they produce enormous benefits and advantages for entrepreneurs, consumers, and society in general, although there are environmental issues that must be addressed (Yoo et al., 2010). The disruptive effect resulting from digitalization has also reached the automotive industry and is the most important phenomenon in the industry's history of more than 140 years. Digital transformation, globalization, and more severe competition are leading the way (Gao et al., 2016). Digital transformation strategies across the value chain are important because they reflect the omnipresence of the changes brought about by digital technologies in an organization (Chanias and Hess, 2016). Hence, organizations have to change traditional business models, which have been robust for many decades, and transform their organizations to adapt to these trends, e.g. car-sharing platforms or new telematic services (Riasanow et al., 2017).

The trends and factors that affect the automotive industry, with increasing influence and complexity, are diverse and complex. These factors include, in particular, globalization, which gives manufacturers the opportunity to expand into new markets, the diversification of consumers and the accelerated modification and diversification of products. The diversification of consumers will contribute to new patterns of behaviour and the need to satisfy their tastes individually, while the diversification of products will imply the reduction of the lifecycle of models to react to the fast and changing demand of consumers with innovative products (World Economic Forum, 2016). The average product lifecycle of a vehicle used to be around 10 years, while today manufacturers have changed and modified their models within a space of 3 to 5 years.

Nowadays, digital technologies in vehicles represent at least 50% of the total value of a vehicle (CCOO, 2018). The integration of software and hardware has increased not only the functionality of a car but also its complexity. Key aspects have been identified that contribute to accelerating the process of digitalization of the automotive sector, such as driver connectivity, location-based services and the type of driver based on their tastes and preferences, a feature that did not exist 20 years ago. Another key aspect is autonomous driving, where drivers will only need to press a button to go to their destination. In this regard, assisted driving and autonomous driving can be highlighted. Assisted driving covers functions for assisting the driver, which will become increasingly common until the driver becomes a passive element in the transport process, while autonomous driving entails that vehicles are capable of moving and navigating on their own in adequate traffic conditions on all types of roads (Farahani et al., 2017).

Digitization will bring significant improvements to the value chain by boosting efficiencies, reducing costs and generating greater collaboration and innovation. It will make it possible to evolve from business-to-business approaches through their dealerships to a business-to-consumer model, with new ways of engaging with

customers and partnerships with suppliers interacting through data. Increasingly connected vehicles will change business strategies from selling a product to offering value focused on customer experience. Digitization will influence the connected supply chain from raw material suppliers to end customers, which has the advantage of cost reduction and better management of the whole process from the beginning to the end. Additionally, digital manufacturing will play a major role, with new generations of robots that allow multiple assemblies, and the increasing importance of robotics, artificial intelligence and the internet, which will be part of the new industrial revolution.

Other factors should also be considered in the digital transformation of the automotive industry. The effect on the retailer, which covers manufacturers, the sales force and consumers, is dynamically redefining the way they interact and communicate with each other. Moreover, clients expect a fluid interaction both physically and digitally when buying products or services. Maintenance and connected services, which will provide predictive maintenance, are sophisticated diagnostic systems. For instance, intelligent components and ubiquitous connectivity will allow certain components to send a signal when they need maintenance or replacement. Digital transformation in the aftermarket will facilitate both hardware and software updates, but manufacturers and suppliers should make their systems compatible. The car data market will also be a key factor, where the commercial promise of more precisely targeted customer offers, new business models and increased efficiency from data and analytics will make these new businesses a veritable gold mine for automotive players. Furthermore, V2V and V2I connected infrastructures (Vehicle-to-Vehicle and Vehicle-to-Infrastructure, respectively) are key enablers of intelligent transportation, which will create an integrated communications network of continuously moving digital information to increase safety and improve traffic flow. They cover sensors, transponders, radio-frequency identification (RFID) readers in the road, traffic lights, bridges and parking lots.

In addition, customer experience has been and will continue to be a key differentiator in the automotive market, whether during the sales process, the in-car driving experience, or in the aftersales market.

### 13.6.2 Change of Customer Behaviour: Multiple Usage of Vehicles

Not necessarily that they are buying new cars, but that those who already own cars rely on them more in order to maintain safe distances. The market for second-hand cars has increased this year for the same underlying reason. There is also a rather imminent possibility that, as more people expect to work from home indefinitely, some will abandon expensive city centres in favour of the outskirts. This is a trend that may swing the soon-former-urbanites into cars as public transport services are less efficient outside metropolitan areas (Laya et al., 2020).

Not all consumer behaviours and expectations are equal. A lot is said about declining interest in car ownership among younger generations. However, what we have seen from consumers is that, rather than age being the differentiating factor, it is the life stage that pronounces the difference in interest. Of millennial parents living in cities, 76% say it is very important to own a car since it is the only way to

coordinate the multiple schedules, chores and activities for the family. They face the difficult dilemma of balancing their environmental concerns with their daily parental duties without having a convincing or practical alternative to owning a car.

Perhaps car is losing its relevance as a status symbol, but it is gaining more relevance as a solution based on user experience, something that is increasingly reliant on digital features. This leads us to another interesting aspect that is crucial in shaping the relationship consumers will have with future automotive: their tech engagement and interest, since we see digital technologies clearly influencing mobility experience and even innovation in transport modes and services.

To assess consumers' tech engagement and interest, we surveyed a global sample of 16,000 respondents and grouped them into consumer types, based on their interest in cars on the one hand and their interest in technology on the other. Four distinctive consumer groups emerged:

The (car) enthusiast: these consumers show high interest in digital technologies and everything car related, as well as high involvement in the driving experience.

The cautious (driver): this group demonstrates high involvement in the driving experience but is overly cautious about new technologies.

The (roaming) multitasker: these consumers are highly involved in digital technologies but show very low interest in cars or driving involvement.

The pragmatic (commuter): this group mostly cares about getting from A to B, and shows no particular interest in cars or new digital technologies (Fig. 13.4).

### 13.6.3 Revenue Expansion

The automotive industry is dramatically changing, triggered by development in emerging markets, the accelerated rise of new technologies, sustainability policies, and changing consumer preferences around ownership. Digitization, increasing automation, and new business models have revolutionized other industries, and automotive will be no exception. These forces are giving rise to four disruptive technology-driven trends in the automotive sector: diverse mobility, autonomous driving, electrification, and connectivity. Revenue expansion is the exploitation of custer demands and additional requirements in the automotive field by offering shared mobility, connectivity services, feature upgrades, new business models or other important automotive revenue pools.

### 13.6.4 Rise of Electric Vehicles (EV)

As for electric vehicles (EV), there will also be competition between manufacturers to deliver the latest EV model. An area that will attract special interest and will be a challenge is the aftermarket.

Currently, original equipment manufacturers (OEMs) are investing heavily to adapt to these trends. However, it remains unclear which technologies will prevail, leading to tensions in the automotive industry, as OEMs do not want to give up their leadership in products and technology (Simonji-Elias et al., 2014; Farahani et al., 2017; Fig. 13.5).

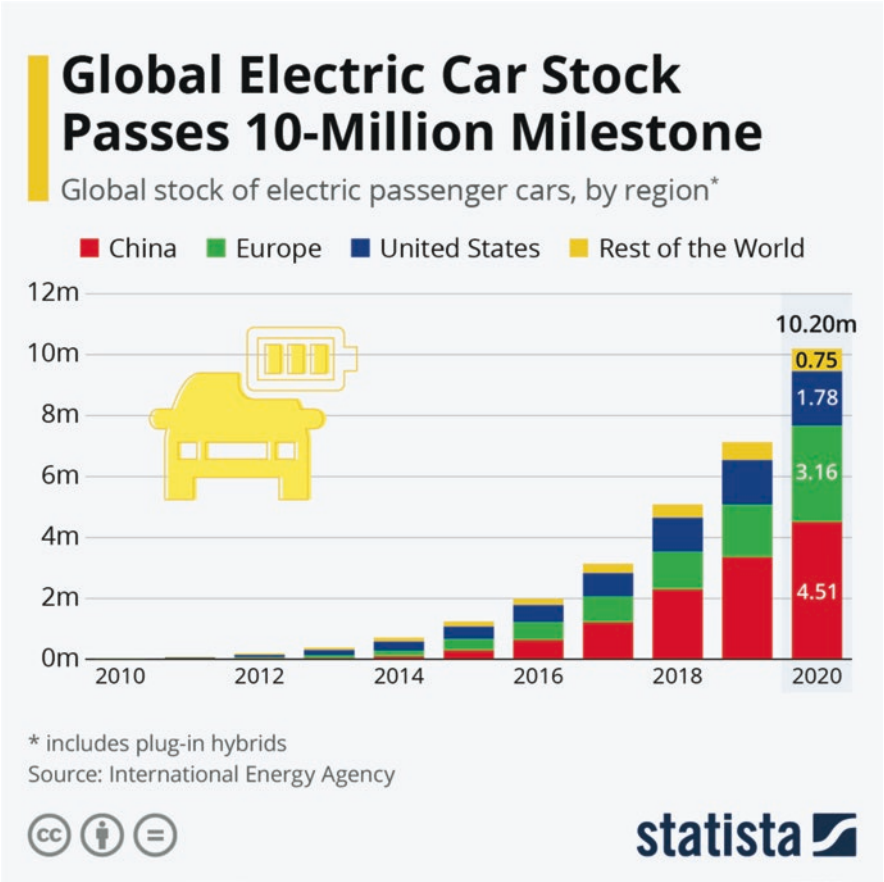


**Fig. 13.4** Trends in the automotive industry

**Fig. 13.5** Automotive sales of EV

## 13.7 Case Study: Japanese Car Makers Form New United Front for Change

Last year, even during the COVID-19 pandemic, while employment in Japan as a whole declined by 880,000 jobs, the automotive industry not only maintained employment but added 120,000 jobs. Assuming that the average annual income from such jobs is five million yen, you can understand that this means that an additional 600 billion yen is making its way into household budgets. Also, the breadth of the automotive industry produces a large economic ripple effect. Profits from automobile-related OEMs are steadily spreading to suppliers and small- and medium-sized companies. As the domestic shipments by OEMs totalled 330 trillion yen over the 12 years following the global financial crisis, considering that about 75% of that was purchased from suppliers, this indicates that about 250 trillion yen went to suppliers (Toyota Times, 2021).

Also, if we set FY2007, which was the year before the global financial crisis, as 100, and make a comparison with the rate of increase in operating income and wages in FY2018, which was before COVID-19, the rate of increase in operating income in the automotive industry was 95 for large companies compared to 144 for small- and medium-sized companies. For wages, the rate of increase was 112 for large companies and 126 for small- and medium-sized companies, indicating that the rate of increase was higher for small- and medium-sized (automotive industry) companies and that the increase was widely distributed and spread.

It is with great regret that I often feel that these continuous efforts are not properly understood by the government and the world in general. I would be very grateful if you could correctly understand the automotive industry's efforts to keep the economy going while maintaining jobs, and I hope that next year's labour-management wage consultations will not only be viewed from the perspective of whether or not management will respond in full to labour's requests for a single year, but that medium- to long-term trends will also become points of focus (Reuters, 2021). At any rate, even though the automotive industry has continuously been making efforts since previous administrations, a change of government brings new demands as if what happened in the past never took place. I hope that you will by all means correctly evaluate and support the automotive industry, which is continuously and earnestly doing what it can.

As for contribution to growth, the total capital investment and R&D expenditure of JAMA companies in FY2019 totalled 6.2 trillion yen, and we are promoting enormous investments that will lead to Japan's economic and social revitalization.

The automotive industry is a leading industry even in terms of its impact on the economy. So I hope that the government will, by all means, create a path that will allow the automotive industry to serve as a pacemaker on the road to achieving carbon neutrality (Figs. 13.6, 13.7 and 13.8).

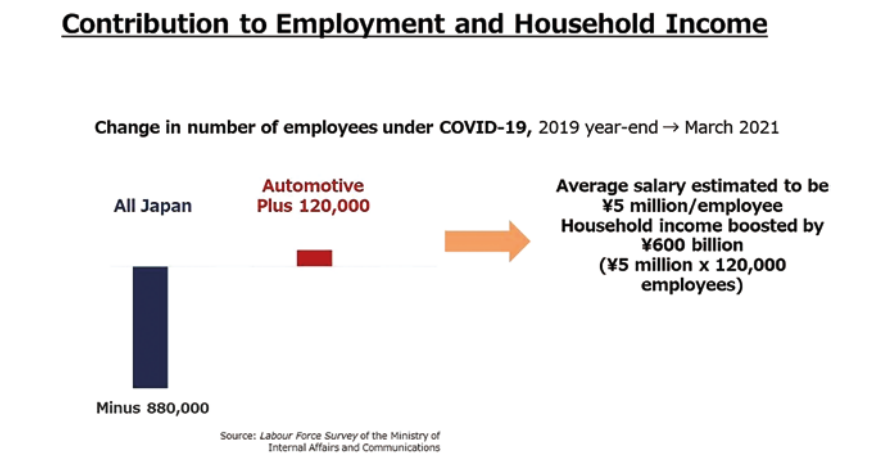


**Fig. 13.6** Contribution of car makers to employment and household income

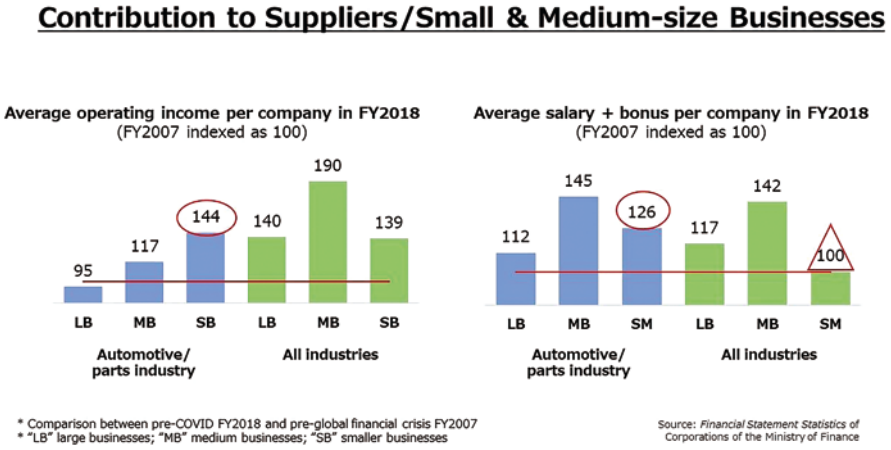


**Fig. 13.7** Contribution to suppliers and SMEs

**Fig. 13.8** Toyota production in Toyota city

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# Lean Management in the Construction Industry

# 14

*Out of clutter, find simplicity. From discord, find harmony. In the middle of difficulty lies opportunity.*

Albert Einstein

## 14.1 Introduction to Lean Construction

In the construction industry, there is almost full employment, which is why the question arises as to why this industry has to change at all. The answer is obvious if you think of the almost everyday delays, cost and quality deficiencies as well as legal disputes and consider the image of this industry. The causes of these problems are usually and typically poor planning and execution. But what is the reason for this?

In addition to the high economic pressure in the construction industry, there are also the constraints from the use of renewable energies, the need to save energy and the increased use of building technology. In particular, the increased use of building technology has the consequence that the construction processes are even more complex and the planning and execution of structures are even more complex and cost-intensive. As a result of this emergency, a change is slowly emerging in the construction industry, which will give lean thinking an additional boost.

Despite great advances in machine technology and building materials science in recent years, the construction industry has been able to record almost no productivity increases (see also Haghsheno et al., 2016). In addition to possible standardization of buildings and/or parts of buildings, the planning processes and workflows are better controlled. It is important to ensure standardization and, above all, transparency, which does not correspond to the status quo, as only a few people with a great deal of freedom are responsible for the project. In addition to the resulting lack of objectivity with regard to the current and forecast status, the inaccuracy of schedules due to only rough estimates, the monthly estimates are not short-cycle enough and therefore not always up-to-date, which means that timely and active reactions are not possible.



M. Helmold et al., *Lean Management, Kaizen, Kata and Keiretsu*, Management for Professionals, https://doi.org/10.1007/978-3-031-10104-5_14

In order to eliminate the shortcomings in construction projects, a rethinking of the project participants is necessary, from "thinking the best for yourself" to "thinking the best for the project", which is not through coercion but through incentive systems – a trusting contractual relationship based on willingness to cooperate can arise. Successfully implemented project contracts, for example, in the USA and Australia, which have even led to cost savings compared to comparable projects with traditional project contracts, show that this is not an unrealistic illusion (Zimina et al., 2012; El Amsar et al., 2015). For these new forms of contract, regulations for coordination and cooperation and thus for the implementation of lean construction can be included in the previous construction contracts (Tezel, 2017). As a result of the implementation of lean construction, the resources of the construction industry can be better utilized, the willingness to cooperate is strengthened, and a more project-oriented thinking and acting emerges.

## 14.2 Lean Management to Improve Planning and Execution

The increased complexity of the construction projects due to the latent, meanwhile high requirements due to the constructive diversity, safety and sustainability makes it more and more difficult to control projects according to previous methods and thus to comply with costs, deadlines and quality. Ultimately, the effects of this can be felt, especially in the execution phase. In this service phase, the planning deficits come to light with a time lag and noticeably. When speaking of planning deficits, it must be made clear that due to the complexity of today's construction projects, these inevitably have to occur, regardless of the qualification and skills of the planner.

Establishing lean management in the construction industry is a major challenge. Although many construction projects are not alike, they are based on a standardized process. The fee schedule for architects and engineers (HOAI, 2022, Fig. 14.1) includes nine service phases for planning through to execution and eventual use of the building. The term planning includes the design and ends with the concrete work preparation, which includes the construction processes. Due to the similarity of many components, the construction processes "only" have to be adapted to the surrounding situation, whereby the risks and content of the respective project must be considered. In the construction process, there are almost identical supply chains and processes according to the other branches of industry. However, it must be stated that the construction industry only uses the potential from series production to a limited extent. In this way, modular systems can also be used in the construction industry, to the benefit of the customer, since this shortens the construction time and also lowers costs. Timely and high-quality planning is therefore the basis and at the same time a prerequisite for high customer satisfaction, which is based on the three pillars: costs, deadlines and quality. The preparation of the project as part of the individual planning phases has a direct impact on management throughout the project, which means that optimal planning should aim to reduce complexity and the likelihood of errors. Planning and quality management ensure that there are no

| No. | German | English |
|---|---|---|
| 1. | Grundlagenermittlung | Foundation Analysis |
| 2. | Vorplanung | Pre-Planning |
| 3. | Entwurfsplanung | Design Planning |
| 4. | Genehmigungsplanung | Approval Planning |
| 5. | Ausführungsplanung | Execution Planning |
| 6. | Vorbereitung der Vergabe | Preparation of Selection |
| 7. | Mitwirkung bei der Vergabe | Participation of Selection |
| 8. | Objektüberwachung | Property Surveillance |
| 9. | Objektbetreuung und Dokumentation | Prperty Management and Documentation |

**Fig. 14.1** Example of the HOAI (fee schedule for architects and engineers)
Source: Author
*HOAI* Honorarordnung für Architekten und Ingenieure

defects and that deadlines and costs are met. In order to establish lean management and lean methods in construction, the aforementioned rethinking is necessary. Behaviour patterns that have existed for a long time in this very old production sector, characterized by primarily manual production methods, must be reconsidered and, if necessary, replaced with new methods. These traditional patterns have so far meant that lean management and lean methods have only been used to a very limited extent in the construction industry. The three essential requirements of lean thinking.

- The focus is on the added value of the product from the customer's point of view
- The flow efficiency, less the resource efficiency, is decisive
- The human being has to be in the foreground

are also the only goal-oriented in the construction industry and should therefore be established, which means that lean management in the construction industry is also a holistic optimization approach, a process optimization. Essential prerequisites for the implementation of lean management are free access to information as well as training and qualification measures.

## 14.3 Prerequisites of Lean Management in Construction

These prerequisites go hand in hand with a lean corporate culture, open communication, the willingness not to be fundamentally negative about changes and appropriate motivation. On the other hand, in the construction industry, there are still often very bulky processes, with the consequence of a lack of adherence to deadlines and cost explosion for larger projects.

All those involved in the project would benefit from lean thinking, the realistic recording of the scope of construction and a secure planning and construction status. This is where the planners as well as the construction workers are in demand, as it is important in all phases of work to plan and execute a building that meets the actual needs of the customer, in the quality that the customer wants. A stabilization of the construction processes is also decisive for ensuring these requirements in order to, among other things, adhere to the completion dates. The new corporate culture also requires the abandonment of the management of problems that are still often present in this industry and also the establishment of swarm intelligence and the removal of the basic attitude of rejection towards everything new. Due to the fact that the protagonists of construction projects do not pass on information or only pass them on to a limited extent, possible solutions are often lost, information cannot multiply, and deficits in the planning and execution of construction projects are the result. The above-mentioned deficits (often a lack of adherence to costs and deadlines as well as quality defects) are usually associated with relatively low productivity and efficiency in the construction industry compared to other branches of the economy.

Of course, when making such comparisons with other branches of the economy, one should not ignore the fact that there is no stationary production or assembly line production in the building industry (apart from the construction product manufacturers and individual component manufacturers). Previous lean tools and methods from the established lean industry with its stationary production cannot therefore be adopted across the board in the construction industry. A transformation to the construction planning and execution is necessary, always against the background of a constant improvement process to avoid waste and to increase customer satisfaction. The prerequisites for implementing lean management in the construction industry are also given. Usually, the same processes are always present. A move away from traditional unique thinking towards process thinking in the construction industry has to take place.

The solution-oriented lean management requires a corresponding attitude on the part of those involved, which ultimately results in an optimal interaction of all people involved in a construction project, the optimization of functions and sustainability. Building information modelling (BIM) represents an important step, also through the inherent interface optimization, for the implementation of lean management in the construction industry (see below). Even though establishing lean thinking in the construction industry is a long-term task, the use of lean management methods in this branch has been around since the 1990s. The reasons for this are obvious: an essential improvement in planning and execution processes and an increase in productivity in the construction industry. As a result of the use of lean management principles in the construction industry, the construction industry as a whole benefits, also through increased stability.

In the case of complex projects, which always involve a high level of uncertainty, it is almost impossible to completely determine the construction target in advance, although this unrealistic requirement has been assumed so far. As part of consistent

lean management, cooperation models can be created in which the focus is no longer primarily on individual "Grail Guardians", but instead the team members deal and act with these uncertainties. Flat hierarchies and transparent structures and processes are essential for the implementation of such structures. As a result, customer demands will also be better met. Information about the construction progress becomes more realistic, and quality, budget and deadline frameworks can be adhered to more easily.

In addition to the construction costs and quality, the construction time in particular contributes significantly to the success or failure of a construction project. Construction times, which are determined in the first performance service phase (LPH 1, German: Leistungsphase 1) of the "Fee Regulations for Architects and Engineers", represent the basis of profitability calculations and thus the basis for making decisions about feasibility, measurable parameters and the complexity of the building project are only rarely observed. The construction time determination in LPH 1 is not carried out on the basis of process-oriented flowcharts, as the level of detail of the planning is not yet available. Accordingly, neither production quantities nor expenditure or performance values are available. Construction drafts are only made in the subsequent planning phases. Only empirical values and/or key figures, approximation formulas or regression models are latent in LPH 1 before the actual construction process is finally considered in LPH 7 as part of the bid processing. In other words, the realistic and economical construction times are determined at a later point in time. The construction time calculation up to LPH 6, which has been carried out up to now, is therefore unsuitable, as it is based only on simple object-oriented reference values. New methods for economical and realistic determination of construction times are required so that construction times can be controlled by means of scheduling measures. Groundbreaking research in this area has been carried out by Mr. Andreas. On the basis of LPH 1, a reference building is to be generated in each case, which in turn is the basis of the process-oriented construction time determination. The reference building to be created according to the planned object contains the input parameters from LPH 1 of the planning. The individual components and production quantities can be determined using the building parameters. Together with a construction process model, a realistic calculation of the construction time is finally created. The research has confirmed that the accuracy of the construction time determination in the early planning phases can be increased by using the process-oriented method. Along with this, it was also possible to prove that the production quantities for process-oriented construction time determination on the basis of a reference building can be determined with a very high degree of accuracy. This new procedure also enables a transparent and sufficiently precise determination of the construction time at the beginning of the planning.

The knowledge of the construction process is essential for the process-oriented construction time determination since realistic and economical construction times can be determined on this basis. The previously used methods based on object-oriented reference values for determining the construction time are unsuitable. Sometimes unrealistic results contradict building management principles. This is

particularly devastating against the background that these construction times, determined in the early planning phases, represent the basis of profitability calculations and decisions on fundamental feasibility. Process-oriented methods for determining construction times must therefore be used in the early planning phases, with network plans and the process-oriented structure of the construction project as well as the representation of process-oriented dependencies and process durations with corresponding production quantities and cost values. Realistic construction times can now be determined even before the first construction draft is prepared. It is important to know about the building parameters influencing the construction period (e.g. number of floors, building depth, ceiling thickness, wall thickness, window areas, etc.). Thus, a method could be researched and made applicable, which makes a documented, process-oriented and practical construction time determination possible in the early planning phases, before the construction design is made, and which will thus further advance the establishment of lean construction. As a result, there is now an alternative to the usual object-oriented methods, which, since they are based on very simple reference values, are unsuitable for realistically determining construction times. With an economical and therefore realistic construction time, all those involved in the project benefit from a safer construction process, which can also be managed by means of scheduling measures. In addition, and unlike object-oriented methods for determining the construction time, there is also the option of a step-by-step plausibility check of the results.

## 14.4 Lean Management Examples from Japan or the USA

While lean construction has not yet become widespread in German-speaking countries, the methods of manufacturing wooden structures in the USA and Japan serve as role models for the establishment of lean construction. In these lightweight wood construction methods, prefabricated parts are used to a large extent, which in turn allows the lean principles to be implemented more easily due to the mass production compared to other construction methods, e.g. masonry construction. However, precast construction is not to be understood as a basic requirement for lean construction. As a result of industrialization, lean construction is not limited to certain building materials and/or construction methods. Lean construction is used to improve processes, starting with resources through to construction. Maximum customer benefit is sought through clear assignments and a better flow of information. A number of innovative instruments have already been developed to implement lean thinking in the construction industry, to involve all those involved in the project to increase productivity, to stabilize the workflow and to manage deadlines and subcontractors. This also includes, for example, the Last Planner® System (LPS), founded by Glenn Ballard and Gregory Howell. As a result of the use of lean construction and the existing “tools”, it has been proven that construction project costs and construction time have been reduced and productivity and safety improved (cf. Daniel & Pasquire, 2016).

Increasing the performance, which at the same time brings improvements in terms of safety, quality, time and costs, requires an improvement in the reliability of the workflow (Workflow Reliability). To achieve this, a transition from the traditional approach towards lean and agile scheduling is required. Predictions made relatively early in the planning stage usually do not correspond to reality, since too many unknowns are latent and the level of detail is not yet available. Therefore, the new research results must also be integrated when creating schedules (see above).

In the Last Planner Systems®, completed and still-to-be-done tasks are better linked, which improves interaction and makes the workflow in construction projects more accurate and reliable. The restrictions for planned work packages that have not yet been removed should be included in the forward-looking process planning. Such a schedule usually has to map a forecast of between three and 12 weeks. Classic restrictions in the construction process are usually missing or incomplete information from the planning phase, missing approvals and others. If lean thinking and thus lean construction are consistently implemented in the construction industry, you can quickly see that the project-specific requirements and processes often do not correspond to the master plans. Using lean construction and the solutions already available for the construction industry, e.g. the LPS, work processes can be stabilized and productivity increased, which benefits everyone involved in the project.

Beginning with the basic assessment and extending through to implementation planning, the processes involved are extraordinarily complex, often made even more difficult by rescheduling. Since the construction project to be carried out is based on the planning, a structured approach, but also flexibility, is very important here. Often, problems with the interface organization, a lack of exchange of ideas, a lack of interaction between those involved in the planning and consequently a lack of trust between those involved in the planning occur already in the planning phases, and not just in the execution, which usually leads to deadlines and cost overruns (Fosse & Ballard, 2016). The previous static planning does not do justice to the complex and sometimes also unpredictable planning processes and has to be replaced by flexible and agile methods, for which lean management methods are predestined. The individual planning processes must be constantly adapted to the current project status, with a focus on the overall goals.

The way to meeting deadlines, also with construction projects, leads through quantity and productivity. This means that waste of resources and non-value-adding activities must be reduced, which consequently leads to an increase in performance. Both the building owner and the customer, the planners and the construction companies benefit from this increase in performance. Lean construction means that those who implement the work and are therefore best able to plan it are directly involved in the planning process, as it can be made more transparent and better for visual control.

Lean construction therefore represents a team-oriented approach, which of course requires partners who are willing to work. The key to implementing lean

construction lies in targeted and solution-oriented communication and thus the transparent flow of information.

Lean construction can be further optimized through the use of coordinated models such as building information modelling (BIM). Lean construction can be used over the entire life cycle of a building and has many advantages. Instead of the reactive process that is currently widespread in construction projects, a proactively controlled, solution-oriented and no longer problem-oriented construction process occurs thanks to a high degree of transparency and trust.

## 14.5 Case Study: Building Information Modelling (BIM)

Basically, as shown, deficiencies in construction project planning and implementation often lead to considerable construction time and construction cost overruns. Small-scale processes but also a noticeable digital backwardness in the planning and execution process are primarily responsible for this. These deficiencies are to be remedied by means of building information modelling (BIM) and its implementation in the construction planning and execution process. The goal of this approach has already been demonstrated in the USA and Great Britain, for example. In addition to the major projects, this paradigm shift also has a direct impact on small and medium-sized construction projects and everyone involved in the planning and execution. The BIM-related technological innovations include smart modelling, loss-free data transfer and multi-dimensionality, among other things, with clear advantages for everyone involved in the project. In addition to the construction process, there are also direct economic effects from a BIM application.

Since 2020, an important step has been taken in Germany to establish lean construction through the mandatory use of BIM for public infrastructure projects. In contrast, the number of actual BIM users is still low in many countries. A lack of knowledge, a basic attitude of rejection towards everything new and the resulting reservations and fears are the cause. The question arises as to how this can be overcome. From the author's point of view, through an objective assessment of the economic and construction process benefits of lean construction and BIM. A holistic, systematic evaluation model is therefore required. With regard to the BIM application goals, it is thanks to the research of Mr. Jung-Lundberg that such an evaluation model is already available for small and medium-sized residential construction projects, on the basis of which other models for evaluating the benefits of lean construction seem conceivable and feasible. The relevant BIM application goals and BIM advantages were precisely worked out, taking into account the already existing relevant publications on major projects. Fundamental to this is also the question of the requirements and boundary conditions associated with BIM. The monetary effects are also quantifiable and significantly supportive of decision-making regarding the establishment of lean construction and BIM. In his work, Mr. Jung-Lundberg succeeded in creating an objective, individual option for assessing the benefits of the BIM application. Lean construction and BIM are therefore essential prerequisites for the urgently needed digitization of the construction industry and also

demand this. The prerequisite for the establishment of lean construction as well as BIM is to overcome the already discussed rejection attitude towards technical innovations. Persuasion and motivation are required from all those involved in the project, starting with the implementation of lean construction and BIM in university teaching. In addition to the junior staff, the current generation of planners and construction workers must also be trained, although this is offset by relatively high training costs. Subsidies and bonus programs can help here, based on the existing bonus programs in the automotive industry. Further prejudices in connection with lean construction and BIM have to be eliminated, e.g. that this entails a loss of responsibilities and thus the withdrawal of one's raison d'etre. The opposite is the case. The individual roles are even further strengthened through a further high level of knowledge build-up.

Lean construction and BIM will therefore lead to more efficient and effective construction projects in the future. The use of lean construction and BIM can lead to cooperation instead of the previously widespread conflict in the construction industry. Lean construction and BIM offer the urgently required transparency, by means of which many of the latent problems in construction projects will be a thing of the past. In order to implement this successfully and to go along with the transparency, the required collaborative approach in the cooperation in the projects (instead of the confrontational approach) is very important. The question of who is to blame must no longer be in the foreground. Mistakes always represent an opportunity for change.

Some large companies in Germany have already successfully implemented the potential of lean construction. Examples include Deutsche Bahn, BMW, Mercedes and Siemens.

Originally from the automotive industry, lean thinking and lean production have found their way into almost all industrial and service areas. Lean construction is the adaptation of lean management and thus lean thinking to the construction industry. And so it is important, also in the construction industry, to optimally coordinate the activities required for value creation. Although the individual structures are different, the same process steps are always repeated in planning and execution (see above). With lean construction, processes are arranged more clearly, work content is better organized, structured and, if necessary, standardized. In this way, the entire planning and construction process can be optimized, with the involvement and appreciation of all those involved in the project. The focus here is always on maximizing customer benefit and looking at it from the customer's point of view. The burden on those involved in the project is reduced, and planning and implementation are more resource-efficient and also more economical. How can this be achieved? By using the high repetition factor, which is also used in the planning and execution of latent activities, lessons can be learned from mistakes and thus efficiency is increased. Practice shows that projects can be planned and executed without the use of BIM, but using lean construction, as well as the planning and execution of construction projects with the help of BIM and without lean construction. By merging lean construction and BIM, the information from BIM can also be used for lean construction. To ensure a transparent flow of information, to organize it is

inherent in BIM like lean construction, which is why, from the author's point of view, BIM is an obvious further tool for lean construction. Interface risks are minimized, and information is obtained and used better and faster. In BIM, the information is available in a data model. Making this accessible to all project participants means that knowledge is available very early and transparently so that proactive action can be taken. The argument that lean management and lean thinking are not feasible in construction projects because they are unique pieces can be refuted quickly. As a rule, always repeat the same planning and execution processes for construction projects, regardless of the uniqueness of the respective building (see above). This means that successful processes can be standardized and further optimized. Along with standardization, there are more structured work processes, quality improvements and a reduction in defects.

The construction process is essentially determined and influenced by the early project phases, the planning phases, which is why it is essential to optimize the planning. Planning changes and disruptions in the construction process must flow into the process immediately at all times so that all those involved in the project can act accordingly. The prerequisite for this is the transparency of the knowledge of all planners and construction workers. The entire planning process to be optimized therefore requires that the specialist knowledge is globally available in the project and shared and thus also used in process management. By increasing the quality of the processes, a significant increase in productivity in the construction industry can be brought about, above all by standardizing the planning and execution processes.

In the construction industry, too, as written, a high degree of prefabrication is now possible. The building materials and building products must therefore be further processed and put together on the building site in order to erect the structure. The clearly defined information delivery, a transparent flow of information, is one of the essential pillars of lean construction and this is exactly where BIM is a target-oriented tool to establish lean construction in the construction industry. BIM and lean construction therefore pursue very similar goals, combined with corresponding requirements for those involved in the project and from which the potentials of BIM and lean construction derive. An implementation and realization of these goals, eliminating deficits in the construction industry, however, above all requires transparency and collaboration.

With the focus on the customer, this can be optimally supported by the information of the building information model, which supports the decision-making processes. For example, more realistic predictions can be made about later usage and maintenance costs. In addition, since the customer always has access to the building information model, the current status of the planning can always be read on the BIM. The BIM ensures better communication due to a large amount of information it contains. Planning alternatives and the resulting dependencies, costs and deadlines can be presented realistically and decision-making processes can be accelerated noticeably – an essential factor in increasing customer satisfaction. In addition, another lean principle, the value stream is better identified using BIM. The flow principle can also be better implemented in the construction industry through BIM. The continuous flow of work and information without interruptions can be

ensured through early decision-making based on the information contained in the model, which also ensures a high level of planning security. However, the following trades are also to be understood as customers, depending on previous planning and/or execution processes. BIM also intervenes here in that the services are provided as required by the customer, in the required quantity and on the set dates, since the BIM allows very precise quantities to be determined through the quantity of data contained and changes in planning also result in automatic adjustments to the quantities. Accordingly, the amount of data in the building information model can be used very well to optimize processes and customer requests. Lean construction and BIM obviously complement each other due to their comparable goals. Linking lean construction and BIM means that lean construction is supported by the applications inherent in BIM.

Another tool for implementing lean management in construction is, for example, Lean Construction Management (LCM®), with which the transparency of processes in construction projects in the execution phase (LPH 8 according to HOAI) is increased through visualization. In addition to the problems described in the planning and execution of many construction projects, another cause of the known deficits in this industry is that the reality often does not coincide with the planning, in which an attempt is made to record everything and set schedules before the start of the project. It is based on prerequisites that are often not available. In addition, the entire construction planning and execution process is hampered by a lack of transparency of interfaces. In addition to the scarcity of natural resources, the construction industry also has to struggle with a lack of qualified employees, which has led to outsourcing, along with partial deficits in know-how and a lack of training. Instead of optimizing processes, the reduction of personnel costs still seems to be the top priority in many construction companies. However, this entails a high risk with regard to the qualification of the staff and the quality of the workmanship. Another problem is the fact that the building contractor bears the majority of the risk, which he tries to avoid through corresponding subcontracting contracts, mostly with smaller craft firms. The associated long chains lead to long decision-making paths or missing decisions and thus to the high probability of delays in the construction process, cost and quality problems up to the worst case, the construction freeze. The customers always suffer. In addition, the margins of construction companies and their subcontractors are falling. In contrast, the effort involved in coordination and support increases exponentially. As a result of this increasing effort, the personnel resources of all those involved in the project, architects, civil engineers and craft and logistics companies are tied up and thus wasted. The previous outdated project approaches no longer do justice to the increasingly complex planning and construction processes. This also includes the previously existing system for awarding construction works. Bringing this back into focus, aligning the construction processes with its needs, is the central idea of lean thinking. The danger, seen by many, of losing the building industry's inherent culture, the pride of working on successful projects, is unfounded and (according to the author) has its roots in the fundamental rejection of everything new, especially in areas with a very long tradition.

This danger is not latent, as lean thinking and thus lean construction are geared towards people, can only be implemented in a team and therefore seem predestined for the construction industry, in which the projects are always implemented by a large number of participants. More efficient building is imperative and can only be brought about by changing the processes. The change in the construction industry through the use of lean construction has to consider the culture that is inherent in construction. Uncertainties of those involved due to changes need to be reduced, which must be taken into consideration in lean thinking and its introduction in construction, appropriately adapted to this special branch of industry. In relation to all those involved in the construction project, it must be clearly postulated that so far, de facto, not everything has been done wrong, "only" has to be optimized. The necessary changes can only be implemented successfully with openness and transparency.

In order to prevent resentment, it is also helpful to refer to construction projects that have already been successfully implemented, based on the lean construction philosophy, with the cross-reference that these projects neither show a loss of the familiar building culture nor the individuality of each individual project despite lean construction. Instead, all those involved in the project benefited from a greater planning depth and optimized planning and control tools. Another company, Drees & Sommer, should be mentioned here as an example, which has been successfully implementing lean construction management (LCM) in construction projects for many years, with the result of accelerated processes, cost reductions and the associated relief for building owners, construction companies and others.

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# Lean Management in the Railway Industry

# 15

*I shall try to correct errors when shown to be errors; and I shall adopt new views so fast as they shall appear to be true views.*

Abraham Lincoln

## 15.1 Overview of the Global Railway Industry

Rail transport (also known as train transport or railway industry) is a means of transferring passengers and goods on wheeled vehicles running on rails, which are located on tracks. In contrast to road transport, where the vehicles run on a prepared flat surface, rail vehicles (rolling stock) are directionally guided by the tracks on which they run. Tracks usually consist of steel rails, installed on sleepers (ties) set in ballast, on which the rolling stock, usually fitted with metal wheels, moves. Other variations are also possible, such as "slab track", in which the rails are fastened to a concrete foundation resting on a prepared subsurface. The railway industry consists of sale, manufacture and operation of railway technology. Rail transportation, primarily consisting of freight shipments and passenger service, plays a vital role in the economy of many countries. The industry is characterized by a high extent of labour division and globally collaborating value chain networks (Helmold et al., 2017). Value chain and supply chain partners are integrated into supply chain networks and concepts. The world's railway network spans over 1.3 million route-kilometres worldwide. The United States operates by far the longest railroad network in the world, closely followed by Russia, China, India, Canada, Germany and France. Japan was adjudged number one in the ranking of countries with the highest-quality infrastructure for railroads in 2019. The average annual market volume of railway technology in North America is forecasted to reach around 32 billion euros by 2023. Western Europe will be the region with the highest market volume. The collective region of Asia, Oceania and the Middle East accounts for the largest rail passenger traffic globally, with around three trillion passenger-kilometers travelled annually (Kleinova, 2016).



M. Helmold et al., *Lean Management, Kaizen, Kata and Keiretsu*, Management for Professionals, https://doi.org/10.1007/978-3-031-10104-5_15

Identifying key market players. The current leading railway vehicle manufacturer is CRRC Corporation, as shown in Fig. 15.1. The company is a state-owned enterprise headquartered in Beijing and formed in June 2015 from the merger of China CNR Corporation and CSR Corporation Limited, the leading rolling stock manufacturers in the world. In the fiscal year of 2019, CRRC generated operating revenue to the value of 17.72 billion US dollars with its railway equipment business line alone. In response to the intensified competition and efforts to push past the Chinese manufacturer, France's Alstom and Canada's Bombardier announced to merge both their railway manufacturing units in February 2020. Earlier in February 2019, the European Commission announced that it would not allow Siemens' planned takeover of Alstom, as it would have significantly reduced competition in the railroad signalling and very-high-speed rail markets. In North America, one of the leading railroad companies based on revenue was Union Pacific. In 2019, the company generated over 21.7 billion US dollars in revenue, generating an estimated 21.3 billion euros of revenue. In February 2020, Alstom announced the acquisition of Bombardier and received all the necessary regulatory approvals to complete this acquisition by December of that same year. The combined revenue from Alstom and Bombardier would have reached some 16.9 billion euros in revenue in 2019, making it second in the ranking while still considerably behind the CRRC. Rolling stock refers to any vehicle able to move on a railway. Broadly, this can be categorized into passenger cars, freight cars and the locomotives which pull them. Asia and Europe

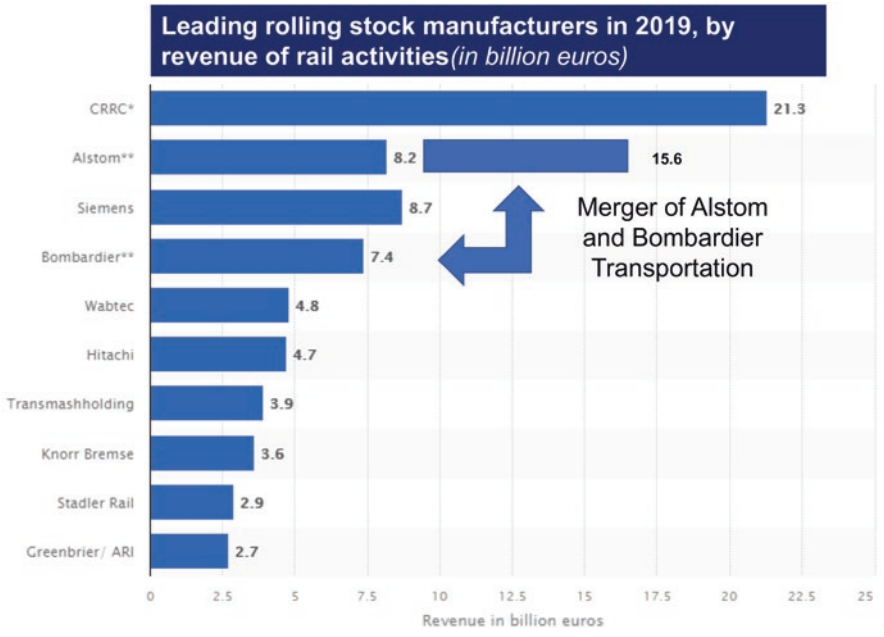


**Fig. 15.1** Global railway manufacturers
Source: Author

(including Eastern and Western Europe) are the two largest markets, with both being over double the size of North America in 2018. Short-term growth is expected to be highest in the more underdeveloped markets of Africa, Australia and the Middle East; however, European and North American growth predictions are not far behind market leaders. In 2019, CRRC remained somewhat uncontested as the largest global manufacturer of rolling stock, with the combined revenues of Alstom and Bombardier trailing over 4 billion euros behind. In 2019, CRRC sold around over 61,000 units, including some 7400 rapid transit and metro vehicles and over 48,700 freight wagons. This allowed the company to have employees of over 166,000 people and generate over 229 billion yuan (just under 33 billion US dollars) in revenue (Statista, 2021). Whereas there are only a few manufacturers world-wide, the operations are still run by predominantly state-owned companies including a high extent of vertical integration (Sanchez, 2001; Böndorfer et al., 2001).

## 15.2 Synchromodality of Global Supply and Value Chain Networks

The globalization and increasing labour division trigger the rise of global trade and business relationships (Helmold & Terry, 2016). From these trends, a new definition emerged: synchromodality. Synchromdality is the combination of synchronization and modality. It is a novel supply chain concept that integrates the flexible use of different transport modes based on real-time information. At a time when global supply chains are complex and subject to uncertainty, synchromodality has emerged at the forefront of research and practice as a tool to ensure efficient delivery performance and thus supply chain competitiveness. As part of the lean approach, railway companies are using multimodal transportation planning systems, wherein the different agents and supply chain actors are involved in the supply chain work in an integrated and flexible way (Railfreightforward, 2021). This approach enables all involved parties to dynamically adapt the transport mode they use based on real-time information from stakeholders, customers and the logistic network. Synchromodality is a new concept in transportation research that has also been developed through a few practical projects. Because we believe that a holistic supply chain perspective is required to exploit the potential of synchromodality, we focused our effort on the development of the synchromodality scale, in the belief that future research can provide a better understanding of its antecedents and outcomes.

## 15.3 Lean Management Techniques in Railway Industry for SME

The lean management concept was invented by Taiichi Ohno. Ohno studied at the Nagoya Institute of Technology. He joined Toyota in 1932. In the 1950s, he became production manager at the main Toyota plant. In 1956, he travelled to Detroit to visit

the Ford Motor Company and General Motors automobile factories. Ohno analysed Henry Ford's production system and modified it for his own purposes since this system of mass production was not suitable for small quantities with large variations. Manufacturing had to be efficient. At Ford, the scope of work was so minimal that the worker no longer had to think. There was only one motto here, and it was "move the sheet!". Ohno has given its workers the opportunity to stop the assembly line if there was a problem and to solve the problem on the spot. The same principles are now applied in the assembly of trains in small production sizes. This concept is called Small Train Concept (STC). The Small Train Concept is a consequent continuation of lean principles in intralogistics in manufacturing. The core of lean management is the so-called "pull principle": the synchronization of customer demand, manufacturing and the accompanying material flows. Small Train combines the supply of material of work stations with the pick-up of finished components and products, avoiding empty trips of transport means in intralogistics. Advantages are reduction of work in process, better utilization of transport means and reduction of industrial accidents. A single realization of Small Train could not be recommended. Small Train should be embedded in a pull system covering all processes of scheduling, manufacturing and intralogistics. Besides pull or flow concepts, railway companies use other techniques, e.g. FMEAs, Faul Tree analyses or decision tree analyses (Tzanakakis, 2021). Figure 15.2 shows the German high-speed production.

**Fig. 15.2** Railway assembly of ICE in Germany
Source: Author

## 15.4 Lean Production (LP) Principles in Railway Industry Flow

If coupled with railway transportation production technical characteristics, LP can be perfectly adapted to the railway transportation production process, enhance railway transportation organization optimization, ameliorate transportation resource allocation efficiency and shape the core competence of railway transportation enterprise. The reasons are as follows: (1) LP can effectively adapt to the production process of railway transportation products and improve its punctuality. The output of railway transportation is intangible spatial movement, and consumption and production are the same production process. Thus, it's impossible for railway enterprises to produce in advance and sell in late days. Through run diagrams and routine traffic control optimization, railway LP can organize non-stop trains, improve line passage density and average wagon load weight, reduce useless locomotive waiting etc. In particular, when some accidents beyond expectation arise, LP can retrieve or adjust the production chain rapidly so as to improve the quality and quantity of railway transportation product. (2) LP can effectively coordinate complicated work division and coordination activities. Railway transportation production inputs a set of production factors and outputs multi-products; therefore, it will involve multiple working units, broad management span and complicated activity chains. By means of LP operational methods such as modularity, JIT, standardization, institution etc., responsibility and rights of different functions can be clarified, core business process and supplementary business process can be identified, and transportation resource and organization mode can be optimized. (3) LP can effectively reduce or eliminate various kinds of uncertainty (Holweg, 2007). Railway transportation production cannot avoid such uncertainties as environmental uncertainty, market uncertainty, technical uncertainty and man-made uncertainty. All of the possible uncertainties can lead to a change of the railway run diagram, which is planned beforehand. By adopting Kanban management, teamwork organization, lean maintenance and technical operation, railway LP can, to the extreme extent, take most factors that can influence railway production into consideration and, correspondingly, improve the level of just-in-time production, fix transportation tasks in advance and respond to accidents rapidly. Thus, railway transportation production can be executed in a smooth and balanced way. (4) LP can effectively realize network economy in transportation production. In the transportation process, network economy, which is the sum of scale economy and scope economy, transforms into density economy and size economy. The economy of density refers to the decrease of cost with the expansion of transportation volume while size keeps constant. The economy of size refers to a decrease of cost with the expansion of size or track miles while density keeps constant. Track density economy refers to the phenomenon when average transportation cost reduces as transportation density on specific line increases, or the density index of ton-kilometre per kilometre goes up. Whereas single product density can lead to a decrease of average transportation cost, multi-product density also contributes to cost savings for transportation production. Movable equipment capability economy means that average transportation cost

reduces while the load weight of transportation equipment mounts up. Fleet economy of wagon, ship or plane refers to the phenomenon that average transportation cost decreases when number of means of conveyance in one organization group grows up. Station or port disposal capability economy indicates that average transportation cost decreases as wagon, container or cargo and passenger throughput increases at a specific station, airport or port in the transportation network. Distance economy is the phenomenon that transportation cost reduces as shipping distance prolongs. Through resource pull, process pull and product pull, railway LP adjusts the spatial layout of transportation resources, cut down useless production procedures and improve both the quality and quantity of transportation product. Whatever methods railway LP takes, the performance of railway transportation enterprise manifests finally as the quantity and quality of passenger and cargo trains on railway lines. Railway transportation product is produced through passenger or cargo trains whose organization determines the technical efficiency, management efficiency and transaction efficiency of railway transportation enterprise. The quantity index of train can be measured by the number of trains passing a certain line overnight, in short, train density, while the quality index of train can be computed by weight, speed, punctuality and operation distance. By taking advantage of LP measures such as vehicle weight improvement, production process reengineering, assessment index constraint etc., quantity and quality of train operation can be improved, at the same time, transportation costs can be cut down dramatically, and potential transportation production power can be released further (Gorecki & Pautsch, 2011).

## 15.5 Digitization of Railway Companies

Digitization in railways plays an essential role in applying lean concepts in the railway industry (Durakbasa & Gençyılmaz, 2022). The major elements in railway digitization comprise digital data, connectivity, automation and digital customer access, as shown in Fig. 15.3. Lean digitalized concepts are applied in design, construction, maintenance, monitoring and upgrading of roads; railways; airfields; and harbour facilities and other ground transportation infrastructure with the goal of providing safe, economic, environmental, reliable and sustainable infrastructures (Tutumluer et al., 2022). The creation of smart and environment- and user-friendly mobility systems is among the high priority directions in the evolution of transport worldwide. Rail transport is recognized as a vital part of this process. Meanwhile, radical advancement in the business environment, facilitated by ICT technologies, requires the existing business models and strategies adopted by rail operators to be brought up to date. A thorough understanding of the concept of digital transformation is paramount in the development of rail and transport sectors. Digitalization, as an ongoing process of a convergence of the physical and virtual worlds, is bound towards cyber-physical systems and is responsible for the innovation and change in multiple sectors of the economy. The main technical solutions and concepts that have accelerated digital transformation in the railway sector in recent years are.

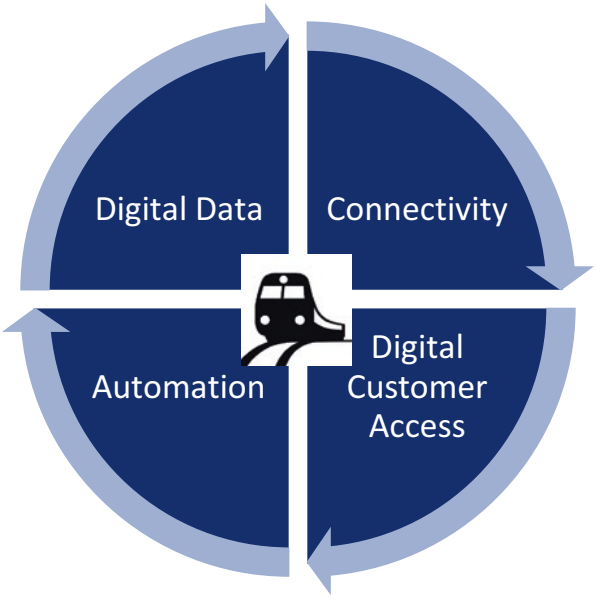


**Fig. 15.3** Lean management and digitization in railways

- Internet of things (IoT)
- Virtual reality (VR)
- Cloud computing
- Big data analytics (BDA)
- Automation and robotics

The adaptation to the new conditions of the digital economy is visibly marked by the emergence of the concept Industry 4.0. Mobile applications, e-ticketing, digital train control, signalling and traffic management and digital platforms for predictive maintenance are the key applications of digitization in the railway industry. New products and services are becoming an integral part of the operations of railway undertakings, infrastructure managers and manufacturers for the industry. As such, they contribute to the creation of added value for multiple stakeholders in public transport initiatives, which facilitates the implementation of new concepts of mobility. Digitization in the social-economic context is understood as a process involving a substantial change of how digital and computer-based technologies can be used by the society, business entities in different sectors of the economy and the public administration. Besides digital economy, other notions pertaining to the new model of economy have been coined. These include E-Economy, Network Economy, Mesh Economy, Data Economy, Bit Economy, Access Economy, Platform Economy and On-Demand Economy. Digital business transformation is a special kind of organizational change of the enterprise, sector and entire supply chains through the use of

digital technologies and new business models to improve their performance. Digital transformation has an impact on three major areas of business activity:

- Modelling of customer relations, embracing the understanding of customer experience, cross-channel coherence including self-service
- Operational processes, including the organization's internal processes and worker enablement, as well as performance management
- The business model understood as the selection of products to offer and markets to serve

The progressing digitalization affects the tightening of competition between companies using more traditional business models and those embracing the newly emerged ones, which offer

- Multi-products/services
- Connected products
- Embedded services
- Shared products/services

Recently, the term digital disruption has been created, denoting the effect digital technologies and business models have on a company's current value proposition and the resulting market position. This assumes the impact the company has on the competition as a result of the implementation of new business models combined with the emerging technologies.

## 15.6 Case Study: Bombardier Transportation (Alstom) in China

Bombardier is recognized as a successful foreign enterprise in the Chinese rail industry. Bombardier is also a specially qualified Western enterprise that supplies railway passenger trains (high-speed trains and intercity passenger trains), metro vehicles, monorail trains, APM systems and metro vehicle maintenance/services. Bombardier Transportation in China has six joint ventures, seven wholly foreign-owned enterprises and around 7000 employees (Bombardier 2017).

A wide range of our rail transportation and aerospace products are currently in service in the Chinese market. In total, more than 30,000 rail vehicles, locomotives, bogies and propulsion systems are in operation or on order in China, including more than 3500 high-speed train and intercity passenger train cars, 580 electric locomotives, over 2000 metro cars, and maintenance for 1600 metro cars as part of China's growing urban mass transit market. Bombardier is also supplying, or has already supplied, APM systems to China's five largest cities: Beijing, Guangzhou, Shanghai, Shenzhen and Hong Kong. In addition, Bombardier has supplied 104 tram cars for

two other Chinese megacities (Nanjing/Suzhou) and in 2017 won its first monorail contract in China for 240 cars. A total of over 14,000 Bombardier bogies are currently in use in China's mainline and urban mass transit vehicles while Bombardier's propulsion and signalling equipment, largely supplied to third-party metro car builders, are in operation in more than 30 Chinese cities.

Figure 15.4 displays the assembly and testing line of high-speed trains in Bombardier Sifang Transportation. Figure 15.5 shows the visualization room (War Room or Obeya) of the International Procurement Office (IPO) in Shanghai. International purchasing offices or supplier management centres are part of the internationalization and change of the corporate model in supplier management (Helmold 2014). Multinational corporations such as Volkswagen, Daimler, Siemens, Bosch or Bombardier have purchasing offices in regions such as China, India or Eastern Europe, which offer savings potential or are geographically far removed from the parent company. Medium-sized partners expand through smaller offices or through collaboration with partners, purchasing offices or institutions such as the German centres in the metropolitan areas of China (Helmold & Terry, 2016). In addition to offices, the German centres also offer contacts to government representatives or Chinese suppliers in order to make purchases from China (Helmold & Terry, 2016). In 2015, Deutsche Bahn opened an international purchasing office. Previously, the logistics division, DB Schenker, had successfully established itself in many locations over the years. In 2005, companies such as Bombardier

**Fig. 15.4** Final assembly of highspeed trains at BST China


**Fig. 15.5** Bombardier Alstom in China

Transportation or IBM opened an international purchasing office in Shanghai, China (Bombardier, 2017). In 2015, Deutsche Bahn decided to open a point-of-sale office in the same location. Developments show that it is advisable to establish an international purchasing office in China. Advantages can be outlined as follows:

- Proximity to markets with a high degree of product and know-how maturity, e.g. automotive industry or railway industry
- Establish relationships with Chinese manufacturers and ensure compliance with quality requirements
- Transfer of customer and production requirements to the suppliers
- Early involvement of suppliers in the product development process as well as joint development
- Exploitation of savings through direct purchasing as well as through the use of local pre- and semi-finished products in the production process of the suppliers
- Acquisition of own end products in domestic markets
- proximity to other high maturity Asian markets, e.g. Japan or South Korea

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# Lean Management in Healthcare and Hospitals

# 16

*Improvement usually means doing something that we have never done before.*

Shigeo Shingo

## 16.1 Lean Management in Healthcare Sector

Lean experts investigate to what extent the principles of lean management, which are already a proven concept in industry for process-oriented quality assurance while increasing efficiency, can be applied to the control, support and core processes in the healthcare sector (Kraft, 2016). Learning from the best-practices examples of other industries, there are three success-relevant recommendations for action for the introduction of lean projects in hospitals:

1. A hospital-oriented change management
2. A procedural strategy for process-oriented organizational development
3. An approach to operationalizing the first lean projects

Lean starts from the refusal to accept waste as defined by several authors like Helmold & Samara, Ohno or Liker. Credited to Taiichi Ohno, the lean system was developed in the 1950s and 1960s to provide the best quality, lowest cost, and shortest lead time through the elimination of waste. The Japanese term for what American companies usually categorize as waste is muda and was defined by Fujio Cho of Toyota as "Anything other than the minimum amount of equipment, space and worker's time, which are absolutely essential to add value to the product". The presence of these types of waste in a system has a negative impact on lead time, cost and quality (Millard, 2016). In the early 1980s, companies in other sectors like the healthcare sector have understood that the introduction of lean principles will lead to several advantages. Waste in healthcare can be described, amongst other elements, in excessive transport of medicine or patients, waiting time for treatments or underutilization of equipment and machines in hospitals. Moreover, duplications and inefficiencies by nurses may also impact the creation of waste.



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## 16.2 Waste in the Healthcare Sector

### 16.2.1 Applying the TIMWOOD Model in Healthcare

Although the lean business improvement methodology was initially developed to improve the quality and productivity of automotive factories, it has been used with great success in industries and settings of all types, including software development, government, retail and other service settings.

Healthcare organizations, in particular, have found that the approach can be used to reduce costs and improve quality and patient satisfaction at the same time. One of the core principles of lean is the elimination of waste, which is defined as anything that doesn't add value to the customer. Practitioners target eight specific types of waste (there were originally seven – more on that later). They are as common in healthcare as they are in manufacturing. Lean management targets therefore the elimination like waiting times or overmedication as outlined in Fig. 16.1 (Gupta, 2013).

### 16.2.2 Transport in Healthcare

The waste of transportation occurs when materials are moved around inefficiently. In healthcare, it occurs when

- Patients are moved from department to department or room to room

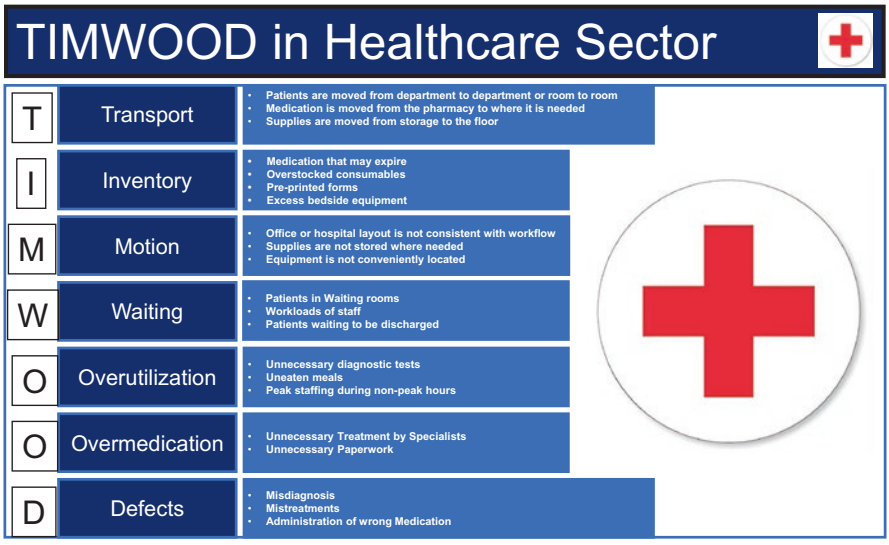


**Fig. 16.1** TIMWOOD concept in healthcare sector
Source: Author

- Medication is moved from the pharmacy to where it is needed
- Supplies are moved from storage to the floor

Some of this transportation is considered "necessary" waste to be minimized, even if it can't be completely eliminated.

### 16.2.3 Inventory in Healthcare

Manufacturers have largely moved to a just-in-time approach to inventory in order to reduce costs related to storage, movement, spoilage and wastage. Healthcare organizations look to do the same as it relates to

- Medication that may expire
- Overstocked consumables
- Pre-printed forms
- Excess bedside equipment

### 16.2.4 Motion in Healthcare

Motion refers to the unnecessary movement of people within a facility or campus. This happens when

- Office or hospital layout is not consistent with the workflow
- Supplies are not stored where needed
- Equipment is not conveniently located

The first step in combating the wastes of lean is recognizing them within your organization. For most, examining each of these specific frequent contributors to waste leads to the discovery of multiple opportunities for improvement. We can also strive to eliminate wasted motion (including clicks) in software systems.

### 16.2.5 Waiting in Healthcare

During manufacturing, waiting occurs when parts can't flow or when team members can't perform their tasks due to problems, such as a lack of inventory or equipment failure. Waiting in healthcare is a problem for both patients and providers.

- Patients in waiting rooms (or exam rooms)
- Staff members with uneven workloads waiting for their next task
- Emergency department patients and physicians waiting for test results
- ED patients waiting to be admitted to the hospital
- Patients waiting to be discharged once medically ready

### 16.2.6 Overutilization in Healthcare

Overproduction in manufacturing results in excess "work in process" or unsold inventory of "finished goods". It is more difficult to spot in healthcare, but it occurs when providers do more than is needed by the customer at this moment. It includes

- Unnecessary diagnostic tests
- Uneaten meals
- Ordering medications that the patient doesn't need
- Peak staffing during non-peak hours

### 16.2.7 Overmedication in Healthcare

Over-processing means doing more work, making it more complex or more expensive than is necessary. It takes the form of

- Ordering complex diagnostic imagery (MRI) when a simpler method would suffice (X-ray)
- Unnecessary paperwork
- Surgical intervention in lieu of an equally effective medical alternative
- Follow-up appointments that don't improve patient outcomes
- Treatment by specialists that could be done by primary providers

### 16.2.8 Defects in Healthcare

While defects in manufacturing are expensive and troublesome, in healthcare they can be deadly. They may include

- Misdiagnosis
- Administration of incorrect medications
- Hospital-acquired conditions
- Incorrect IDC codes

The waste includes the time spent creating a defect, reworking these defects and inspecting these defects. Even though we consider inspection to be waste, we can't eliminate inspection altogether until we have a perfect defect-free process. Even Toyota still has a final inspection in the year 2016 … but they consider it to be waste that they'd hope to eliminate some day.

**Fig. 16.2** Lean hospital example

## 16.3 Lean Hospitals: Outlook in Lean Management in Healthcare

For many acute healthcare clinics and hospitals in Germany, efficient service provision and increased patient and employee loyalty are becoming strategic success factors. In order to strengthen their market position, hospitals are increasingly making use of the principles of lean management (Pöhls, 2012). Figure 16.2 shows the example of a lean patient and surgery room. Medical care is geared towards human well-being, combined with a culture of success – this is where the future lies. The COVID-19 pandemic in particular has shown how important quality and efficiency are in terms of patient well-being in hospitals. Quality management and lean management can benefit from each other, and both have the potential to form a successful integrated management system together. Concepts like quality management and lean management focus in their development on the process-oriented approach for more quality, the need for continuous improvement and efficient work (Börchers, 2021).

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## 16.4 Case Study: Virtual Hospital

### 16.4.1 Combination of Digital and Lean Tools

The virtual hospital is a collection of different technologies that work together to allow healthcare professionals to let a patient recover, convalesce or even receive treatment at home. It means rather than having to spend both time and money in a hospital bed, or take the time out of the day to go down to a clinic or hospital for an appointment, all of this is now transferred to the comfort and familiarity of home. The virtual hospital is improving medical care in many ways, but this is only possible as a result of the Internet, and here's why.

### 16.4.2 Electronic Health Record

The electronic health record, or EHR (see Fig. 16.3), is an early beneficiary of the Internet revolution. It simply means that all of a patient's relevant medical record data – including insurance information – is centralized in one file of data, but, more importantly, that data is accessible to anyone who needs it. In the past, if a patient had one regular doctor, but then visited another doctor, say, during a trip, the patient would have to remember all relevant medical information to relay to the new doctor, since he or she wouldn't have access to the medical records a regular family doctor had been filling. Now, however, whether it's an emergency room situation, or just a


**Fig. 16.3** Virtual and lean tools in healthcare

new nurse practitioner visiting a home for a routine virtual hospital check-up, the important medical data is always available for the professionals that need it.

### 16.4.3 Real-Time Medical Data Gathering

In the past, if a patient needed vital signs monitored, such as the heart rate, or blood pressure, this required a person to be "hooked up" to large, bulky, delicate electronics that monitored the vital signs. That data was relayed to a central nurse's station in a hospital so that appropriate staff could keep an eye on things and react if anything went wrong. Today, there are mobile medical devices that are much smaller and can easily be worn or moved into a person's home. However, they are now also wireless, not requiring thick cables directly connected to a monitoring station. This information is then sent, constantly, or as required to medical professionals so they can still get a good feel for a patient's progress, or be notified if something goes wrong. There are several companies acting as a pioneer in this new type of patient-centric care, and the virtual hospital concept can only continue to make use of the Internet in new, innovative ways.

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# Lean Management in Higher Education (LHE)

# 17

*You must have long-range goals to keep you from being frustrated by short-range failures.*

Charles C. Noble

## 17.1 Lean Management in Universities and Schools

The origins of lean practices date from late nineteenth- and early twentieth-century industrial engineering. Lean practices have evolved over the decades since then to become much easier for non-specialists to understand and use. It is now common for people with backgrounds and interests far from industrial engineering to become highly competent lean management practitioners. Therefore, the lean management system has the benefit that everyone in an organization can apply the practices without the need for specialists. Lean higher education (LHE) refers to the adaptation of lean thinking to higher education, typically with the goal of improving the efficiency and effectiveness of operations (Moore et al., 2007). Lean, originally developed at the Toyota Motor Corporation, is a management philosophy that emphasizes "respect for people" and "continuous improvement" as core tenets. Lean encourages employees at all organizational levels to re-imagine services from a customer's point of view, removing process steps that do not add value and emphasizing steps that add the most value. Lean focuses on the concentration of valued-added activities or products and the elimination of waste. Examples of waste in higher education can be described with the TIMWOOD model given in Table 17.1.

While the concept of "customers" and "products" is controversial in higher education settings, there are certainly diverse stakeholders who are interested in the success of colleges and universities, the most common of which are students, faculty, administrators, potential employers and various levels of government. Lean in higher education has been applied both to administrative and academic services. Balzer (2010) described such initiatives within university settings, including the critical factors for success and ways to measure progress. He noted that LHE can be effective to respond to higher education's heightened expectations, reducing expenses in an era of rising costs, meeting demands of public accountability, and leveraging institutional resources to fulfil the educational, scholarship, and outreach



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**Table 17.1** Waste in higher education

| No. | Type of waste | Description |
|---|---|---|
| 1. | Transport | Students or lecturers are going to the wrong lecture room due to missing information |
| 2. | Inventory | Flip chart papers and other accessories are purchased without proper planning of demand situation |
| 3. | Motion | Lecturers have to re-organize tables, chairs, flip charts etc. in the lecture room |
| 4. | Waiting | Lecturers or students have to wait in the lobby for registration or lectures due to inefficient processes |
| 5. | Overproduction | Printing and filing of unnecessary lecture materials, documents or examination papers due to missing information |
| 6. | Overprocessing | Explanatory, labour-intensive planning of courses or evaluation of projects, courses using questionnaires |
| 7. | Defects | Not functioning equipment in lecture rooms, e.g. beamers, monitors, markers |


**Fig. 17.1** Application of lean management at universities
Source: Author

missions of higher education (Emiliani, 2015). Lean can trigger significant and measurable impacts when used to improve academic and administrative operations. Concepts like 5S, strategic planning, improvement initiatives, customer satisfaction, better capacity utilization of lecturers or lecture rooms, flawless launches of new programs or employee empowerment are only few areas, where universities and business schools can implement successfully lean management principles (Radnor & BUcci, 2011; Langer, 2011).

Such improvements are effective at the site, department or functional levels or throughout an entire institution. Figure 17.1 shows a classroom of the IU International

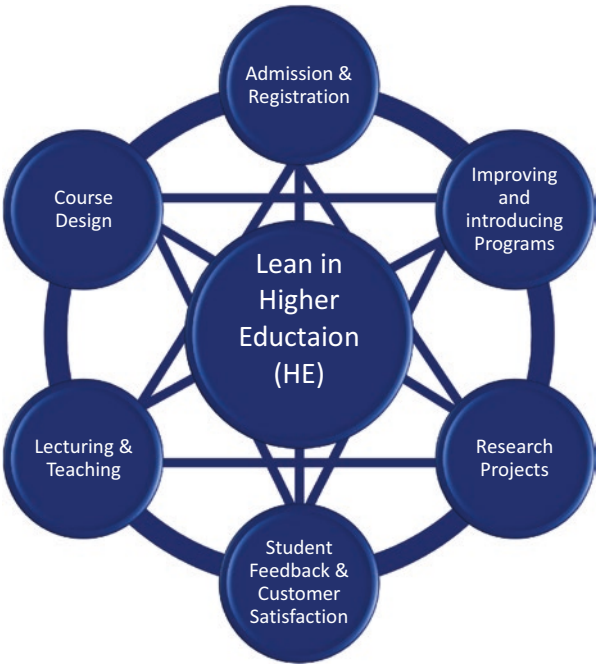


**Fig. 17.2** Application of lean management in LHE
Source: Author

University of Applied Sciences in Berlin. 5S principles are put in order to enable a flawless and smooth lecture without waiting times for lecturers or students (Helmold & Terry, 2021). The lobby enables the staff and students to familiarize with the plan, rooms and lecturers. Lecture rooms are technically well equipped, bright, user-friendly and named so that a smooth operation is given and possible.

Though the application of lean management in higher education is more prevalent in administrative processes (e.g. admissions, registration, human resources (HR) or procurement), it has also been applied to academic processes (e.g. course design, lecturing, research projects, introducing new and improving degree programs, student feedback and handling of assignments) in an increasing number of cases (Fig. 17.2).

## 17.2 Lean Higher Education (LHE)

Lean higher education (LHE) refers to the adaptation of lean thinking to higher education, typically with the goal of improving the efficiency and effectiveness of operations. Lean, originally developed at the Toyota Motor Corporation, is a management philosophy that emphasizes "respect for people" and "continuous improvement" as core tenets. Lean encourages employees at all organizational levels to

re-imagine services from a customer's point of view, removing process steps that do not add value and emphasizing steps that add the most value. While the concept of "customers" and "products" is controversial in higher education settings, there are certainly diverse stakeholders who are interested in the success of colleges and universities, the most common of which are students, faculty, administrators, potential employers and various levels of government. Lean in higher education has been applied both to administrative and academic services. Balzer (2010) described such initiatives within university settings, including the critical factors for success and ways to measure progress. He noted that LHE can be effective to respond to higher education's heightened expectations, reducing expenses in an era of rising costs, meeting demands of public accountability and leveraging institutional resources to fulfil the educational, scholarship and outreach missions of higher education.

## 17.3 Continuous Improvements and Respect for People

Of great importance in the application of lean management in any organization is the recognition and daily practice of the lean principles: "continuous improvement" and "respect for people". The "respect for people" principle is challenging for management to implement because most managers have risen to their level of responsibility based on their superior "fire-fighting" skills. With lean, managers are coaches who guide their employees through a problem-solving process. The employee learns how to ask themselves the questions that enable them to solve problems on their own, with the same or better quality that the manager would have achieved. Problems occur when managers cannot relinquish control, resulting in zero-sum (win-lose) outcomes for people and inferior results. In other words, one party gains at another party's expense, and the losers are much less willing to participate in continuous improvement. This outcome impedes teamwork and information flows and discourages daily efforts by administration, faculty and staff to improve processes. In order to function properly, lean management must be understood and practiced in a plus-sum (win-win) manner. The "respect for people" principle is required in order to sustain continuous improvement. The origins of lean practices date from late nineteenth- and early twentieth-century industrial engineering. Lean practices have evolved over the decades since then to become much easier for non-specialists to understand and use. It is now common for people with backgrounds and interests far from industrial engineering to become highly competent lean management practitioners. Therefore, the lean management system has the benefit that everyone in an organization can apply the practices without the need for specialists.

Figure 17.3 shows a lean management workshop in the IU International University of Applied Sciences.

**Fig. 17.3** Lean management workshop at the IU M.B.A. class
Source: Author

## 17.4 Introducing Lean Management in Laboratories

The implementation of the 5S methodology in the laboratory is beneficial for both university personnel and students in the learning process. In this way, university personnel could prepare in a simple and fast way for teaching, carry out clear procedures and be able to easily return the equipment to the adequate place in the storage without waste of time for preparation and organization of workplace (Kang & Manyonge, 2014). Since most students did not have the opportunity to visit companies and production systems in order to get acquainted with the examples of how to use lean thinking, the lab is actually their first encounter with this kind of thinking. Moreover, in laboratory conditions, students can now learn steps for implementation of the 5S method, in order to apply gained practical knowledge at their future workplace. In the given literature review, applying lean principles and practice in education results in higher level of student satisfaction, which benefits their engagement, performance and benefits to educators in a way where teaching process will flow without defects. In order to improve student learning, university educators' task, besides teaching about lean principles and its tools, is to apply lean philosophy in their teaching. Last but not the least, the lectures and exercises should be organized in such a manner to add value to student knowledge, reduce waste of time and stimulate continuous perfection pursuit. Figure 17.4 shows a laboratory, which is designed in line with lean principles. The U-shape type of operations enables the employees to efficiently execute their research operations without waste of time or waiting.

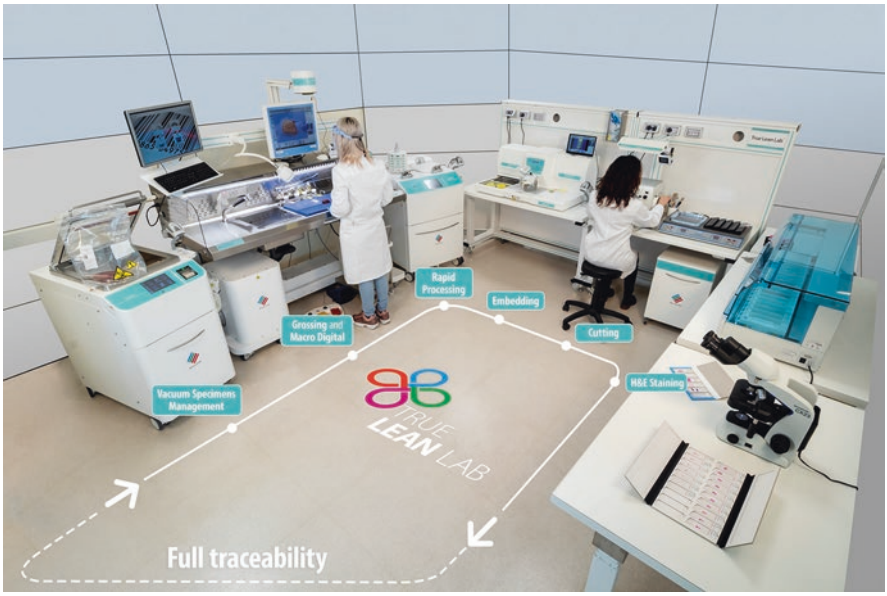


**Fig. 17.4** Lean research laboratory
Source: (Milestone, 2022). True "Lean" Lab

## 17.5 Case Study: University of Oklahoma Becoming a Lean University

The University of Central Oklahoma is a regional institution with a current enrolment of 15,000+ students. Centrally located in Edmond, Oklahoma, a suburb of Oklahoma City, the University is in the top 7% of university enrolment across the nation. The student population drawing from 76 (out of 77) Oklahoma counties, 47 states and 76 countries provides the University with a rich cultural diversity. The University of Central Oklahoma is Oklahoma's oldest institute of higher learning, established 17 years before statehood in 1890. The Oklahoma State Regents for Higher Education was formed by state leaders in 1941 and has governed the University since then. The University currently has five academic colleges offering both undergraduate and graduate programs. UCO is dedicated to educating responsible, productive and engaged Oklahomans in a dynamic environment where building leaders and welcoming the challenge of change are endorsed. Three core principles are embraced by the University: civility, community and character.

Under the direction of the Executive Vice President of Administration, the University of Central Oklahoma has embraced the concept of lean thinking as it faced significant financial issues. In Fiscal Year 2002, the University experienced a 15% budget reduction. A significant revenue increase from state appropriations is not expected in the foreseeable future. In fact the UCO students pay 50% of the cost of their education. Outdated and patched administrative processes were contributing

to employee job dissatisfaction and low productivity levels. Because of recent budget cuts and insufficient funding to cover mandatory cost increases, the University needed to find ways to dramatically improve productivity and improve deteriorating employee morale. The primary focus of lean is identifying and eliminating waste from the product or service provided. Lean thinking methodology was introduced in the administration area through a comprehensive employee training program designed to foster program acceptance, create more efficient job processes and generate greater job satisfaction through job improvements. Although lean thinking projects were initially focusing on administration processes, other divisions on campus have found value in the approach. Lean thinking is very well received because of its relatively quick rate of implementation.

**Implementation** Utilizing the four-step lean model, the University of Central Oklahoma began implementation of the lean initiative by holding an informational meeting attended by all administrative support staff. This meeting was used to provide a brief overview of lean, to convey the reasons for implementing lean, to stress that all administrative support staff would be involved and to explain the steps required for achieving this cultural change. Argent and Francis Tuttle Technology Center partnered to provide the training at the University. Step One of the lean model was already in process. The campus-wide survey results were constantly being analysed and reviewed for where the "pain" was greatest. Steve Kreidler, Executive Vice-President of Administration, and his immediate staff began prioritizing issues and opportunities, looking for possible pilot projects and other areas where immediate attention was necessary to improve customer service. Processes in every department were identified for the lean approach. A priority list was developed. The work order process used by the Facilities Management department was selected as the first process to be analysed with the lean approach for two reasons: (1) number of complaints regarding delays in work order completion and (2) impact of improvement on the whole campus, encompassing all divisions. The Facilities Management staff welcomed the opportunity to participate in this first workshop and improve their service. Step Two was launched within 2 weeks of the development of the priority list. One-day classes were offered to train all administrative support staff from the lowest paid employees to the Executive Vice-President of Administration, with the Quality-Driven 7 Lean Enterprise™ class, offered by Argent. This lean class focused on the way lean is used in administrative, service and support type processes and how lean ties into quality initiatives that may be implemented in parallel or are already in place. Each class contained a lecture and simulation to not only explain the concepts of lean but also demonstrate the power in a hands-on fashion. A simulation exercise with class participants playing a role of an empty and critical position demonstrated the lean tools and techniques using the hiring process. These classes were followed by a Value Stream Mapping (VSM) workshop. This two-day workshop on-campus used a value stream of the university as the basis for learning. During the 2 days, a current state map and a future state map were created by the workshop participants. Approximately 50% of the time was spent in the classroom learning of VSM techniques and the remainder of the

time was spent actually walking the process, mapping it and discussing opportunities with the employees working the process on a daily basis. At the conclusion of the workshop, participants had acquired basic VSM skills to build on and had a current state and future state map that were approximately 60–70% accurate. This level of accuracy is very close to being good enough to start making improvements. Step Three began at the conclusion of this workshop. VSM maps visually illustrate the process for employees, first in the current state (as it is now) and then in the future state maps (defining priority changes). A lean implementation project, also known as a kaizen event, is used to address VSM maps' future state. Departments independently implemented changes in their process based on the maps prepared in the workshop. Some examples of major changes made to improve processes include the following:

- Employment Services – online hiring system.
- Purchasing – online requisition process.
- Budget Office – electronic monthly reports.

As previously stated, the work order process for Facilities Management was the first facilitator-lead project targeted to be improved through the lean approach. The flow of the process improvement with the work order process is described below: The 5-day kaizen event dedicated the efforts of five employees for the entire week. Two other employees were assigned on an as-needed basis. This core team under the direction of a facilitator from Argent and UCO's designated Lean Management Coordinator reviewed the two maps created during the VSM workshops and made minor corrections and updates to get a map defined that the core team believed was approximately 90% accurate. From this, an action plan consisting of prioritized tasks was developed and a set of lean metrics (measurements illustrating efficiency) was agreed upon by the core team. A small group of team members collected data for the current state (before) metrics. These metrics were posted to a display board in the core team meeting room. The action plan included assignments for team members with specific instructions on who to talk to, what order to complete tasks and how to explain the efforts to the staff. Small group meetings were held with all employees in Facilities Management to explain the project and to solicit additional issues, opportunities and possible solutions. As the changes were implemented, the team members explained them to employees within the process and observed how the changes worked. Minor adjustments were made on the spot using the combined knowledge of the employees and team members to get a workable solution that created positive change.

Benefits Implementation of Lean University™ has resulted in numerous benefits and reduced waste. The overall impact is the cultural concept that positive change can and does happen at the University of Central Oklahoma. Employees have realized that they have been empowered to make improvements that help the financial position of the university, make their sense of satisfaction higher, reduce their frustration and increase their productivity. The following summary demonstrates many of the benefits experienced to date:

Training: (1) By providing the basic one-day introductory lean course, all employees of Administrative Services have begun to realize that they are a part of the big picture, that they do have input into the processes they work within, and that good things can and do occur as a result of continuous improvement. (2) Creating a common understanding and explaining to groups consisting of both management and staff positions that everyone is expected to participate have opened the door for positive input and constructive criticism without fear of retribution. Many employees are not even waiting for events and workshops to occur. They are proactively making small immediate changes with excellent results.

Cost Savings: Even though the emphasis of this effort is on improving customer service across campus, there have been multiple instances of cost savings through project work. The first Facilities Management project was able to save more than $14,000.00 in annual paper cost with only 1 week's worth of work.

Efficiencies: In addition to the obvious efficiencies that have been created in Facilities Management, several other areas have experienced improved efficiency. In the Purchasing Department, the flow of processing purchase orders was changed from a batch and queue methodology to a synchronous flow. By working each purchase order as far into the process as possible and completing the work and printing in a non-stop manner, one process agent has been able to reduce the average time to complete a work order by over 70%.

Personnel Performance Improvements: The overall morale and work ethic of employees in areas where changes have been made has improved significantly. By empowering employees to make positive process changes, actually have accountability and be responsible for their work, lean thinking has brought out the best in many employees. It has also on occasion motivated some employees who have stagnated or are entrenched in their ways to move on. Removing these human roadblocks in many departments has only made it easier for the rest of the employees in these departments to embrace the culture of continuous improvement.

Student Satisfaction: Students have already begun to see the positive impact on services offered. The Facilities Management work order process improvements gained immediate support from students living on campus in student housing. Work order requests are considered to be part of the solution instead of a useless and prolonged step in the process.

Faculty Satisfaction: While the efforts of this initiative have primarily focused on Administrative processes, the lean core teams have addressed processes in Academic Affairs and Enrolment Management divisions. Faculty members are benefiting from the improved processes. Faculty feedback has provided insight into the wants and needs of faculty and how they interact with Administrative staff. Faculty members whose responsibilities include the role of building monitor have once again become engaged in the process. These building monitors funnel work order requests to Facilities Management and monitor progress on the work. Under the old process, faculty members attempted to avoid this role. With the improved process, faculty members have become supportive team members.

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# Lean Management in Project Management

# 18

*A bad system will beat a good person every time.*

W. Edwards Deming

## 18.1 Project Management Strategies

A project is a purposeful and mostly unique project, which is subject to constraints on time, resources, costs and other elements, e.g. the use of personnel, financial means or operating resources (PM, 2018). Within projects, there are client-determined begin and completion dates inside which the task must be handled. Complex projects and task management are not the same as would be expected, as ordinarily several capacities are included. The functions often comprise project management, design, production, procurement, quality management, logistics, human resources, finance and other departments. The term project is derived from the Latin language (Latin: proiectum, thrown forward). In the seventeenth century, the meaning of "construction project" as a project definition prevailed in Germany (PM, 2018). Due to their developing multifaceted nature, ventures place unique requests on the project board and hence additionally arrange the executives for both clients and the contractor and order processors. Frequently, there are a few included groups or offices in complex tasks (Helmold et al., 2017). Because of their unpredictability, ventures involve huge arrangements with clients, providers, banks or different stakeholders. Examples of projects include.

- Construction of a railway station in one of the major cities such as Stuttgart, e.g. Stuttgart 21st
- Construction of an airport, e.g. construction and completion of Wiliy-Brandt Airport BER
- Renovation of a museum, e.g. Neues Museum in Berlin
- Construction of a highspeed train, e.g. construction of the ICE by Siemens and Alstom (formerly Alstom)
- Construction and completion of an opera house, e.g. the Elbharmonie in Hamburg



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According to the project management manual, projects have certain criteria (PM, 2018). Key criteria for projects are defined in Table 18.1. If these project criteria are not met, there is usually no real project. This does not mean that methods of project management cannot be put to good use beyond project work. However, one should not speak of project work in order not to confuse.

Projects always include an organizational structure and a process organization. The organizational structure forms the hierarchical framework of the project organization and defines the organizational framework, which tasks are to be managed by which functional units and sub-departments. By contrast, the process organization regulates the processes that take place within this framework (process and information processes within the project phases). Companies usually have a line organization or a project matrix organization, whereby in many cases there is a combination or a hybrid of both forms of organization (Helmold, 2019). Projects usually take place under the pressure of costs, production and performance so that projects involve numerous negotiations. For the realization of projects, project teams are formed, which consist of different functions (PM, 2018). These then take over control and steering tasks as part of project management (PM, 2018). Projects go through four phases, as shown in Fig. 18.1. Projects start with a feasibility check. If the feasibility is given, project planning will begin in the next phase. In this context, a project assignment is recommended in which important key figures such as quality, costs, time or resources are clearly defined (PM, 2018). After confirmation of all features, the project can be started in phase three. After successful completion of the project, the project validation takes place with a target/actual comparison. In particular, deviations must be negotiated via the supplementary management (Helmold, 2021).

Complex projects are usually carried out in cross-functional and interdisciplinary project groups, which contain experts from departments like project

**Table 18.1** Project criteria

| Project criteria | Description |
|---|---|
| Time limit | Projects are limited in time, meaning that both the beginning and the end are defined by dates |
| Uniqueness | Projects are unique; they are not suitable for the reproduction of existing things (this process management is much better suited) |
| Resource scarcity | Projects are equipped with limited resources in terms of budget, people or assets |
| Targets | Projects have a clearly specified and positively formulated goals and objectives |
| Organization | Projects require their own project management organization including a project manager |
| Interdisciplinary | Projects work interdisciplinary and cross-departmental, i.e. project management, purchasing, design, quality etc. |
| Novelty and risk | Projects are breaking new ground. They realize solutions that do not yet exist in the desired form |
| Project phases | Projects are handled in certain phases and contain project milestones |

Source: Author

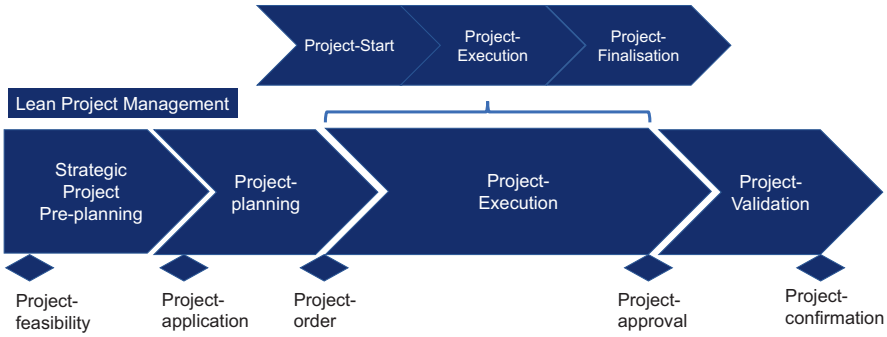


**Fig. 18.1** Project phases
Source: Author

| Function | Project A | Project B | Project C |
|---|---|---|---|
| Lean Management | | | |
| Procurement | O | O | O |
| Operations | O | O | O |
| Marketing & Sales | O | O | O |
| Quality | O | O | O |
| Finance & Controlling | O | O | O |
| Human Resources | O | O | O |

**Fig. 18.2** Project organization
Source: Author

management, procurement, production, marketing and sales, quality management, finance and controlling or other departments, as shown in Fig. 18.2 (Helmold et al., 2019; Helmold, 2021). The advantages of a project management organisation are the following:

- Short decision-making through co-allocation
- Representation of all functions
- Operational alignment leads to quick decisions to implement measures
- Project-specific material budgets create transparency about the real purchasing costs for all products
- Group dynamic advantages through cooperation of all areas (no "silencing" or autonomous thinking of departments or functions, but joint project thinking)

## 18.2 Project Management Criteria

### 18.2.1 Success Criteria in Lean Project Management

The project management manual defines key criteria and success factors for controlling and steering projects (PM, 2018). These criteria comprise a total of nine categories that must be taken into account for the successful completion of the project.

### 18.2.2 Integration Management

Integration management in project management describes the processes that are required for good coordination and integration of the different activities of a project. It includes project plan development, project plan implementation and change management (PM, 2018).

### 18.2.3 Performance Management

The project scope management deals with the ongoing planning and control of the progress of the project. As part of the scope management, it is checked at regular intervals whether the project is within the objectives defined in the project order or whether there are deviations. Project scope management includes project initiation, content and scope planning, performance definition, performance verification and performance review (PM, 2018).

### 18.2.4 Time Management

Time management in projects has to ensure that a project is completed on schedule from project start until the final validation (PM, 2018). Time management in projects contains processes like scheduling, progress control, the scheduling and sequence of operations and the estimated time for the operation (PM, 2018).

### 18.2.5 Cost and Finance Management

Cost and finance management includes the cost and expenses for the approved project (PM, 2018). The objective of this category is that the project is monitored and closed within the anticipated budgets. Subcategories of cost management are resource planning, cost estimations, budgeting and cost control (PM, 2018).

### 18.2.6 Quality Management

Quality management in projects should ensure that the quality requirements defined by the client are met or even exceeded. These include quality planning, quality assurance and quality control (PM, 2018).

### 18.2.7 People Management

The main task of HR management is to make sure that the people involved in the project work as efficiently as possible. The following functions and tasks can be assigned to personnel management: project organization, personnel acquisition and team development (PM, 2018).

### 18.2.8 Communication Management

The aim of communication management in the project is to create, collect, disseminate, store and define all project information in a timely and appropriate manner. These include the development of an information and reporting system, the distribution of information, the determination of progress and administrative completion (PM, 2018).

### 18.2.9 Risk Prevention Management

Risk management describes all the iterative processes necessary to identify, analyse and respond to project risks. These include risk identification, risk assessment, risk mitigating and risk tracking (PM, 2018).

### 18.2.10 Procurement Management

The knowledge field procurement management includes the procurement of goods and services outside the organization as well as the associated contract design. This area includes procurement preparation, quotation preparation, bid solicitation, supplier selection, contract drafting and contract (PM, 2018).

## 18.3 Recommendations for Executing Successful Lean Projects

Projects with complex objectives need a competent project leader or manager. This requires both hard (e.g. project management skills) and soft skills (e.g. emotional intelligence) to convince both internally and externally. In addition to a good and

sustainable relationship with the management, one of the key components of project managers is to lead a team successfully. Project managers must choose their employees to have a healthy mix of expertise and social skills. Projects should be projected by a robust project job in which performance parameters are clearly defined and scheduled (PM, 2018). Goals must have specific attributes and be specific, measurable, acceptable, realistic and timed (SMART methodology: specific, measurable, achievable, realistic, and timely) (Helmold, 2021). Sustainability as well as a permanent and regular success control completes the SMART goals. Here, an incentive system is recommended so that employees are sufficiently motivated by material or immaterial advantages for project success (Helmold & Terry, 2021). Internationality and diversity strengthen project teams and help to successfully implement projects in an international context. The use of digital media supports networking, especially across country borders and time zones. Finally, organizations should allow project members to return to the line function. Table 18.2 summarizes the main recommendations (PM, 2018).

## 18.4 Case Study: CRRC Project Management in the USA

The North American Chicago Transit Authority (CTA) announced that it had awarded the order to build 8,467,000-series rail cars to CRRC subsidiary CSR Sifang America, which had submitted the most competitive bid in terms of cost, quality, delivery time, design and other project elements. It did not name the other bidders. The company, formed from the merger of former rivals CNR Corp and China CSR, won its first U.S. contract in 2014 when CNR was awarded a $567 million deal to supply subway trains to Boston. Chicago will first place a base order of 400 cars, with options to buy the remainder in the coming years, the CTA said. CSR will build a new $40 million factory in the city, with the aim of seeing the first

**Table 18.2** Recommendations for lean project management

| No. | Recommendations |
|---|---|
| 1. | Engage lean experts in all projects |
| 2. | Employ people with social competencies and expert knowledge |
| 3. | Set clear project milestones and objectives through project order |
| 4. | Set objectives according to SMART aspects |
| 5. | Sustainability in project management |
| 6. | Success control and project validation |
| 7. | Incentive system and career opportunities |
| 8. | Return to line organization after project finalization |
| 9. | Internationality and diversity |
| 10. | Usage of digital tools |
| 11. | Apply lean management tools |

cars going into service in 2020. CRRC undertakes design, manufacture, testing, commissioning and maintenance of locomotives and rolling stock, including electric locomotives, diesel-electric and diesel-hydraulic locomotives, suburban and regional transport, trams and light rail vehicles, metro cars and passenger coaches, as well as a full line of rolling stock cars. This Chinese state-owned rail company's assembly plant will produce up to 846 new rail cars for the Chicago Transit Authority. The project will return CTA rail car manufacturing to Chicago after a 50-year absence. CRRC Sifang will invest $100 million in building a 380,944-square-foot manufacturing facility on 45 acres in Chicago's Hegewisch neighbourhood on the Southeast Side. Production will begin in early 2019. The facility will begin testing the new car prototype later that year and the cars will hit the rails by 2020.

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# Lean Management Tools

# 19

*The most dangerous kind of waste is the waste we do not recognize.*

Shigeo Shingo

## 19.1 Creativity Lean Management Tools

### 19.1.1 Pecha Kucha (ぺちゃくちゃ)

Pecha Kucha (Jap.: ぺちゃくちゃ) is a lecture technique in which images (slides) suitable for an oral lecture are projected onto a wall. The format is specified: 20 images (slides), which are faded in for 20 s each. The total time of 6:40 min is therefore also the maximum speaking time and ends there. Pecha Kucha is a registered word mark in Japan, Germany and other countries. Pecha Kucha was first used in Tokyo in February 2003 by the two architects Astrid Klein and Mark Dytham as part of a design event and has meanwhile found widespread use in business and at universities. In the meantime, the format is also used for communication in museums, for example, in the Stadtmuseum Berlin since 2012. The topics are mainly in the areas of design, art, fashion, culture and architecture. However, this presentation style has also been transferred to other areas. The major aim of Pecha Kucha is to eliminate the waste of time for audience. The advantages of this technology lie in the short, concise presentation with rigid time constraints, which make lengthy presentations and the associated fatigue of the listener ("death by powerpoint" syndrome) impossible from the outset.

### 19.1.2 Action Learning Sets (ALS)

In action learning, a team works on a specific and relevant project for an organization and at the same time reflects on the learning process. Action learning is based on the belief that employees in an organization learn best from a real challenge. Action learning is a continuous process of learning and reflection that happens with



M. Helmold et al., *Lean Management, Kaizen, Kata and Keiretsu*, Management for Professionals, https://doi.org/10.1007/978-3-031-10104-5_19

the support of a group or "set" of colleagues, working on real issues, with the intention of getting things done. The voluntary participants in the group or "set" learn with and from each other and take forward an important issue with the support of other members of the set. The collaborative process, which recognizes set members' social context, helps people to take an active stance towards life, overcome the tendency to be passive towards the pressures of life and work and aims to benefit both the organization and the individual. ALS was developed by R. Revans. The key experience for Revans was the sinking of the Titanic. Revans' father was on the commission that was supposed to clarify why a ship, which had been built by a large number of the best engineers in England and which was considered completely unsinkable, had already sunk on its maiden voyage. The result of the commission was astonishing: many of the engineers stated that they had occasionally had serious doubts about the design. But since the responsible authorities saw it differently, they changed their perception and finally believed themselves in the unsinkability of the ship. Now, after the disaster, they remembered well their original doubts, which had come true in a cruel way. The phenomenon that individuals adapt to the group's opinion and the group makes such fatal decisions is called groupthink. Action learning aims to counteract this by working in a team with people from different areas and asking critical questions from their different perspectives (Fig. 19.1).

### 19.1.3 Design Thinking

Design thinking is a customer-centred and iterative method for solving complex problems and developing new ideas. With the design thinking method, you succeed in developing a solution that is superior from the customer's point of view, taking into account economic efficiency, feasibility and desirability.

Design thinking is based on the assumption that problems can be solved better if people from different disciplines work together in an environment that promotes creativity, develop a question together, take into account the needs and motivations of people and then develop concepts that are repeatedly checked. The process is based on the work of designers, which is understood as a combination of understanding, observation, definition of standpoints, brainstorming, prototype development and testing. At the same time, the word thinking stands for the fact that, as in a research project, the feasibility and profitability of the innovations are systematically examined. According to another understanding, design thinking means "any process that applies the methods of industrial designers to problems beyond how a product should look" ("any process that applies the methods of industrial designers to problems that go beyond the appearance of a product"). Design thinking thus combines three fundamental core aspects: benefit, feasibility and marketability. Accordingly, the benefits for people, the technological feasibility and the economic marketability are brought into harmony in order to create a perfect innovation and to solve the problem flawlessly. All points should be weighted equally. The six named and basic steps of design thinking can be described as follows:


**Fig. 19.1** Action learning sets (ALS)
Source: Author

1. Understanding
2. Observing
3. Defining a point of view
4. Finding idea
5. Prototyping
6. Testing

The problem at the beginning is at best defined with a team of several people. It is important to create a general understanding and to bring everyone involved on the same page. Specific questions can be, for example, What should be newly developed? For whom should the development be relevant? Which essential (current or future) framework conditions have to be taken into account? Which final state should the solution achieve?

**Observing**
Observing is about being able to empathize with the customer. An analysis of the customer's will is possible, for example, through an interview or role play. It is important to let the customer do the talking. Good listening is the most important part of the job; otherwise, misunderstandings can arise. The wishes of the customer are always in the foreground.

**Defining a Point of View**
The results of the first two steps are combined. Techniques such as personas or point-of-view are used to define the point of view both visually and in writing.

**Finding Ideas**
At the beginning of the brainstorming process, there is a general brainstorming session in which all ideas, no matter how crazy or utopian, are brought together. The results are structured and sorted according to priorities. Questions about the efficiency, the feasibility or the economic viability of the individual ideas are important. A look at the competition is also not uncommon.

**Prototyping**
A prototype is created for illustrative purposes. Perfection and completion are insignificant. More important is: the simpler, the better. Creativity is given free rein. Techniques that are used in prototyping include wireframes, post-its, role-playing games, storyboards or models. The prototype is tailored to the needs of the customer. It is important that the customer can imagine the solution to his problem based on the prototype.

**Testing**
Finally, what has been developed must be tested. Feedback plays an important role in this. Flexibility is also required. If an idea does not work, it can also be discarded. Customers are closely observed during tests with the prototypes. Based on their reaction, further ideas and improvements develop. Design thinkers are also open to new suggestions at this step. If a defect is found during a test, it is eliminated and the steps are repeated with the improved or new prototype. It is quite common for new products to have multiple test phases until the customer is satisfied and the product can be approved (Fig. 19.2).

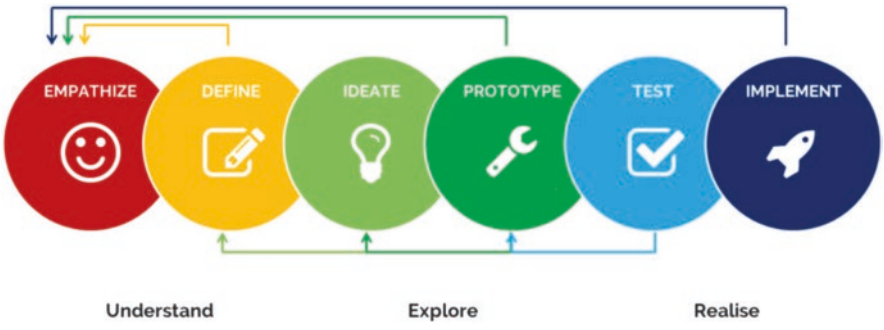


**Fig. 19.2** Design thinking

### 19.1.4 RPR Method

RPR deals with failures, incorrect output and performance issues, and its particular strengths are in the diagnosis of ongoing and recurring grey problems. The method comprises the following:

- Core process
- Supporting techniques

The core process defines a step-by-step approach to problem diagnosis and has three phases:

- Discover
- Gather and review existing information
- Reach an agreed understanding
- Investigate
- Create and execute a diagnostic data capture plan
- Analyse the results and iterate if necessary
- Identify root cause
- Fix
- Translate diagnostic data
- Determine and implement fix
- Confirm root cause addressed

The supporting techniques detail how the objectives of the core-process steps are achieved and cite examples using tools and techniques that are available in every business.

### 19.1.5 Brain Storming

Brainstorming is an idea generation method developed by Alex F. Osborn in 1939 and modified by Charles Hutchison Clark, the purpose of which is to encourage the generation of new, unusual ideas in a group of people. He named it after the idea behind this method, namely using the brain to storm a problem (literally: using the brain to storm a problem). In brainstorming, ideas and suggestions on a topic are freely expressed and collected. It does not matter how mature and high quality an idea is, but first of all that as many ideas as possible are collected. It is important that all participants collect and publish ideas.

### 19.1.6 Mind Mapping

A mind map describes a cognitive technique coined by Tony Buzan. This can be used for developing and visualizing a topic, for planning or for taking notes. The

mind map is a visual method to represent complex thoughts, ideas and associations on a central topic or concept. Mind maps offer numerous advantages when managing projects, brainstorming or meeting discussions. Mind maps are a non-linear way of taking notes (Gassler & Suttler, 2010). Thanks to their clarity and the brain-friendly notation, you can quickly get useful results with mind maps.

## 19.2 Problem-Solving Tools

### 19.2.1 A3: Problem-Solving Tool

The A3 process in Fig. 19.3 allows groups of people to actively collaborate on the purpose, goals and strategy of a project. It encourages in-depth problem-solving throughout the process and adjusting as needed to ensure that the project most accurately meets its intended goal. The A3 process is a problem-solving tool Toyota developed to foster learning, collaboration and personal growth in employees. The term "A3" is derived from the particular size of paper used to outline ideas, plans and goals throughout the A3 process (A3 paper is also known as 11″ x 17″ or B-sized paper). Toyota uses A3 reports for several common types of work:

- Solving problems
- Reporting project status
- Proposing policy changes (policy meaning rules agreed upon and enforced by the group)

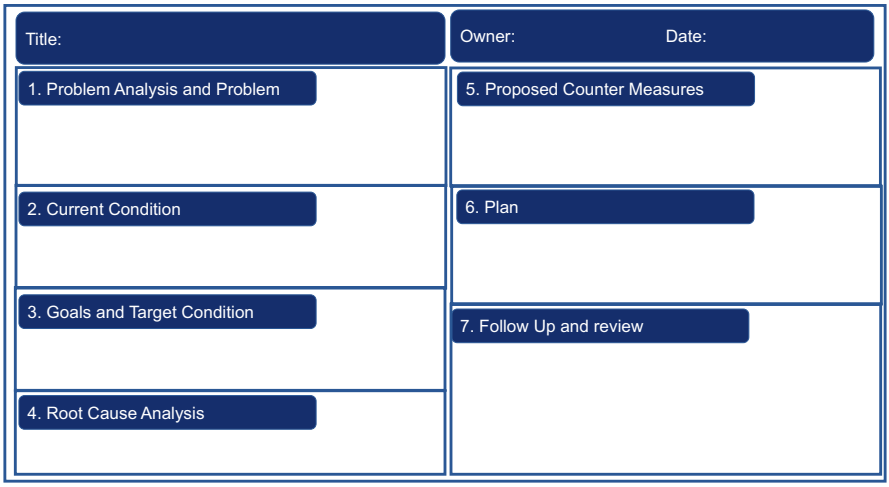


**Fig. 19.3** A3 method
Source: Author

In most organizations, on most teams, we aren't collaborating as strategically as we could be. We leave meetings with ideas half-baked. We often move hastily to begin working on implementing a solution, without aligning around important details. Projects move slowly due to rework and duplicate effort, two symptoms of a lack of alignment.

The A3 process allows groups of people to actively collaborate on the purpose, goals and strategy of a project. It encourages in-depth problem-solving throughout the process and adjusting as needed to ensure that the project most accurately meets its intended goal.

The A3 process prescribes the famed quote by Abraham Lincoln: "Give me six hours to chop down a tree and I will spend the first four sharpening the axe". The A3 process helps an organization sharpen its proverbial axes by fostering effective collaboration, bringing out the best problem-solving in teams.

Collaboration between talented people is critical for innovation and speed. Using the A3 process to foster collaboration can help organizations and teams invest their time, money, and momentum most effectively.

Steps of the A3 Process?

There are nine (well, ten) steps in the A3 process.

0: Identify the problem

Since the purpose of the A3 process is to solve problems or address needs, the first, somewhat unwritten, step is that you need to identify a problem or need.

1: Capture the current state of the situation

Once you align around the problem or need you'd like to address, then it's time to capture and analyse the current state of the situation. Toyota suggests that problem solvers.

Observe the work processes first-hand and document your observations.

Gather around a whiteboard and walk through each step in your process. You can use fancy process charting tools to do this, but stick figures and arrows will do the job just as well.

If possible, quantify the size of the problem (e.g. % of tickets with long cycle times, # of customer deliveries that are late, # of errors reported per quarter). Graph your data if possible; visualizations are really helpful.

2: Conduct a root cause analysis

Now that you see your process, try to figure out the root cause of the efficiencies. You can ask questions like

Where do we suffer from communication breakdowns?

Where do we see long delays without activity?

What information do we need to collaborate more effectively/smoothly?

Document these pain points, then dig deeper. The five whys is a helpful tool for conducting a thorough root cause analysis. The basic idea is that you begin with a problem statement, and then you ask "Why?" until you discover the real reason for the problem. You may or may not have to ask why exactly five times – this is simply an estimate.

3: Devise countermeasures to address root causes

Countermeasures are your ideas for tackling the situation; the changes to be made to your processes that will move the organization closer to ideal by addressing root causes. Countermeasures should aim to

Specify the intended outcome and the plan for achieving it.

Create clear, direct connections between people responsible for steps in the process.

Reduce or eliminate loops, workarounds and delays.

4: Define your target state

Once you've selected your countermeasures, you are able to clearly define your target state. In the A3 process, you communicate our target state through a process map. Be sure to note where the changes in the process are occurring so they can be observed.

5: Develop a plan for implementation

Now that you've defined your target state, you can develop a plan for how to achieve it. Implementation plans should include

A task list to get the countermeasures in place

Who is responsible for what

Due dates for any time-sensitive work items

Most teams choose to document their implementation plan in their A3.

6: Develop a follow-up plan with predicted outcomes

A follow-up plan allows lean teams to check their work; it allows them to verify whether they actually understood the current condition well enough to improve it. A follow-up plan is a critical step in process improvement because it can help teams make sure the

implementation plan was executed

target condition was realized

expected results were achieved

These first six steps are captured in the A3 report. Most teams use a template for their A3.

7: Get everyone on board
The goal for any systemic improvement is that it improves every part of the system. This is why it's vital to include everyone who might be affected by the implementation or the target state in the conversation before changes are made.

Building consensus throughout the process is usually the most effective approach, which is why many teams choose to include this at each critical turning point in the A3 process. Depending on the scope of the work, it might also be important to inform executives and other stakeholders who might be impacted by the work.

8: Implement!
Now it's time for implementation. Follow the implementation as discussed, observing opportunities for improvement along the way.

9: Evaluate results
In far too many situations, the A3 process ends with implementation. It's critical to measure the actual results and compare them to your predictions in order to learn.

If your actual results vary greatly from what was expected, do research to figure out why. Alter the process as necessary, and repeat implementation and follow-up until the goal is met.

### 19.2.2 8D Process

Eight-discipline problem-solving (8Ds) is a method developed at Ford Motor Company used to approach and to resolve problems, typically employed by engineers or other professionals, as shown in Fig. 19.4. Focused on product and process improvement, its purpose is to identify, correct and eliminate recurring problems. It establishes a permanent corrective action based on a statistical analysis of the problem and on the origin of the problem by determining the root causes. Although it originally comprised eight stages, or disciplines, it was later augmented by an initial planning stage. 8D follows the logic of the PDCA cycle. The disciplines are.

- D0: Preparation and Emergency Response Actions: Plan for solving the problem and determine the prerequisites. Provide emergency response actions.
- D1: Use a Team: Establish a team of people with product/process knowledge. Teammates provide new perspectives and different ideas when it comes to problem-solving.
- D2: Describe the Problem: Specify the problem by identifying in quantifiable terms the who, what, where, when, why, how and how many (5W2H) for the problem.
- D3: Develop Interim Containment Plan: Define and implement containment actions to isolate the problem from any customer.


**Fig. 19.4** 8D process
Source: Author

- D4: Determine and Verify Root Causes and Escape Points: Identify all applicable causes that could explain why the problem has occurred. Also identify why the problem was not noticed at the time it occurred. All causes shall be verified or proved. One can use five whys or Ishikawa diagrams to map causes against the effect or problem identified.
- D5: Verify Permanent Corrections (PCs) for the Problem That Will Resolve the Problem for the Customer: Using pre-production programs, quantitatively confirm that the selected correction will resolve the problem (verify that the correction will actually solve the problem).
- D6: Define and Implement Corrective Actions: Define and implement the best corrective actions. Also, validate corrective actions with empirical evidence of improvement.
- D7: Prevent Recurrence/System Problems: Modify the management systems, operation systems, practices and procedures to prevent the recurrence of this and similar problems.
- D8: Congratulate the Main Contributors to Your Team: Recognize the collective efforts of the team. The team needs to be formally thanked by the organization.

The 8D approach has become a standard in the automotive, assembly and other industries that require a thorough structured problem-solving process using a team approach.

### 19.2.3 Kepner Tregoe

Kepner-Tregoe (also sometimes called KT Analysis) is a company that specializes in problem-solving (also sometimes known as problem-solving method). Kepner-Tregoe was founded in 1958 by Charles Kepner and Benjamin Tregoe. The two company founders are considered pioneers of rational working methods and have researched and visualized the basic solution thought patterns of people (Kepner-Tregoe, 2020). In the area of these thought processes, problem analysis, decision analysis, rational project management, analysis of potential problems, situation analysis, strategy formulation and implementation and are fundamental methods to permanently establish thought processes. Under the term "Kepner-Tregoe" there are several methods to solve different "tasks". Basically, the term "problem" is differentiated from "decision". Different tasks that people face require fundamentally different approaches. The processing of these tasks sometimes requires different processes. Exactly this difference becomes clear through the situation analysis. Furthermore, the classified tasks can be solved through various processes. Problem analysis is now regarded as "best practice" in the field of operational and service excellence. It enables the identification of unknown causes in order to subsequently eliminate them. Decision analysis provides the rational claim for the best available solution that is to be implemented. Situation analysis determines all necessary tasks, clarifies and prioritizes them, presents them in a special to-do list, the so-called action item list (AIL) and prepares the solution with the right tools. The analysis of potential problems is a process to avoid future problems and to be prepared for the damage reduction in an emergency.

### 19.2.4 TRIZ

TRIZ is the Russian acronym for (Russian: теория решения изобретательских задач, Teoria reschenija isobretatjelskich sadatsch), which translates as the theory of inventive problem-solving. TRIZ was founded on the assumption that by sifting through a large number of patents, then selecting and valuing those describing technical breakthroughs, one would discover generally applicable innovative principles and even laws of invention. Figure 19.5 shows the concept of TRIZ, in which specific problems can be resolved with generic problem solutions. The method was initiated by Genrich Saulowitsch Altschuller and Rafael Borissowitsch Shapiro under the influence of Dmitri Dmitrijevitsch Kabanov around 1954 to 1956. G. Altschuller and R. Shapiro, who did further research and improvements, recognized three essential principles as early as 1956:

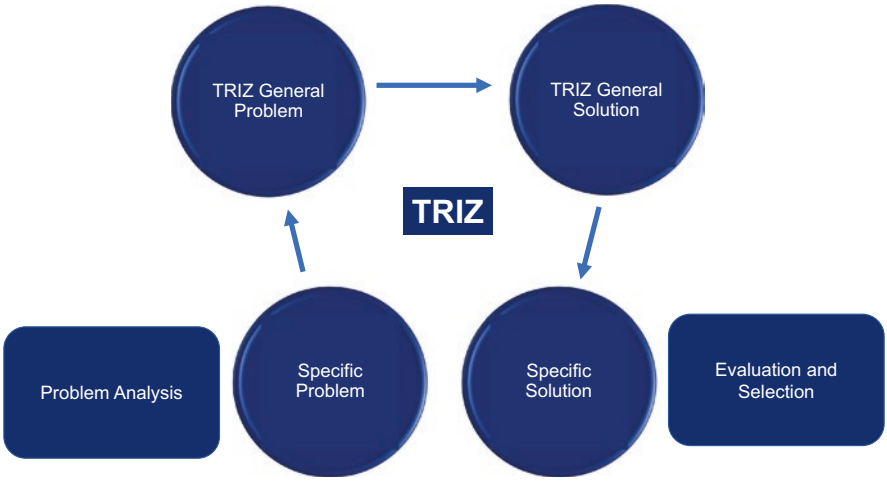


**Fig. 19.5** TRIZ model
Source: Marc Helmold

- A large number of inventions are based on a comparatively small number of general solution principles.
- Only overcoming contradictions makes innovative developments possible.
- The evolution of technical systems follows certain patterns and laws.

With the help of this method, inventors try to systematize their activities in order to find new solutions to problems faster and more efficiently. The TRIZ method has meanwhile spread around the world and is "rapidly developing" (Zobel). In the Anglo-Saxon language area, the term TIPS (theory of inventive problem-solving) is also common. The TRIZ contains a number of methodical tools that make it easier to define and analyse a specific technical problem based on a target description in order to break it down to its abstract components and to find a solution in the abstract space. The abstract solution is then creatively translated into possible specific solutions; A solution is selected from this amount. This prevents the problem from being prematurely deduced to a solution. Instead, TRIZ uses a stock of already existing solution processes. The methods of classic TRIZ are the following:

- Innovation principles and contradiction table
- Separation principles for solving physical contradictions
- Algorithm or step method for solving invention problems (ARIZ)
- System of 76 standard solutions and substance-field analysis (SFA, formerly also called WEPOL analysis)
- S-curves and laws of the development of systems (evolution laws of technical development, laws of technical evolution)
- Principle (law) of ideality
- Modelling of technical systems with the help of "little men" (dwarf models)

Further methods that are assigned to TRIZ, but which are not included in the classic teaching, but were developed by Altschuller's students, are

- Innovation checklist (Innovation Situation Questionnaire)
- Functional structure according to TRIZ (a kind of cause-and-effect diagram, which however does not correspond to Ishikawa Kaoru's cause-and-effect diagram, is also called problem formulation)
- SAO functional model (Subject-Action-Object, an extended functional model based on Miles' basic work on "value analysis")
- Process analysis
- GZK operator (size-time-cost)
- Anticipatory error detection
- Resource checklists

In most cases, TRIZ does not mean the above-mentioned collection of methods and tools but only refers to the contradiction table and the 40 innovative principles as "the TRIZ". However, these are controversial in the professional world in terms of handling and mode of operation.

The TRIZ contains 40 principles or "40 rules of innovation" (sometimes also 40 innovative principles, 40 IGP – 40 innovative basic principles). One of these rules is the "principle of the nesting doll (matryoshka)" (also called "integration"): You transfer an object into the inside of another. These abstract rules are in detail:

1. Dismantling
2. Separation
3. Local quality
4. Asymmetry
5. Coupling
6. Universality
7. Integration (plug-in doll, matryoshka)
8. Counterweight
9. Previous counteraction (early counteraction)
10. Previous effect (earlier effect)
11. Principle of the "previously placed pillow" (prevention)
12. Equipotentiality
13. Function reversal (inversion)
14. Similarity to spheres (spheroidality)
15. Dynamization
16. Partial or excessive effect
17. Transition to other dimensions (transition to higher dimension)
18. Use of mechanical vibrations
19. Periodic effect
20. Continuity of useful effect (continuity of active processes)
21. Principle of rushing through (skipping)
22. Conversion of harmful into useful

23. Feedback
24. Principle of the “mediator”
25. Self-service
26. Copy
27. Cheap short life instead of expensive long life
28. Replacement of the mechanical system (replacement of mechanical operating principles)
29. Use of pneumo and hydrosystems
30. Use of flexible sleeves and thin foils
31. Use of porous materials
32. Colour change
33. Similarity (homogeneity)
34. Elimination and regeneration of the parts
35. Change in physical and chemical properties (change in physical state)
36. Application of phase transitions
37. Application of thermal expansion
38. Use of strong oxidizing agents
39. Use of an inert medium (use of an inert medium)
40. Use of composite materials (use of composite materials)

These rules are mostly used in connection with a so-called contradiction matrix or contradiction table. This matrix has different technical parameters in the first row and in the first column (in an identical order). In the individual fields of the matrix, the individual parameters are thus opposed to each other (similar to a season game table in soccer). The diagonal of the matrix remains empty because here one and the same parameter is facing each other (that could be solved with the physical contradictions). As far as the other fields are concerned, it is assumed that the assigned parameter in the column is supposed to improve while the parameter in the corresponding row deteriorates as a result. Herein lies the contradiction. The field in which row and column cross each other uses individual numbers to name the innovative basic rules of TRIZ that can help to overcome this contradiction. A developer who works with the contradiction matrix must therefore first be clear about which parameters of the system he is developing should be improved. He then has to determine which other parameters would usually worsen as a result of these improvements. Finally, the developer abstracts these parameters so that he can assign them to parameters of the first row and column of the contradiction matrix. Ultimately, this brings him to the abstract rules of TRIZ, which are suitable to help overcome the contradictions that arise in the course of development. On the basis of examples and the concretization of the rules for the development object, thoughts are stimulated how the existing development contradictions can be overcome.

### 19.2.5 PDCA Cycle

Deming defined the PDCA sequence for optimizing concepts, processes and procedures in terms of an incessantly repeating cycle as follows:

- Planning (plan)
- Application (do)
- Verification of the results (check)
- Optimization with standardization (act)

The PDCA cycle is (see Fig. 19.6) used as a problem-solving strategy. First, the problem is precisely defined and specified so that it can be analysed more clearly and effectively. Then the real cause of the problem is eliminated, and the effectiveness of the improvement is checked. If one comes to the result that the improvement was successful, standardization prevents falling back in times before the improvement.

### 19.2.6 Six Sigma

Six Sigma (6σ) is a management system for process improvement, statistical quality target and at the same time a method of quality management. Its core element is the description, measurement, analysis, improvement and monitoring of business processes with statistical means. It is a method with a comprehensive set of tools for the

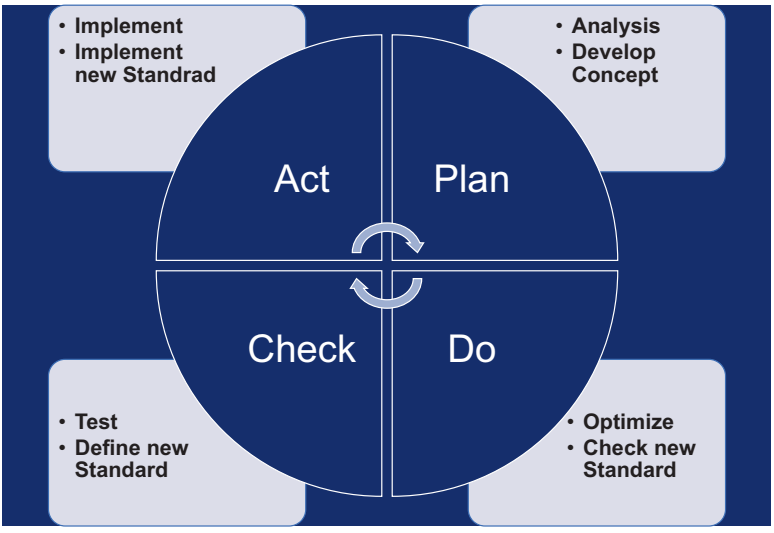


**Fig. 19.6** PDCA cycle
Source: Author

systematic improvement or redesign of processes. The work breakdown structure for process improvement projects follows the procedure Define – Measure – Analyse – Improve – Control (DMAIC). DMAIC stands for the phases of a process management process (Back & Weigel, 2014). DMAIC is the core process of the Six Sigma quality management approach and is used to design processes in such a way that they stably maintain a specified Six Sigma performance level. DMAIC is used to improve existing products. Within the individual phases of a DMAIC or DMADV project, Six Sigma utilizes many established quality-management tools that are also used outside Six Sigma. The following table shows an overview of the main methods used.

- Whys
- Statistical and fitting tools
- Analysis of variance
- General linear model
- ANOVA Gauge R&R
- Regression analysis
- Correlation
- Scatter diagram
- Chi-squared test
- Axiomatic design
- Business process mapping/check sheet
- Cause-and-effects diagram (also known as fishbone or Ishikawa diagram)
- Control chart/control plan (also known as a swimlane map)/Run charts
- Cost–benefit analysis
- CTQ tree
- Design of experiments/stratification
- Histograms/Pareto analysis/Pareto chart
- Pick chart/process capability/rolled throughput yield
- Quality function deployment (QFD)
- Quantitative marketing research through the use of enterprise feedback management (EFM) systems
- Root cause analysis
- SIPOC analysis (Suppliers, Inputs, Process, Outputs, Customers)
- COPIS analysis (customer-centric version/perspective of SIPOC)
- Taguchi methods/Taguchi loss function
- Value stream mapping

### 19.2.7 Value Stream Mapping (VSM)

The value stream analysis is a business management method for improving process management in production and services. It is also referred to as the value stream recording of an actual state. This first process step of the so-called value stream management provides a model of the material and information flows of the individual value streams. The non-value-adding processes are identified in the analysis.

In the following design approach, an improved value stream is designed in the context of a value stream design, in which the non-value-adding activities and unnecessary idle times are eliminated. The transition from the actual to the target value stream is planned using the value stream planning. The comparable approach in service management does not minimize idle times but the individual waiting times between activities.

## 19.3 Seven Quality Management Tools (Q7)

### 19.3.1 Error Correction List

Error collection lists are used for appropriate recording and clear presentation of errors according to type and number. The detected errors can be further evaluated, for example, by a Pareto analysis.

### 19.3.2 Histogram

The histogram is a graphic representation of the frequency distribution. Measured values are divided into classes. It consists of columns, the width of which corresponds to the class width and the amount of which indicates the number of measured values allocated to the respective classes. This form of representation allows that certain forms of distribution are determined and conclusions on possible causes for deviations (scatter) are drawn.

### 19.3.3 Pareto Analysis

The Pareto analysis structures the errors of a problem (partial problems of an overall problem) according to their frequency. The basis is the knowledge that 70% of the effects are caused by only 30% of the errors. The Pareto analysis provides information about which errors or sub-problems should be dealt with first. The procedure takes place in six steps:

- Listing and collection of errors in a problem.
- Order of errors (e.g. according to frequency or costs incurred).
- The errors are plotted in descending order from left to right in a bar chart.
- Plotting the cumulative curve (cumulative proportions of the errors).
- Analysis of the diagram for essential and insignificant errors and formation of classes (A, B, C).
- Processing of Class A errors.

Figure 19.7 shows an example of a Pareto Analysis with the frequency and the type of defects for shirts (Helmold, 2021).

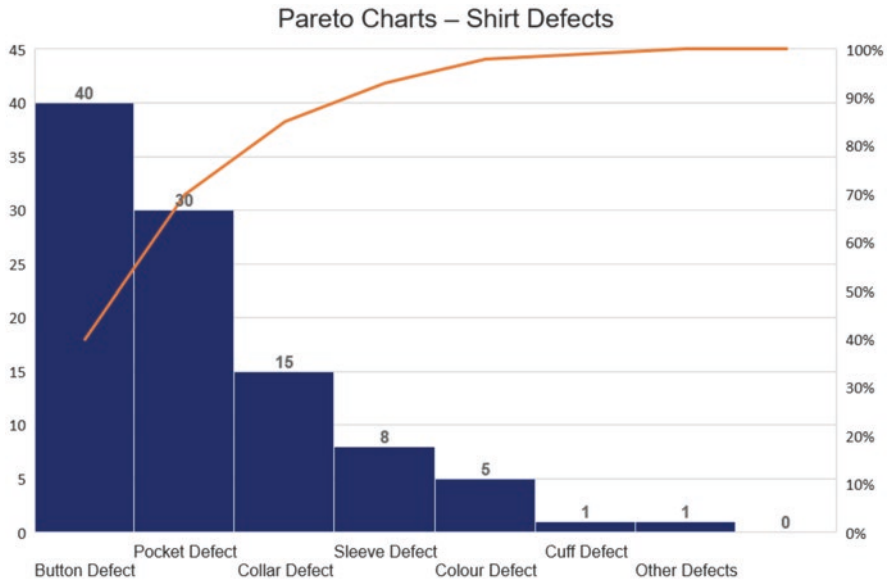


**Fig. 19.7** Pareto analysis
Source: Author

### 19.3.4 Correlation Diagram

The correlation analysis serves to prove or reject assumed (statistical) relationships between any two measurable features. With the help of graphical evaluations, it is examined whether and to what extent there is a linear relationship, e.g. between a suspected cause of the error and a certain error.

Procedure is as follows: (1) determination of the two features, between which a connection is suspected; (2) paired acquisition of the values of the two features, i.e. acquisition of the values at the same point in time (for time-dependently variable features) or on one object each (for object-dependently variable features); (3) representation of the value pairs in an x/y diagram; and (4) interpretation of the relationship based on the diagram. The following typical case can arise: strong positive or negative linear correlation.

### 19.3.5 Quality Control Cards (QCC)

The quality control chart, also known as the control chart, is used to monitor manufacturing processes on a statistical basis. For this purpose, data that were determined during the testing of random samples from a production process are entered in a form with a coordinate system. The data are measured values or key figures calculated from them, which, in conjunction with a previously drawn mean value as well as warning, intervention and tolerance limits, serve to examine and control the process under consideration.

### 19.3.6 Fishbone Diagram

The fishbone diagram or Ishikawa diagram is a cause-and-effect diagram that helps managers to track down the reasons for imperfections, variations, defects or failures. The diagram looks just like a fish's skeleton with the problem at its head and the causes for the problem feeding into the spine. Figure 19.8 depicts an example with the 6 M categories: Man, Material, Machine, Method, Macro-Environment and Monetary Factors.

### 19.3.7 5-Why Method

The questioning technique is used to narrow down a problem. Possible causes of problems can be found and narrowed down (Brunner et al., 2016). The principles of the questioning technique are to think in advance about which information is required and to formulate the corresponding questions. The 5-why method is a systematic and structured and comprehensive collection of information. An example of the 5-why method looks as follows (Table. 19.1):

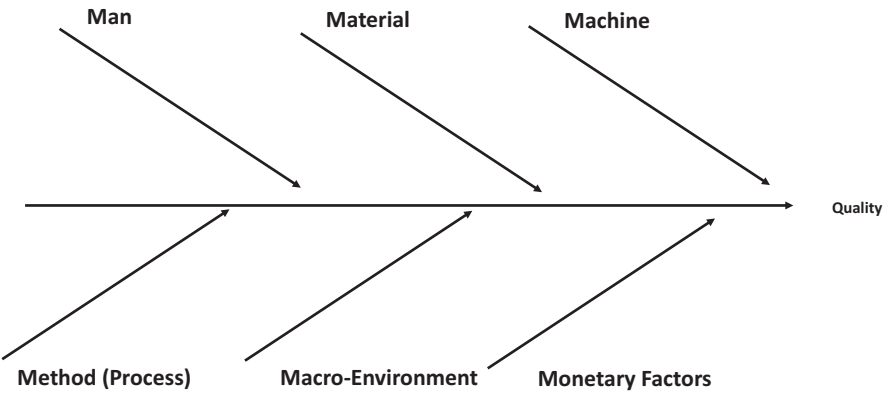


**Fig. 19.8** Example of a fishbone diagram
Source: Author

**Table 19.1** 5-why concept

| No. | Why | Description |
|---|---|---|
| 1. | Why? | The battery is dead. (First why) |
| 2. | Why? | The alternator is not functioning. (Second why) |
| 3. | Why? | The alternator belt has broken. (Third why) |
| 4. | Why? | The alternator belt was well beyond its useful service life and not replaced. (Fourth why) |
| 5. | Why? | The vehicle was not maintained according to the recommended service schedule. (Fifth why, a root cause) |

Source: Author

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# Lean Management Outlook 2030

# 20

*If you define the problem correctly, you almost have the solution.*

Steve Jobs

## 20.1 Continuation of Lean Management

A real and profitable lean organization understands customer value and focuses its key processes to continuously increase it. The ultimate goal is to provide perfect value to the customer through a perfect value creation process that has zero waste. An ideal way to introduce a practical view in terms of lean thinking is to deploy the 7 Manufacturing Basics, a handpicked selection of core lean improvement tools, methodologies and techniques to grasp control of any shop-floor situation. He has used many tools independently to tackle various situations. But as time progressed, it became very apparent that some combinations of these lean tools and elements work very well together when deployed in a specific sequence. They should be part of the skill set a team leader uses in daily work on Jidoka and Kaizen reinforcement, assuring quality, controlling processes and making incremental improvements often.

- Autonomous Maintenance – ensure you have the pre-conditions for production set-up before running the process; equipment can run at a rate without losses or interruptions.
- Gemba Cadence – establishes a fixed routine for observing employees and processes at work in the real environment.
- Change Point Management – capture and control all unplanned change points. Unplanned events are the "silent killers" that induce, waste, OEE losses, defects and workarounds.
- A3 Thinking Mentality – teach team members how to do fishbone diagrams and the Five Whys. They are the very basics of problem-solving and build the mental muscle for developing A3 capabilities (ask why).
- See Disconnects in the Entire Processes – examine the four levels of how any process is configured: systems, pathways, connections, activities – to confirm it is working as intended.



M. Helmold et al., *Lean Management, Kaizen, Kata and Keiretsu*, Management for Professionals, https://doi.org/10.1007/978-3-031-10104-5_20

- Kaizen Mindset – make one small incremental improvement often, every day if possible. But they must be small gains that can be sustained because they are accepted and adopted by team members.
- Leaders Are Teachers – coach people. Don't just tell them what to do; lead them to answers by asking questions that make them think to solve problems. This is very hard to do because we are programmed as leaders to take control (remind the previous blog: lean leadership is a behaviour not a concept isolated).

## 20.2 VUCA as Driver for Change

Business life is characterized by more volatility and need for adjustment, more uncertainty, more complexity and more ambiguity (VUCA). In addition, there are increasing demands from employees who at the same time feel overtaken and overwhelmed by technology and who feel left behind with old technologies (Bearingpoint, 2019). Both arise from the exponentially increasing speed of technological progress, which means that we have been living in a time of permanent transition technologies for about 10 years and probably for another 10 to 20 years. None of the technologies in use today are what we used to call mature. The Internet is changing in terms of usable bandwidth in the fixed network and mobile communications, as well as in terms of the devices that allow us to access the "network" anytime and anywhere (Henao et al., 2019). Virtual reality glasses and augmented reality are changing the way and the way we see the world. In the combination of platform thinking, autonomous driving and the networking of vehicles, completely new mobility concepts emerge under our eyes. The idea of sharing, instead of the felt need to own, changes the way we think about status symbols. The world is divided into those who love, drive and use progress and those who feel left behind or who condemn development and do not want to go with it.

## 20.3 Trends in Lean Management

Especially in times of digitization and the "Internet of Things", we can bring our know-how to bear in a targeted manner. The factory clocked for tenths of a second, the perfectly organized management process, the detailed planning round – in all of this we are almost unbeatable. We have a precise overview of who is doing what, when and why. Bain & Company have put together an overview of values that generate loyalty among customers and thus have an impact on sales. If you transfer this view to the B2B focus that prevails in many (manufacturing) companies, this also results in a high accuracy of hits with regard to these requirements. It shows that the core activities often perfectly match the needs of business customers. In many areas of the economy, including those that were previously characterized by a B2B market, a new trend is now establishing itself, which is leading to highly individualized products and requirements and, in some cases, own B2C business. But even where this trend does not have an impact, changes are becoming increasingly visible that make it appear necessary to react to them – changes that can already be seen in the value patterns of the "new" customers.

## 20.4 Algorithms and Virtual Maintenance

Lean management will include algorithms and virtual tools in 2030. In many manufacturing industries, device failures and failures result in high inventory levels, significant working capital costs, and low efficiency (Küpper et al., 2017). Organizations can use lean methods such as autonomous or preventive maintenance to dramatically increase overall equipment effectiveness (OEE). For example, by using autonomous maintenance, companies put their operators in charge of certain do-it-yourself maintenance activities, which significantly reduces downtime for fixing minor issues. Leading manufacturers make the most of these lean methods by using advanced analysis algorithms and machine learning techniques to analyse the huge amounts of data that are being captured by sensors. The output identifies the potential for failures before they occur. Such predictive insights prepare operators to carry out autonomous maintenance at the optimal point in time, which reduces disruptions and minimizes unnecessary downtimes and replacement costs.

## 20.5 Collaborative Robots (Cobots) as Supplementary Partners in Production

The automation industry has been discussing the vision of batch size ONE for a number of years. The question emerging with this issue is, how can production systems manufacture individual items without long retooling or becoming inefficient? With the possibilities of Industry 4.0 and innovative lean management tools, it will not be long before this vision becomes a reality and enables comprehensive customization in production. In order to achieve this goal, machines in production can no longer be used in a rigid and inflexible manner. So far, they have mostly only been put into operation, parameterized and coordinated for a specific product, which is then manufactured over and over again over months or even years. Tomorrow's production lines must be flexible – built from several mechatronic modules that can easily be redesigned and recombined, with more and more robots or "cobots" (collaborative robots that work hand in hand with people). In addition, an AI should be integrated that parameterizes and adjusts the machines for the next – individualized – product that is to be manufactured.

## 20.6 Creation of Industry-Wide Standards for Networked Machines

Since machines and modules are dynamically converted in the factory, it is important to ensure networking. Standardized protocols for computerized production and assembly will play a key role in ensuring that devices from different manufacturers work together smoothly. Bulky cables would disappear and be replaced by wireless protocols like 5G and its successors. But machines are not only connected to one another but also to cloud systems in which flexible computing power is available to apply powerful algorithms to business and engineering data.

## 20.7 Digital Quality Systems and Poka Yoke

Lean Management 2030 methods use digital devices to prevent errors. Production capacity is wasted when products do not meet specifications (Siebenmorgen, 2016). Worse, when a company ships poor quality products to customers, they incur higher costs and they are likely to lose trust in those suppliers. Many lean management tools such as self-inspection, poka-yoke and jidoka have been developed to reduce the likelihood of errors and to increase the rate and speed of error detection. Analysis by the Boston Consulting Group shows, for example, that self-inspections improve the process of providing feedback to engineers and operators, which speeds up error detection and reduces the number of errors by 50–70%. However, to avoid failure, manufacturers need to support self-inspections by using a data-driven analytical approach to identify the root causes of failure. Industry 4.0 technologies and innovative lean methods enable such support by providing reliable context data and enabling detailed tracking. Error analysis is improved, for example, through camera-based visual inspection, correlation models and real-time monitoring of process parameters (Küpper et al., 2017).

## 20.8 Transparency, Flexibility and Agility

Lean management tools of the future (Lean Management 2030) will help companies make complex and global value streams transparent and manageable. Lean offers standardized tools and methods with which companies can concentrate on customer benefits and actively involve and continuously improve each individual employee (Bertagnolli, 2018). But what if people no longer have the opportunity to examine the complexity and thus continually make suggestions for improvement? Big data and additive manufacturing as exemplary drivers of digitization are also used in manufacturing companies and in sectors such as healthcare or the service sector. A continuous introduction to other technology branches will be visible in the next 10 years. Manufacturers who have already successfully used Lean Industry 4.0 can reduce conversion costs by up to 40% in 5 to 10 years in order to be ready for Lean Management 2030, considerably better than the savings that were achieved through the first-class independent use of Lean Industry 4.0. In many cases, the higher cost reductions are achieved with technologies that improve plant processes and structures, for example, by optimizing layouts. However, less than 5% of the manufacturing companies we observed have reached a high level of maturity in Lean Industry 4.0. To achieve the greatest benefits, a manufacturer must adapt the application of Lean Industry 4.0 to address its specific challenges along the supply chain and at the plant level. A recent global survey by the Boston Consulting Group found that leading industrial companies recognize the importance of lean management and digitization for their long-term planning. In a survey of more than 750 production managers, 97% of respondents in the automotive sector said that lean management would be highly relevant in 2030, compared to 70% who consider it important today. Among these respondents, 70% stated that the digitization of systems would

be of high relevance in 2030, compared with 13% who consider this to be important today (Küpper et al., 2017).

## 20.9 Digitalized Human Resources Management and Automatized Training

Elements of health, safety and the environment (HSE) are among the most important production paradigms. To ensure operator safety, a lean approach uses signs to let operators know where to go. Another lean approach uses detailed incident and near-miss tracking to identify areas for improvement. Organizations can use inexpensive wireless sensors to improve the effectiveness of such efforts. For example, they can equip operators with sensors that alert them to the presence of hazardous gases or the possibility of a collision with nearby forklifts or trucks. Companies can further improve security by using virtual reality to train employees. Offsite training in a virtual environment is more efficient and effective than training in an actual work environment, and the approach appeals to the younger generation of workers. In order to reduce the high accident rate for new hires, a provider of service rigs developed comprehensive training courses in which employees often perform dangerous tasks in a virtual simulation of the construction site (Küpper et al., 2017).

## 20.10 Flexible Sensors and Self-Learning Software

Manufacturers want flexible processes that enable them to manufacture several products on one production line. The benefits of flexibility are difficult to grasp, however, as time-consuming retooling is required to prepare machines to manufacture different products (Helmold & Terry, 2021). By implementing lean tools, such as the one-minute exchange of tools, manufacturers can remove non-value-adding activities from the conversion and thus speed up the process considerably. Companies that have implemented lean methods and Industry 4.0 can benefit from these technologies (Küpper et al., 2017). New sensors and self-learning software enable machines to automatically identify products and load the appropriate program and tools without manual intervention. As the changeover is automated, operators can focus on value-adding activities.

## 20.11 Synchronization of Value Chain Networks Through Smart ERP Systems

Future ERP systems will be smart and integrated into the entire value chain from the raw material manufacturer to the end customer. Digitization will enable a transparent and sustainable supply chain, including departments such as procurement, operations, marketing, planning, logistics, finance, human resources and sales (Helmold, 2021) (Fig. 20.1).

**Fig. 20.1** Example of a smart factory in 2030
Source: Author

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# Glossary of Lean Management Terms

> Standards should not be forced down from above but rather set by the production workers themselves.
>
> Taiichi Ohno

**A**

Andon
アンドン
Audio-visual tool in operations to stop the production
Ato Hoju
Replenishment system
Atokotei Hikitori
あとこうてい引き取り
Pull system

**B**

Bacho
場所
Place, location
Baka
馬鹿
Stupid
Baka Yoke
馬鹿
System to avoid any human and stupid mistake

**C**

Chaku Chaku-Line
ちゃくちゃく
Chaku Chaku is a way to operate a semi-automated manufacturing line. One (or more) workers walk around the line, add parts to the processes and then start the process. While the process works on the part automatically, the worker adds the next part to the next process, and so on



M. Helmold et al., *Lean Management, Kaizen, Kata and Keiretsu*, Management for Professionals, https://doi.org/10.1007/978-3-031-10104-5

Chiiku
(知育)
Intellectual knowledge and develop logical thinking for fundamental survival skills
Cobots
Collaborative robots
CSR
Corporate social responsibility
Business model that helps a company be socially accountable

**D**
Design for manufacturing
Product development in line with the objectives to produce the part in an efficient and lean manner
Dou
道, マツダ道
Path, Best Way, Road. Mazda Way or Mazda Path

**E**
Engineering
Functional Department for Product Development
ERP
Enterprise resource planning

**F**
Flow principle
Material is flowing between the operations

**G**
Gemba
現場
The real place, production shopfloor
Gembutsu
現場
Working on the right products
Genchi
現地
Working with the right facts

**H**
Heijunka
平準化
Levelling production
Henko Kanri
変更管理

The Japanese meaning of change management is Henkou Kanri (変更管理) and can be translated from Japanese to mean "change, modification or alteration" in English

HOAI

Honorarabrechnung für Architekten und Ingenieure – Fee Table fo Architects and Engineers

Hoshin Kanri

方針管理

Hoshin Kanri ((方針管理) also called Policy Deployment) is a method for ensuring that a company's strategic goals drive progress and action at every level within that company

**J**

Jidoka

自動化

Jidoka is one of the most important lean methods for ensuring built-in quality. The commonly used English word for jidoka is auto**no**mation, based on autonomous and automation. Others call it intelligent automation, and again others describe it as automation with a human touch (remember the additional character 人 for human)

**I**

Ichiban

一番,いちばん

The best, the most successful

**K**

Kaizen

改善

Change for the good

Kaizen is a compound of two Japanese words that together translate as good change or improvement

Kanban

看板

Visual planning system

Keiretsu

系列 ネットワーク

Keiretsu or Keiretsu value chain networks (Japanese: integration, order or system of stakeholders, partners and suppliers) represent a means of mutual security, especially in Japan, and usually include large manufacturers and their suppliers of raw materials, systems and components. Keiretsu groups are defined as clusters of independently managed firms maintaining close and stable economic ties, cemented by a governance mechanism such as presidents' clubs, partial cross-ownership and interlocking directorates

Kohai
後輩
Junior
KPI
Key performance indicators
Quantified and numeric objectives

**L**
Learning, stuyding
勉強
Continuous learning and studying

**M**
Mottainai
もったいない or 勿体無い
A term of Japanese origin that has been used by environmentalists. The term in Japanese conveys a sense of regret over waste
MRO
Maintenance, repair and overhaul
Muda
無駄
Waste
Muri
無理
Unreasonableness; impossible; beyond one's power; too difficult; by force; perforce; forcibly; compulsorily; excessiveness; immoderation, and is a key concept in the Toyota Production System (TPS) as one of the three types of waste (muda, mura, muri)
Mura
斑
unevenness; irregularity; lack of uniformity; nonuniformity; inequality

**N**
Nemawashi
根回
Nemawashi in Japanese means an informal process of quietly laying the foundation for some proposed change or project by talking to the people concerned, gathering support and feedback

**O**
OKR
Objectives and key results
Quantified and numeric objectives

**P**

Poka Yoke
ポカヨケ
Mistake-proofing or inadvertent error prevention
PDCA
Plan, Do, Check, Act: it is an iterative four-step management method used in business for the control and continuous improvement of processes and products

**Q**

QMS – Quality management system

**R**

RPR Method
RPR deals with failures, incorrect output and performance issues, and its particular strengths are in the diagnosis of ongoing and recurring grey problems

**S**

Seisan Hoshiki
生産方式
Method to prevent any form of waste in production
Senpai
先輩
Senior
Shisa Kanko
指差喚呼
Pointing and calling is a method in occupational safety for avoiding mistakes by pointing at important indicators and verbally calling out their status. It is particularly common on Japanese railways or transportation, where it is referred to as shisa kanko (指差喚呼)
Shopfloor
Production place, operations
Supermarkets
The location where a predetermined standard inventory is kept to supply downstream processes
Taiiku
(体育
Modern education integrating mental and physical education

**T**

TIMWOOD
7 types of waste
Tokuiku
徳育
Kuiku means to develop your rational interpersonal skills as a leader. Rational development (tokuiku) is different from logical development (chiiku)

Toyota Way
Toyota Way トヨタウェイ
Centralizing the customer within the philosophy of operations

**U**
USCM
Upstream supply chain management, supply side, supplier networks
USP
Unique selling propositions; elements, which trigger a competitive advantage

**V**
Value-add
Everything the customer is willing to pay
Value stream mapping
The value stream mapping process helps companies create a detailed visualization of all steps in the work process. It is a representation of the flow of goods from a supplier to a customer through the entire value chain and organization
Visualization
Making results, gaps, processes, or activities transparent, normally via a dashboard. Important tool in lean management
Waste
Anything, which will not be paid by the customer; must be reduced or eliminated
5S
seiri (整理), seiton (整頓), seisō (清掃), seiketsu (清潔), and shitsuke (躾)
Workplace method for eliminating waste and making the workplace more efficient
5 Why Analysis
Root cause analysis by asking five times WHY?